Environmental pollution is a common problem in both developing and developed countries. It has become a serious threat to human beings. Every year large quantities of toxic wastes are discharged into the environment from the ever increasing production of goods and from the burning of fossil fuels to generate energy needed to sustain industrial and domestic activities. Faster urbanization also led to dramatic increase in the number of vehicles, which emit high concentration of lead and other toxic heavy metals.

A study during comparing the rates of economic growth and the rates of growth of vehicular pollution and industrial pollution showed that during 1975-1995, the Indian economy grew by 2.5 times, but the industrial pollution grew by 3.47 times and vehicular pollution increased 7.5 times. Rapid industrial and technological development has made our life comfortable but as a side effect it has led to exploitation of environment. Air pollution poses a worldwide threat to human health and environment. Air pollution in urban areas is mainly due to emissions of industrial gases and traffic related particulate matter which undergo dispersal, transport and chemical reaction in the atmosphere and are deposited as gaseous ions, solid and liquid particles. The high density of population and industries in the cities leads to vehicular, domestic and industrial emissions affecting adversely the health and property of inhabitants.
Air pollutants can be grouped in two categories primary, if emitted directly into the atmosphere and secondary, if formed in the atmosphere as a result of chemical reactions (such as hydrolysis, oxidation, or photochemical reactions) that involve primary pollutants. Primary pollutants emitted by motor vehicles include carbon dioxide (CO$_2$), carbon monoxide (CO), hydrocarbon compounds (HC), sulfur dioxide (SO$_2$), nitrogen oxides (NO$_x$), particulate matter (PM) and lead. Secondary pollutants associated with motor vehicle emissions include nitrogen dioxide (NO$_2$), photochemical oxidants (for e.g. O$_3$) and sulfuric or nitric acids and their salts. NO$_2$ is formed through oxidation in the air of nitric oxide (NO), a gaseous pollutant formed at high combustion temperature and emitted by motor vehicles. Ozone (O$_3$) is formed from NO$_x$ and the reactive HC in the presence of sunlight. SO$_2$ and NO$_x$ can react with atmospheric moisture, oxygen and PM to form sulfuric or nitric acid or their salts.

Motor vehicle emission results from fuel combustion or evaporation. The most common types of transport fuels are gasoline (in leaded or unleaded form) for light-duty vehicles (such as cars) and diesel fuel for heavy-duty vehicles (such as buses and trucks). Other commercial fuels used in vehicles include alcohols, gasoline-alcohol mixture, compressed natural and liquefied petroleum gas. Emissions from motor vehicles with spark ignition engines (for e.g., gasoline-fueled vehicles) are from the exhaust, engine crankcase and fuel system (carburetor, fuel line and fuel tank). Carbon dioxide (CO$_2$) and water vapours (H$_2$O), the main products of combustion are emitted in vehicle exhaust. The major pollutants emitted from gasoline-fueled vehicles are CO, HC, NO$_x$, SO$_2$ and lead. The air conditioning system, tires, brakes and other vehicle components also produce emissions.
Air pollution is one of the serious problems faced by the people in the developing countries like India. The urban areas in India have not only experienced a rapid growth of population but also a huge number of vehicles. Automobiles exhausts play an important role in the formation of pollutants in urban environment. These pollutants affect the health of human beings. Vehicular exhaust causes human respiratory illness like asthma, chronic bronchitis, lung infection, chronic obstructive pulmonary disease etc. Primary pollutants like carbon monoxide, hydrocarbons, sulphur dioxides, nitrogen oxides etc. and secondary pollutants like photochemical smog and acid rain are found to be present in the atmosphere. This problem is a challenge for human beings. The scientists evaluated the environmental hazards based on epidemiological, clinical and toxicological findings. Several factors contributes to the worsening air pollution levels in the developing-country’s cities including rapid growth in urban population, increasing industrialization and rising demands for energy and motor vehicles. Other factors such as poor environmental regulation, less efficient technology of production, congested roads and poor maintenance of vehicles also add to this problem.

