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A Study of Air Pollution and Human Health in Faisalabad City, Pakistan

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Abstract

The environment is an integral part of human life, the quality of which plays a critical role in human health. Every component of the biosphere has its own role in different types of epidemics. Though water and land pollution is very dangerous, air pollution has its own peculiarities, due to its transboundary dispersion of pollutants over the entire world. Therefore the study on air pollution and related impacts on human health have a special consideration today. Western countries have conducted several studies in this area, but there are only a few studies in developing countries like Pakistan. In this backdrop, a study on air pollution and related problems in Faisalabad city has been undertaken. The study area has been divided into three zones namely; residential, commercial and industrial, based on livelihood patterns in order to compare the health impacts in different human activity areas resulting from various types of pollution. The data shows an increasing trend in respiratory diseases with decreasing air quality. The hospital records also support the results obtained from the field study. The industrial effluent gases and low indoor air quality plays a key role in the industrial area, while vehicular pollution and congested housing patterns are the main factors in other zones. The children and elderly are the main victims of the respiratory diseases. This may be because of the accumulation of air pollutants, which needs an exclusive study to find out the root cause of the problem.

Keywords*: Air pollution, human health, urban air quality.*

I. Introduction

Human health is very closely linked to environmental quality, as the Etiology of most of the human diseases being related to the status of the living environment of man. According to statistics, 25% of all preventable illnesses are caused by detrimental environmental factors [UNEP, United Nations Children's Fund, [WHO2002]. In Africa, the environmental influence on disease incidence is even higher, being about 35% [1]. Both the developed and

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developing countries are faced with the problems related to environmental pollution, sourced in air, water or land, and caused by anthropogenic activities of man, disturbing the habitat around. Smoky indoor air, polluted ambient air, poor sanitation and contaminated water play a crucial role in causing ill health. As far as air pollution is concerned, both developed and developing countries are at risk. The main sources of air pollution are the vehicular and industrial sector. Urban air pollution problem is reaching a crisis dimension in many cities of the developing countries. There are several endemic diseases resulting from air borne particulate materials which has drawn public attention .The latest epidemic disease outbreak occurred in April 2003, when Severe Acute Respiratory Syndrome (SARS) appeared suddenly, sending shockwaves throughout the world, disturbing public health systems and economic security world wide. By July 2003, about 8439 cases had been reported world wide, with 812 deaths; the economic loss was estimated to be $50 - $100 billion [2]. Chemical agents, particularly air borne ones, are considered to be major factors in causing tuberculosis, bronchitis, heart diseases, cancers and asthma. Tuberculosis, the single largest cause of death in adults from infectious diseases, was responsible for three million deaths in 1996, 95% of which occurred in the developing world. Prevalence of asthma, often exacerbated by air pollutants, has also increased among children [3]. Studies suggest a quantitative relationship between atmospheric carcinogens, say pollution impacted lung cancer, and WHO has estimated that 50% of the global burden of chronic respiratory illnesses is associated with air pollutants [4]. Environmental threats are compounded by persistent poverty, political conflicts, and natural and man made disasters and social inequity. Higher socio-economic status usually measured by levels of education and income is consistently associated with higher breast cancer risk [5]. Such a relation could be related to chemical exposures from the use of consumer products, pesticides, food habits (especially consuming fatty foods) and even of dry cleaning [6]. Other diseases related to this group are high blood pressure, high cholesterol and obesity. Many western countries had done exclusive studies on air quality and related diseases, which revealed the seriousness of the problem worldwide. As air pollution is a global hazard, one should be very concerned about its quality. The present study is an effort to assess the air quality and its consequences in different parts of the Faisalabad city, within varying activity zones.

