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Health Effects Due to air Pollution in Children and Adults in Urban Area

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ABSTRACT

Air pollution in urban areas induces health effects and poses threat to the life chances and wellbeing of millions of people every day. The study was aimed at estimation of trace metals in particulate matter and studying the health effect of air pollutants on children and adults. The particulate matter samples were collected using High Volume Air sampler SIBATA HV-1000F. The samples were analyzed for metals using Atomic Absorption Spectrophotometer, Shimadzu AA-7000F. Four metals were identified in Particulate Matter which includes cadmium, chromium, lead and nickel. To study the effect of air pollution on children and adults data was obtained from different Hospitals about the diseases that are caused due to air pollution. The most common respiratory diseases observed in children were chest infection, asthma, tuberculosis, cough, respiratory tract infections, cough and fever, epigastria, breathlessness, abdominal pain and sore throat. The most common respiratory diseases observed in adults at Hospital (I) were asthma, pulmonary tuberculosis, COPD, bronchitis pneumonia, chest infection, pneumonia and cough and in at Hospital (II) were chest pain, nasal blockage, epigastria, breathlessness, shortness of breath, cough and sore throat.

KEYWORDS: particulate matter, metals, respiratory diseases, children, adults, health effects

1- INTRODUCTION

Air pollution levels in the Asian cities exceed the World Health Organization Air Quality Guidelines with the presence of dust particles and smoke in the ambient air being double the world average [1]. Children with high exposure to air pollutants are likely to suffer from ill learning and in adult life they will have low skills and qualifications which in turn will have an effect on their quality of life and the economic development of country. Air pollution is caused mainly by fossil fuel (oil, coal and natural gas) use in industry, domestic sector, power generation and transport. In addition animal waste, agricultural waste and biomass burning also contribute in polluting air. The pollutant emission into ambient air can have direct and indirect effects like eutrophication, stratospheric ozone depletion, acidification, ground level ozone. This may in turn worsen the air quality and left its impact on the ecosystem, buildings, agriculture and human health [2]. In 2009 a review was carried out in which air pollution related studies published in all scientific journals and by the government was reported and all criteria air pollutants were evaluated which showed that the most serious air pollutant in the country is particulate matter. The reported values of carbon monoxide, nitrogen dioxide, and sulfur dioxide and lead exceeded the WHO standards and only ozone concentration meet WHO guidelines [3].

Airborne particulate matter includes dirt, smoke, liquid droplets and dust that are emitted into the atmosphere. They are small enough to remain suspended in air. Particulate matter is a complex mixture of inorganic and organic substances. It is chemically a complex mixture of nitrate, ammonium, sulfate, organic carbon, elemental carbon and trace elements [4]. The physical attributes of particulate influence their deposition and transport and their chemical composition effects human health. The health effect range of particulate matter is broad but it is mainly linked with the respiratory and cardiovascular system. All population is susceptible to particulate matter pollution but it may vary with the age and health [1]. Several epidemiological studies revealed the association of air pollutants with health problems. The air pollutants of greatest concern include particulate matter, ozone, nitrogen dioxide, sulfur dioxide and metals present on particulate matter. Particulate matter can cause acute health effects such as the rate of hospital admission increases for the treatment of respiratory diseases, there is an increase in bronchodilator use and it further aggravate coughing and induce chances of increased daily mortality. Short-term exposure to particulate matter is associated with daily hospital admission, bronchodilator use, respiratory symptoms, cough and peak expiratory flow and daily mortality [5, 6]. Long term exposure to particulate matter is associated with cardiopulmonary and cardiovascular mortality. The study was aimed at estimation of trace metals in particulate matter and studying the health effect of air pollutants on children and adults.

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2- MATERIALS AND METHODS

2.1 Sampling and analysis of particulate matter

The particulate matter samples were collected using High Volume Air sampler SIBATA HV-1000F. 24 hour sampling was done. Pre-weighed Teflon filter papers were used to collect samples and the air flow was maintained at 16.6 liter per minute. According to USEPA standard, controlled environmental conditions were maintained to keep filters papers. Before and after the collection of particulate matter filters were kept for 24 hours at 20 ºC temperature. The filter papers containing particulate matter were digested in 50 ml of 4:1(v/v) HNO_3/ H_2O_2 mixture until the original volume reduced to one-third. After that the digested material was concentrated on a hot plate and filtered. The samples were analyzed for metals using Atomic Absorption Spectrophotometer, Shimadzu AA-7000F

2.2 Data collection for Health effects

To study the effect of air pollution on children and adults data was obtained from different Hospitals about the diseases that are caused due to air pollution. The information was collected about the patient gender, age, diagnosis and date of hospital visit.