Fuel combustion is the primary source of a large number of health-damaging air pollutants, including fine and respirable particulate matter (PM$_{2.5}$ and PM$_{10}$), carbon monoxide (CO), sulfur dioxide (SO$_2$), nitrogen oxides (NO$_x$), volatile organic compounds (VOCs), ozone (O$_3$) and atmospheric lead. Some of these pollutants are direct by-products of fuel combustion but others (such as O$_3$) are formed in the air through chemical reactions with other agents in the atmosphere.
Air pollutants

Sulphur dioxide

Sulphur dioxide (SO$_2$) is a stable, nonflammable, non-explosive, colorless gas that can be detected by taste at concentrations as low as 1,000 µg/m$^3$ or by smell at concentrations above 10000 µg/m$^3$. It is extremely soluble in water. SO$_2$ is produced by the combustion of sulfur-bearing fossil fuels for thermal power generation reacting with oxygen. SO$_2$ and SO$_3$ react with the moisture in air to form sulfurous (H$_2$SO$_3$) and sulfuric (H$_2$SO$_4$) acids which may be transported by winds to hundreds of kilometers before falling to earth as acid rain. Sulfates may also be produced through reaction of these sulfur compounds with metals present in PM. Sulphur dioxide is produced from combustion of sulphur containing fuels, manufacturing super-phosphate, metal smelting such as zinc, burning of firewood and refuse incineration.

Nitrogen oxide

Nitrogen oxides include nitric oxide (NO), nitrogen dioxide (NO$_2$), nitrous oxide (N$_2$O), dinitrogen trioxide (N$_2$O$_3$) and nitrogen pentaoxide (N$_2$O$_5$). Nitrogen oxides are produced by natural phenomena such as lightening, volcanic eruptions and bacterial action in the soil and by anthropogenic sources such as combustion of fuels in internal combustion engines, thermal power plants, industrial and heating facilities and incinerators. NO and NO$_2$, collectively represented as NO$_x$, are the main nitrogen oxides emitted by vehicles. About 90 percent of these emissions are in the form of NO, which is produced in the vehicle engine by combustion of nitrogen at high temperatures. NO$_2$, formed by oxidation of NO, has a reddish-brown color and pungent odor and it may be involved in a series of reactions (in the presence of ultraviolet
radiation) that produce photochemical smog, reducing visibility. It may also react with moisture in air to form nitric acid (HNO₃) aerosols. In the lower atmosphere (troposphere) NO₂ forms ozone by reacting with hydrocarbons compounds. In addition, NO₂ and nitrogen oxide also contribute to the generation of ozone and other oxidant pollutants and are precursor for the formation of nitric acid and subsequently the nitrate component. Thus, NO₂ is both a pollutant of concern and a surrogate for other concerns. Nitrogen dioxide is the important air pollutant produced from the reaction of N₂ with O₂ in air during combustion processes as well as from oxidation of nitrogen in the fuel. Motor vehicles are the main contributors to ambient NO₂ emission.

**Ozone**

Ozone (O₃) is a colorless gas that occurs in two separate layers of the atmosphere. Ozone in the outer (stratosphere) layer of the atmosphere is generated by photolysis of oxygen or naturally occurring hydrocarbons compounds and protects the earth from ultraviolet rays. In the lower (troposphere) layer, O₃ is generated at ground level by a photochemical reaction between ultraviolet radiation and atmospheric mixtures of NO₂ and hydrocarbons derived from vehicle emissions. O₃ levels depend on NO₂ emitted by cars and particularly on sunny weather that transforms NO₂ into O₃. O₃ is the most important factor for summer smog because it accounts for up to 90% of total oxidant levels in cities that enjoy a mild sunny climate. Ground-level ozone is formed by the reaction of volatile organic compounds VOCs and NOx with ambient oxygen in the presence of sunlight and high temperatures. Ground-level ozone is a major constituent of smog in urban areas and motor vehicles are the main anthropogenic emission source of its precursors. Areas
downwind of urban centers may also be affected by ground-level ozone as winds carry VOCs and NOx from their original sources.