II. Materials and Methods

Area of Study

Faisalabad, with 4 million population, is the third biggest industrial city in Pakistan, Karachi being the fist and Lahore the second. Textile related Industry is spread in and around all parts of the city without the distinction of locality. This heavy industry is a major source of air pollution in the area. Also there are eight intercity high ways that lead to and out of the city

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on these roads are so busy that heavy traffic flows round the clock. The district lies between East longitudes 73° and 74° and North latitudes 30° and 31.15°. It is bounded in its North by Gujranwala and Sheikhupura districts. In the East by Sheikhupura and Sahiwal districts and In the West by Jhang district, (District Census Report of Faisalabad, 1984). The climate of the district is hot and dry. Its mean maximum and minimum temperatures in summer are about 39°C and 27°C and in winter about 21°C and 6°c respectively. Its summer season starts almost from the end of March and stretches up to October. May, June and July are the hottest months. The winter months are November, December and January, December and January are the coldest months. The rainy season is from July to September, July and August receives more rains than any other months of the year. Most of the winter rains are rained in the months of January, February and March. The mean minimum humidity in winter ranges from 46.9% in March to 54.5% In December while the mean maximum humidity in summer ranges from 57% in May to 79.5% in August. The mean maximum humidity in rainy season is 77.7% and the mean minimum humidity in rainy season is 59.9% (Source; Meteorological Cell Department of Crop Physiology U.AF.)

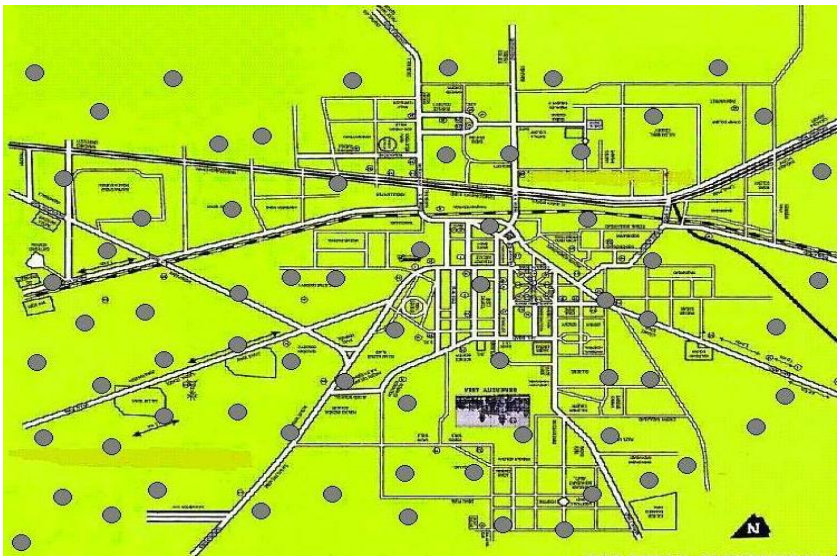

Figure (a): Map of Faisalabad City showing locations of data collection selected through random sampling

- Represents the household selected for sampling purposes

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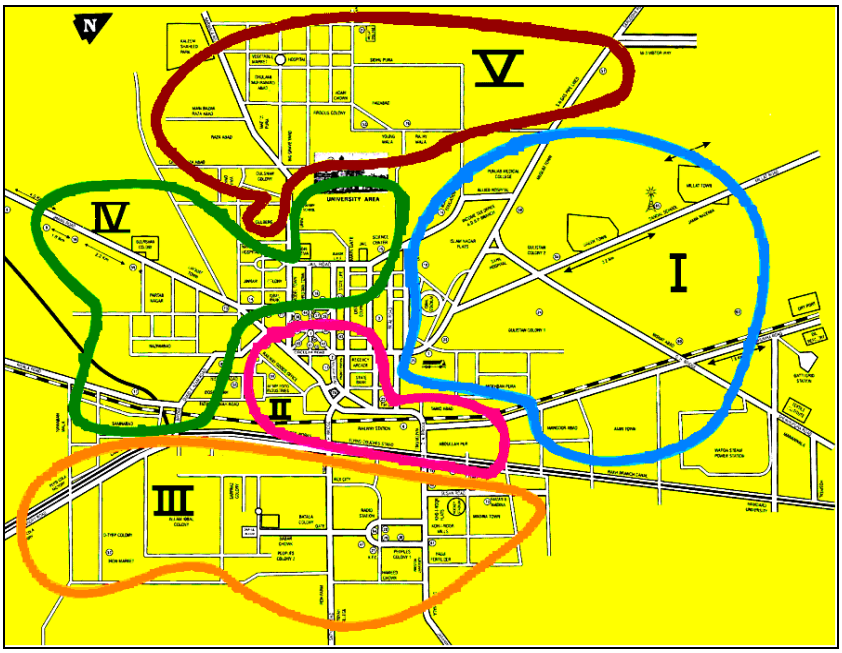