3-RESULTS AND DISCUSSIONS

Four metals were identified in Particulate Matter samples which include cadmium, chromium, lead and nickel. The seasonal ranges of these metals are shown in Table 1. The source of lead and cadmium in particulate matter is vehicular emission and of chromium and nickel is industrial emission. Arifa *et al.* [7] and Suresh *et al.* [8] reported similar results and found the emissions of lead and cadmium to be linked with vehicles and emissions of chromium and nickel to be linked with industries.

Table 1Metals concentration in Particulate Matter.

Season	Cadmium (Cd)	Chromium (Cr)	Lead (Pb)	Nickel (Ni)
Summer	0.08±0.02 (0.06-0.09)	8.74±2.59 (6.91-10.58)	0.98±0.01 (0.97-0.99)	0.09±0.02 (0.06-0.12)
Fall	0.07±0.01 (0.06-0.08)	10.72±0.08 10.66-10.78	1.18±0.11 (1.10-1.27)	0.04±0.01 (0.03-0.05)
Winter	0.06±0.01 (0.05-0.07)	2.47±0.84 (1.87-3.06)	0.74±0.17 (0.61-0.86)	0.03±0.01 (0.02-0.04)
Spring	0.06±0.01 (0.05-0.07)	1.79±0.55 (1.40-2.18)	0.90±0.20 (1.05-0.75)	0.03±0.1 (0.02-0.04)

The distribution of respiratory problems in children by gender and age group is shown in Figure 1. From Figure 1, it is obvious that the children less than 1 year were suffering more from respiratory diseases. As the age increases there was a decreasing trend observed in respiratory diseases. Braga *et al.*[9] reported similar results in Brazil and found that children of 2 year age or less had the highest daily respiratory hospital admissions and as the age of child increased there was a decrease in daily respiratory hospital admissions till the age of 19. The respiratory disorders were more common in male children as compared to female children. Figure 2 displays the distribution of respiratory problems in children less than 1 year. The analysis revealed that there was negligible percentage of patients below the age of 1 month which show that the children did not suffered from fetal exposure .The maximum percentage of patients was of age range 1 month to 3 month. This sharp increase can be attributed to indoor air pollution. Ian *et al.* [10] reported that 58% of urban household in Pakistan rely on biomass fuel. The particulate matter produced by burning of this biomass fuel can be held responsible for high incidence of respiratory diseases in children. Cooking, smocking and cleaning are the major contributor to particulate indoor pollution which has the potential to effect health of children. After that a decreasing trend was observed till the age of 1 year. This may be due to reason that as the age increases the internal system becomes stronger which reduce the vulnerability of children towards air pollution. The most common respiratory diseases observed in children were chest infection, asthma, tuberculosis, cough, respiratory tract infections, cough and fever, epigastria, breathlessness, abdominal pain and sore throat. The percentage of patients is presented in Figure 3.

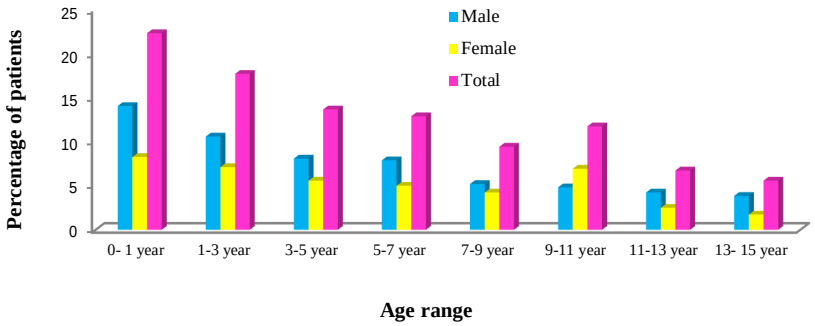

Figure1: Distribution of respiratory problems in children by gender and age group.