**Suspended Particulate Matter (SPM)**

SPM comprises a wide variety of substances, which include inorganic and organic carbon (containing polycyclic aromatic hydrocarbons), acidic or neutral sulfates and nitrates, fine soil dust, residues of lead and other metals, asbestos and other fibers. Particulate matter (PM) consists of fine solids and liquids droplets, other than pure water, that are dispersed in air. PM originates from natural as well as anthropogenic sources. Natural sources include wind-blown soil dust, volcanic ash, forest fires, sea salt and pollens. Anthropogenic sources include thermal power plants, industries, commercial and residential facilities and motor vehicles using fossil fuels, heating, cooking and transportation. Petroleum refining and ore smelting are additional sources. In the atmosphere SO$_2$ may be converted to sulfur trioxide (SO$_3$).

Total suspended particulate matter (TSP) are particles with an aerodynamic diameter of less than 70μm. PM larger than 10μm in diameter results from physical actions such as wind erosion or grinding operations and tend to settle near their emission source. PM with an aerodynamic diameter of 10μm or less, known as suspended inhalable particulate matters or PM$_{10}$ remains in the atmosphere for longer periods because of its low settling velocity. PM$_{10}$ can penetrate deeply into respiratory tract and cause respiratory illnesses in humans. PM with an aerodynamic diameter of 2.5-10μm or less is defined as fine particles (PM$_{2.5}$), while larger PM is called coarse particles. Coarse particles are generally emitted from wind-blown dust, vehicles traveling on unpaved roads, materials handling and crushing and grinding operations. Nearly all PM emitted by motor vehicles consists of fine particles and a large
fraction of these particles has an aerodynamic diameter less than 1 um. PM$_{2.5}$ results from combustion of fossil fuels in power generation and manufacturing facilities, residential fireplaces and wood stoves, and agricultural burning. PM$_{2.5}$ can also be formed in the atmosphere as aerosols from chemical reactions that involve such gases as SO$_2$, NO$_x$ and VOC. Smog is a type of large-scale outdoor pollution. It is caused by chemical reactions between pollutants derived from different sources, primarily automobile exhaust and industrial emissions. Cities are often centers of these types of activities and many suffer from the effects of smog, especially during the warm months of the year

**Hydrocarbon Compounds**

Hydrocarbon compounds (HC) are defined chemically as compounds consisting of carbon and hydrogen. In air quality studies, however, the term hydrocarbons are often extended to include a variety of other volatile organic compounds (VOCs) such as alcohols and aldehydes. Most HC are not directly harmful to health at concentrations found in ambient air. Through chemical reactions in the troposphere, however, they play an important role in forming NO$_2$ and ozone, which are health and environmental hazards. Among the various HC, methane (CH$_4$) does not participate in these reactions.