Figure (b): Zone wise classification (I, II, III+IV+V)

III. Results and discussion

Data collection has been done by the 'Questionnaire method', covering various households. All aspects of environment of each household, like socio- economic status, indoor air pollution, vehicular pollution, industrial pollution, sanitation, quality of drinking water and diseases like respiratory, gastrointestinal, eye diseases, skin problems, water/vector borne diseases, cancer, cardiovascular and miscellaneous ones have been taken into consideration. Children's health assessment has also given special attention. For the documentation of information regarding specific health end points such as respiratory ailments, infectious diseases, cardiovascular problems and cancer, the secondary data of SPM Samples were collected using standard methods the samples collected from various sites in Faisalabad are described in table 2K special with their codes and physical appearance, which belongs to the area under study for co relationship.

Table 2K1 special: Physical appearance of the selected samples

Code	Color	Code	Color
2K01	Dull Yellow	2K51	Blackish Gray
2K20	Light Gray	2K52	Blackish Gray
2K03	Green Tinge	2K53	Blackish Gray

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2K04	Green Tinge	2K54	Black
2K05	Green Tinge	2K55	Black
2K06	Green Tinge	2K56	Black
2K07	Light Green	2K57	Black
2K08	Light Green	2K58	Black
2K09	Brown	2K59	Blackish Brown
2K10	Black Tinge	2K60	Blackish Brown
2K11	Black Tinge	2K61	Blackish Brown
2K12	Black Tinge	2K62	Blackish Brown
2K13	Black Tinge	2K63	Blackish Brown
2K14	Blackish Brown	2K64	Blackish Brown
2K15	Light Gray	2K65	Blackish Brown
2K16	Light Gray	2K66	Blackish Brown
2K17	Light Gray	2K67	Brownish Black
2K18	Light Yellow	2K68	Brownish Black
2K19	Dull Green	2K69	Brownish Black
2K20	Dull Green	2K70	Black
2K21	Black	2K71	Black
2K22	Light Yellow	2K72	Black
2K23	Light Gray	2K73	Black
2K24	Light Green	2K74	Black
2K25	Dull Green	2K75	Black
2K26	Dull Green	2K76	Blackish Brown
2K27	Dull Green	2K77	Blackish Brown
2K28	Dull Green	2K78	Blackish Brown
2K29	Dull Green	2K79	Gray
2K30	Dull Green	2K80	Gray
2K31	Light Green	2K81	Gray
2K32	Light Green	2K82	Yellow
2K33	Yellow Tinge	2K83	Yellow
2K34	Brown	2K84	Yellow
2K35	Black	2K85	Yellow
2K36	Black	2K86	Light Gray
2K37	Black	2K87	Light Gray
2K38	Black	2K88	Light Gray

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2K39	Black	2K89	Light Gray
2K40	Black	2K90	Gray Tinge
2K41	Muddy Gray	2K91	Gray Tinge
2K42	Muddy Gray	2K92	Dull Green
2K43	Muddy Gray	2K93	Light Gray
2K44	Shining Gray	2K94	Light Yellow
2K45	Shining Gray	2K95	Light Yellow
2K46	Dark Gray	2K96	Light Yellow
2K47	Dark Gray	2K97	Black
2K48	Dark Gray	2K98	Blackish Brown
2K49	Dark Gray	2K99	Brownish Brown
2K50	Blackish Gray	2K100	Brownish Brown

In order to know which region had higher health hazards than the other, zone wise percentages of related diseases are given in Tables 2K01, 2K02, 2K03 and in figures 1, 2 and 3 respectively.