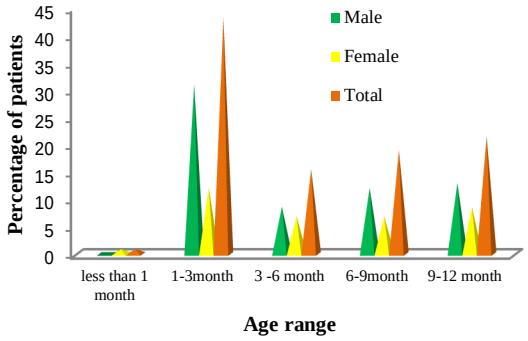

Figure 2: Distribution of respiratory problems in children less than 1 year by gender and age group.

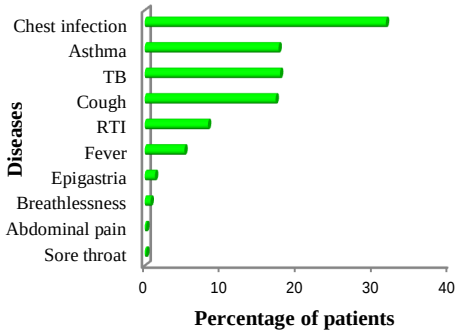

Figure 3: Respiratory diseases seen in children (both sexes and all age groups combined).

The distribution of respiratory problems in adults by gender and age group at Hospital(I) is shown in Figure 4.The percentage of patients of early adulthood age (20-40years) were less in the number as compared to the percentage of patients of middle adulthood age (40-60). The percentage patients of respiratory illness were more common in adult females as compared to the adult males. The Distribution of respiratory illness in adults by gender and age group at Hospital (II) is shown in Figure 6. The maximum percentage of patients was of age less than 20 and age range of 61-70.The respiratory problems were most common in adult males as compared to adult females.

The most common respiratory diseases observed in adults at Hospital (I) were asthma, pulmonary tuberculosis, COPD (Chronic Obstructive Pulmonary Disease), bronchitis pneumonia, chest infection, pneumonia and cough. The percentage of patient of each respiratory disorder is presented in Figure 5. Most common respiratory illnesses observed at Hospital (II) in adults were chest pain, nasal blockage, epigastria, and breathlessness, shortness of breath, cough and sore throat (Figure 7). Ying *et al.*[11] carried out as study in California and linked the incidence of asthma in adults with outdoor air pollution. Aaron and Mehta [12] linked the pulmonary tuberculosis in adults with outdoor air pollution like solid waste burning, industry and motor vehicles. Mario *et al.*[13] reported the linkage of COPD in adults with air pollution. Malek*et al.* [14] reported the association of bronchitis in adults with air pollution. Jesse *et al.*[15] reported the linkage of cough with exposure to gases and particulate matter in air. Many studies linked the association of tuberculosis with outdoor pollution sources. The air pollution produced by process of combustion affects the resistance to infection by affecting the epithelial permeability and reduction in airway resistance [16]. Studies suggest that Particulate Matter has a specific role in aggravating tuberculosis [17]. Transition metals associated with the particulate matter like iron are known to induce oxidative stress in lung and has range of adverse effects associated with it [18]. The amount of iron present in the lung has proved to be adversely influence the progression of tuberculosis [19, 20]

Neeta and Jonathan [21] reported the linkage of Particulate Matter toxicity with respiratory health. A study was carried out in Canada which revealed the association of Nitrogen dioxide, Sulfur dioxide and Carbon monoxide with the daily newborn admission in hospital for respiratory diseases [22]. Michelle *et al.*[23] reported the linkage of asthma morbidity with Particulate Matter, Carbon monoxide and Ozone. Bin *et al.*[24] linked the association of Particulate Matter with asthma and Nitrogen oxides with cough. WHO [25] reported the association of cough and

deficits in lung function with air pollution. Khauadamova and Kumisbaeva [26] linked the association of atmospheric pollutants like sulfur dioxide and carbon monoxide with tuberculosis.