One thousand residents and workers related to the concerned zones were randomly selected and asked to fill out a questionnaire about their health status. The percentages of the patients along with relevant diseases were calculated and presented in tables 2K01, 2K02, 2K03 and figures 1, 2, 3 respectively.

Industrial Zone (2k05, 07, 09, 10, 15, 18, 19, 20, 22, 23, 25, 27-30, 33, 37-44, 46, 47)

Approximately 512 industrial units out of which 328 are textile units, 92 engineering units, 92 chemical and food processing units, other include hosiery. Printing and publishing units along with pharmaceutical products.

People in the industrial zone showed respiratory problems, watery discharge from eyes, skin problems and increased incidence of oral cancer compared to other areas under the study. The major air pollution problem is the smoke discharged from the Textile industrial units, which contributes to the respiratory problems of the people. Many residential houses are situated very near to the effluent discharge point of the industry. During the summer season they are subjected to severe dust problems because of the dry soil from the effluent flowing region. Analysis of data shows an 10% of increase in Respiratory diseases compared to other areas. The respiratory disease includes tuberculosis, wheezing, coughing and hyperactivity of the

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respiratory canal. The prevalence of diseases in industrial zone is shown in (fig.1& Table 2K01).

Table 2K01: Prevalence of Diseases in industrial zone

Disease	Population Effected (%age)
01=ENT	64.75%
02=Giddiness	83.33%
03=Fatigue	16.10%
04=Gastrointestinal	Nil
05=Urinary	6.15%
06=Cancer	0.53%
07=Hear Attack	9.35%35.79%BDL
08=Headache	9.07%
09=Skin Diseases	76.62%
10=Respiratory Diseases	95.25%21.21%BDL

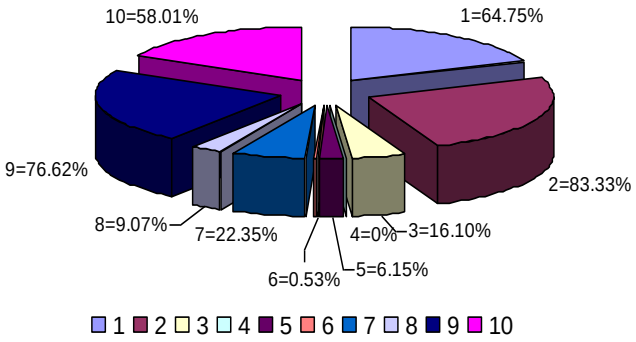

Figure 1: Prevalence of Diseases in industrial zone

The data obtained from different hospitals, clinics through personal interviews with the doctors show that 26.08% belongs to (5-20)years of age, 13.04% belongs to (20-40)years of age, 26.08% belongs to (40-60)years of age and 34.78% belongs to above 60years of age.

The age versus respiratory diseases show that children and aged people are affected most, which is in support of global research findings. It has been reported that long-term exposure to air pollutants such as nitrogen dioxide and particulate matter can cause reduced lung growth in children and the effects are more pronounced in areas where air pollution is higher [7]. The oral cancer ncidences are also common in this area, which may be related to their habits like drinking, smoking and chewing. Indoor air quality in industrial zone. Indoor air quality has equal importance as that of ambient air quality. Indoor smoke from solid bio fuels