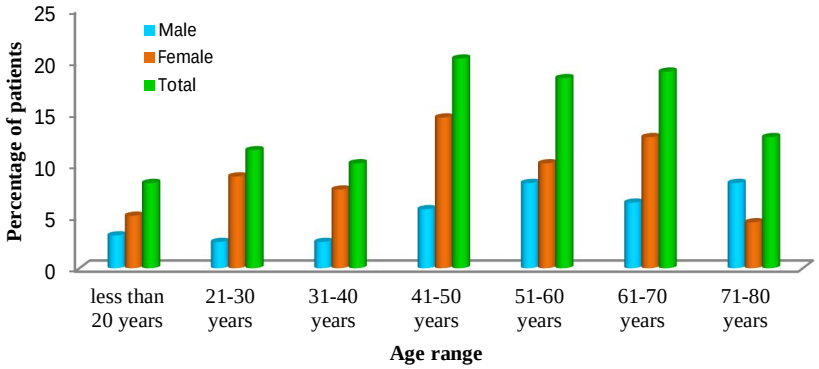

Figure 4: Distribution of respiratory problems in adults by gender and age group at Hospital (I).

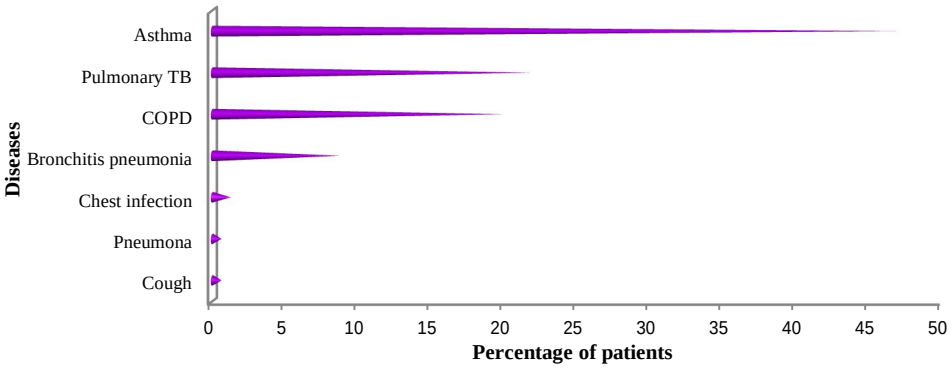

Figure 5: Respiratory diseases seen in adults at Hospital (I)

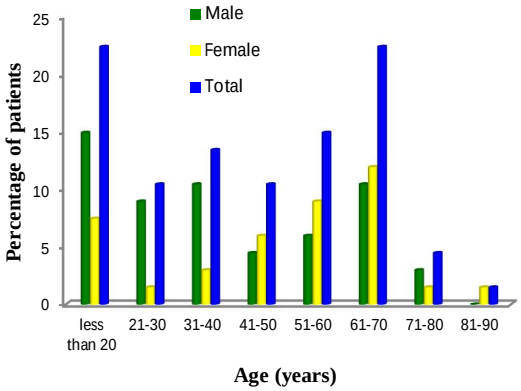

Figure 6: Distribution of respiratory illness in adults by gender and age group at Hospital (II).

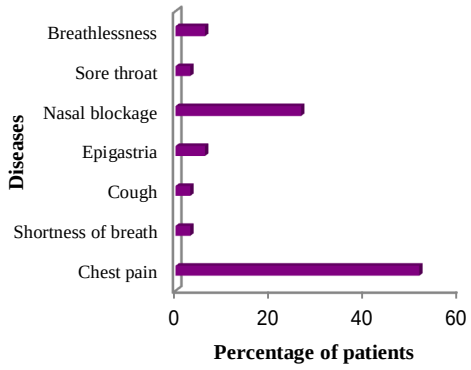

Figure 7: Respiratory diseases seen in Hospital (II) (both sexes and all age groups combined).

CONCLUSION

Air pollutants related diseases were common in both children and adults. Children less than 1 year were suffering more from respiratory diseases. As the age increases there was a decreasing trend observed in respiratory diseases in children. The respiratory disorders were more common in male children as compared to female children.

Children have increased exposure to pollutants in air because they spent more time in outdoors and possess a high level of physical activity. In adults the maximum percentage of patients was of age less than 20 and age range of 61-70.The respiratory problems were most common in adult males as compared to adult females

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