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is one of the top ten health risks identified by WHO [8]. People in developing countries face health risks from indoor pollutants, such as sulphur and nitric oxides and arsenic compounds, due to greater exposure to open fires, or to the burning of biomass, coal or wood as fuel. Indoor pollution, is a potent threat to women and children who spend more time indoors, causing respiratory disorders, and is also linked to heart and lung disease based mortality. Biomass burning is very dangerous especially under unventilated conditions as it produces gases as well as dust particles of carbon, polyaromatic hydrocarbons, trace metals, sulfur etc [9]. About 10 – 30 ng/m3 Polynuclear Aromatic Hydrocarbons (PAHs) were detected in burning wood [10]. A study from Pakistan and Nepal demonstrated that cardiovascular diseases are more common among women who have been exposed to indoor pollutants (WHO1992). Indoor air pollution is strongly related to the socio-economic status of the people. In the Industrial zone, most people belong to low - middle and low classes, with Kaccha houses. And 30.9% of people are depending only on wood as the energy source and about 55.6% of them are using mixed fuel (wood and LPG) under unventilated conditions. Environmental tobacco smoke is also an indoor air pollutant in this area. Indoor air pollution results in a wide spectrum of diseases like acute lower respiratory tract illness, upper respiratory tract infections, Chronic Obstructive Pulmonary Disease (COPD), pneumoconiosis, cataract and adverse pregnancy outcome [11]. Exposure to moulds (Cladosporium and Aspergillus) in the indoor environment can cause an increased risk on allergic sensitization [12]. The increased risk of respiratory and oral cancer diseases may be the result of the cumulative effects of indoor and outdoor pollution, which needs more research in these aspects. Children are particularly vulnerable to environmental toxins. The children in this zone are suffering from high respiratory and malnutrition problems, because they have disproportionately heavy exposure to environmental toxicants affecting their metabolic pathways, especially in the first months after birth. They undergo rapid growth and development and their developmental processes are easily disrupted. Because children have more years of life ahead than most adults, they have more time to develop chronic diseases triggered by early exposures [13]. Indoor air pollution, glob al climate change, persistent organic pollutants, lead and pesticides are the major threats for children. Worldwide, 500 million children are being reported as debilitated by environmental diseases.

Commercial Zone (2k01, 02, 04, 06, 11, 13, 14, 16, 27, 24, 26, 31, 32, 34, 35, 36, 45, 48, 49, 50)

Urbanization has been one of the most striking developments of the 20th century. Sources of urban air quality depend mainly on vehicular density. World wide, more than 1000 million urban residents are exposed to health threatening levels of air pollution [4]. Dust problem is

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severe in many cities, which carry carcinogenic and pathogenic components causing diseases. The concentration of Suspended Particulate Matter (SPM) in mega cities like Mumbai, Delhi and Calcutta exceeded by more than 100 per cent of the limits of WHO [4]. According to Central Pollution Control Board (CPCB), ambient air Polynuclear Aromatic Hydrocarbons (PAHs) in Delhi ranged between 9.4 – 60.9 ng/m3 during 1999 – 2000. Higher values are recorded in winter. Unfortunately there are no standards for PAHs in Pakistan while in Germany and France has limits of 1.3 and 0.7 ng/m3 for benzo (a) pyrene, respectively [10]. In this study, the commercial area includes Bhowana Bazaar, Anar Kali, Jhang Bazaar, Ameenpur Bazaar, Chinot Bazaar, Rail Bazaar along with Bus and Coaches stands, railway station etc. The people of this area belong to low middle and middle class, with average literacy. Most of them are purely vegetarians and keep away from smoking and drinking habits. Like any other city, the vehicular exhaust and dust from various other commercial activities remains as a bane here also. Other environmental problems noticed in this area are solid waste disposal, wastewater stagnation and congested houses. The vehicular exhaust contains NOx, CO, PAHs and carbon soot particles, which have some direct effects on human health. PAHs like benzo (a) pyrene has certain carcinogenic property, which is a well established fact. Similarly other components also play a key role in activating many respiratory diseases like asthma, bronchitis, COPD, and pneumoconiosis (a non-neoplastic condition), especially for those who are already asthmatic. They can contribute to cardiac problems also (Fig.2) & (Table 2K02). The dust released from various sources has its own characteristics (size, shape, chemical composition etc.), and act as a carrier of many pollutant heavy metals, gases and vapors to the lungs, where they either deposited or penetrated into other tissues, which can produce a spectrum of diseases ranging from a simple cold to deadly diseases like cancer. The lung cancer incidents are increasing in most of the metropolitan cities like Faisalabad, Karachi etc.

Table 2K02: Prevalence of Diseases in commercial zone

Disease	Population Effected (%age)
01=ENT	20.10%
02=Giddiness	17.36%
03=Fatigue	9.07%
04=Gastrointestinal	10.97%
05=Urinary	6.15%
06=Cancer	0.53%
07=Hear Attack	9.35%35.79%BDL
08=Headache	16.10%

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09=Skin Diseases	2.45%
10=Respiratory Diseases	7.8%21.21%BDL

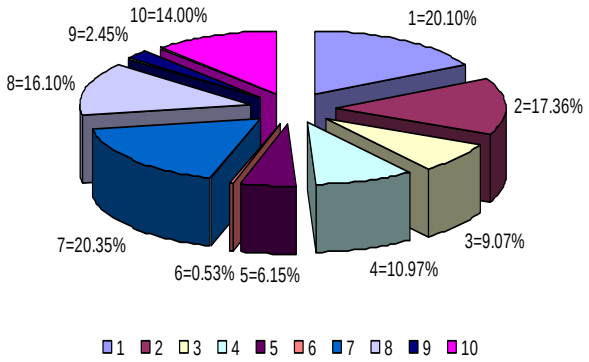

Figure 2: Prevalence of Diseases in commercial zone

Wastewater stagnation is a common phenomenon in the commercial zone. The throwing of solid waste to the wastewater canals helps to clog the system, and encourages mosquito breeding. The flow of wastewater in canals is disrupted in many parts of the city. This reflects in the comparatively high prevalence of vector diseases like filariasis. The solid waste dumping in the market places can create a lot of health problems, both directly and indirectly. As the major part of the solid waste comes under biodegradable, the dumping of this waste creates an anaerobic condition under which gases like hydrogen sulphide (H_2S), methane (CH_4) are released. The leac hate from the dumping site can contaminate soil and water bodies, and indirectly effects human health. Dumping sites act as a source for bio aerosols like fungi and bacteria. The primary pollutants like H_2S, under favorable conditions, converted to H_2SO_4, can be carried by the dust particles to the lungs and produce inflammation of the lining of the lungs. This can cause breathlessness and may be fatal. These acidic dust particles can act as a solvent for the accumulated dust particles in the lungs and can cause lung tissue damage and other related diseases. Insoluble particles deposited in the airways, or lungs, may also penetrate the deeper lung tissue where they may stay for years and can cause damage to the other tissues of the body. The inhaled organic dust can cause pneumoconiosis (non- neoplastic condition). Congested houses are a peculiarity of this zone. Air circulation is very less and this leads to accumulation of dust, sourced from various human activities, inside the houses. Use of mosquito repellents under this unventilated

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conditions can contribute to indoor air pollution and many of the respondents reported allergic respiratory and skin problems by the use of mosquito repellents.

Residential Area (2k03, 12, 21)

The residential area covers fifty percent of the Faisalabad city. Therefore a random sampling is carried out in order to cover almost all the areas of residential activity. The residential zone has its own peculiarities. It comprises of a mixed population in aspects like socio – economic conditions and dietary habits. Mainly consists of the big colonies like Jinnah Colony, Peoples Colony (1, 2), Gulistan Colony, Gulfishan Colony, GM Abad Colony etc. The educational status stands in a high position compared to other zones. Most of the people are concerned about the environmental problems, they are trying to keep their environment clean and this helps to keep away vector and waterborne diseases. Here indoor air pollution from bio-fuels is not a serious problem as most people have switched on to LPG (Liquid Petroleum Gas) system. And the housing pattern in this area helps maximum air circulation. The people of this zone are mainly non- vegetarians and depend on packaged foods. Diseases like cardiac problems; obesity and breast cancer are common in this area, which have a close relationship with dietary habits (Fig.3). Breast cancer incidents are relatively high in this zone and also other forms of cancer like stomach, kidney, lung, uterus, blood and brain are reported from this zone. The people also report some kinds of photo allergic skin problems. Here dust problems and also solid waste problems are not as severe as in the commercial zone. But they are facing difficulties in disposing of household garbage. Almost all people are burning the garbage, composed of plastic, garden litter, pesticide bottles, etc in their courtyard. The burning of these materials will produce Dioxin Like Compounds (DLCs), which are very hazardous to health. Dioxin is a known carcinogen especially for lymphomas and lung cancer. Recent epidemiological studies suggest a possible association between dioxin like compounds and diabetes in the human population [14]. By burning the household garbage all people are exposed to small but measurable levels of DLC. This chronic exposure may hasten the onset of adult diabetes in adult susceptible individuals. This is a very important area for consideration and suitable measures are warranted in order to assess the health risks associated with it in the study area.

Table 2K03: Prevalence of Diseases in Residential zone

Disease	Population Effected (%age)
01=ENT	Nil
02=Giddiness	64.70%

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03=Fatigue	Nil
04=Gastrointestinal	10.97%
05=Urinary	6.15%
06=Cancer	10.75%
07=Hear Attack	12.85%
08=Headache	6.25%
09=Skin Diseases	64.70%
10=Respiratory Diseases	50%

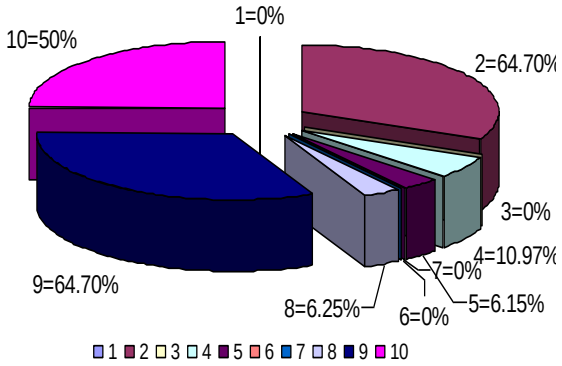

Figure 3: Prevalence of Diseases in Residential zone

There are some pockets of floating population in the residential and industrial zone, where low-income, illiterate people live as a colony. They have common toilets and drinking water facilities. These slums are usually situated along the banks of wastewater streams, and are using that water for many of their domestic purposes like bathing, washing etc. Such places may act as a source of vector and water borne diseases. Again these wastewater streams are dumping places for solid wastes and its degradation results in hazardous products formation, which along with the other factors like tobacco smoke is a major environmental problem in this area. The scarcity of pure water, poor sanitation and above all, poverty related malnutrition problems could have a synergistic effect on the health of these people [15-23].

IV. Conclusion

The present study has shown that each demographic zone has its own environmental problems, as reflected in specific diseases. In the industrial zone, air pollution related respiratory problems are of a high order. In the commercial zone cardiac and vector borne diseases, related to environmental hazards like waste water stagnation, dust and solid waste

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problem, are high and in residential zone diseases like breast cancer, cardiac problems and obesity, related to their dietary habits are reported to dominate. Poverty acts as a catalyzing agent both directly and indirectly, in all environmental and related health problems. An exclusive study on the sources and sinks of pollutants, its reaction mechanisms, antagonistic and synergistic effects on human health, short and long term effects etc are very essential to manage the risks associated with the degradation of environmental quality, particularly in urban areas.

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