**Heavy Metals**

Metals, a major category of globally-distributed pollutants, are natural elements that have been extracted from the earth and harnessed for human industry. Motor vehicles fueled with **leaded** gasoline are the main source of lead in ambient air. Tetraethyl lead is added to gasoline to increase the fuel’s octane number, which improves the antiknock characteristics of the fuel in spark ignition engines. About 70 to 75 percent of this lead is transformed into organic lead in vehicles’ engines upon combustion and emitted to the atmosphere.
through the exhaust pipe along with 1 percent of the organic lead that passes through the engine unchanged. The rest of the lead remains trapped within the exhaust system. Organic lead emissions usually occur as vapors while inorganic lead is emitted as PM, often less than 1 um in size. Human beings are exposed to heavy metals like lead and cadmium through inhalation of ambient air, cigarette smoke, smoke emissions from combustion of fuels and plastic wastes, refining, alloy manufacturing and industries. The world is in grave ecological imbalance due to environmental pollution. Cadmium exposure is encountered in industries dealing with pigment, metal plating, some plastics, and batteries. Airborne cadmium exposure is a risk posed by the incineration of municipal waste containing plastics and nickel-cadmium batteries. Cigarette smoking constitutes an additional major source of cadmium exposure. Nickel is a very abundant element. In the environment, it is found primarily combined with oxygen (oxides) or sulfur (sulfides). Pure nickel is a hard, silvery-white metal that is combined with other metals to form alloys. Major sources of exposure are: tobacco smoke, auto exhaust, fertilizers, super phosphate, food processing, hydrogenated-fats-oils, industrial waste, stainless steel cookware, testing of nuclear devices, tobacco smoke, baking powder, combustion of fuel oil, dental work and bridges. By breathing air or smoking tobacco containing nickel. Zinc is one of the commonest elements in the earth’s crust. It’s found in air, soil, and water and is present in all foods. Pure zinc is a bluish-white shiny metal. Zinc has many commercial uses as coating to prevent rust, in dry cell batteries, and mixed with other metals to make alloys like brass and bronze. Zinc compounds are widely used in industry to make paint, rubber, dye, wood preservatives and ointments. Also used for galvanizing sheet iron; as ingredient of alloys such as bronze, brass, Babbitt metal, German silver, and special alloys for die-casting; as a protective coating for other metals to prevent corrosion; for electrical
apparatus, especially dry cell batteries, household utensils, castings, printing plates: building materials, railroad car linings, automotive equipment; as reducer (in form of the powder) in the manufacture of indigo and other vat dyes; for deoxidizing bronze: extracting gold by the cyanide process, purifying fats for soaps; bleaching bone glue; manufacture of sodium hydrosulfite; as reagent in analytical chemistry. Some zinc is released into the environment by natural processes, but most comes from activities of people like mining, steel production, coal burning and burning of waste. It attaches to soil, sediments, and dust particles in the air. Rain and snow remove zinc dust particles from the air. Copper compounds have been widely used in industrial processes and agriculture. As a result, elevated Cu concentrations can be found in certain areas of the biosphere. Although Cu is a required element, at elevated levels copper become toxic; therefore, copper level in natural environment and its biological availability are important.

Health Effects of Air Pollution

The human health effects of poor air quality are far reaching but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure and the individual's health status. People who exercise outdoors, for example, on hot, smoggy days increase their exposure to pollutants in the air. Chemical agents that are released into the environment from various anthropogenic activities impact human health seriously. The respiratory system is one major route whereby these chemicals and toxic agents enter the body and cause disorders, including mortality. On a global scale, millions suffer from respiratory ailments and other diseases attributed to the presence of toxic chemicals and biological agents in the air.
Although concentration of any pollutant in the environment is a quantitative expression of the presence of the pollutant, there is no exposure unless there is physical contact with human beings. Exposure denotes the event when a person comes into contact with a pollutant for a particular time. On the other hand, dose refers to the actual quantity of pollutant that crosses the barrier of a body. Airborne particulate matter (PM) is the recent focus of the world community as it penetrates the respiratory system of human beings and causes many disorders.

The health effects caused by air pollutants may range from subtle biochemical and physiological changes to difficulty in breathing, wheezing, coughing and aggravation of existing respiratory and cardiac conditions. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and even premature death.

Air pollutants emitted by motor vehicles have a number of adverse effects on human health. Inhalation is the main route of exposure to air pollutants originating from motor vehicle emissions. Other exposure routes—drinking water contamination, food contamination, and absorption through the skin— are also possible. Exposure by inhalation directly affects respiratory, nervous and cardiovascular systems of humans, resulting in impaired pulmonary functions, sickness and even death. Exposure of laboratory animals to fine particles has been shown to lead cause inflammation of the airways and lungs (Peden, 1995). These particulates are smaller than 1 μm and remain suspended for hours or days. It has been estimated that between 20–60% of particles between 0.01 and 10μm which are inhalable will penetrate into the lower respiratory tract. Particulates of smaller size and mass are persistent in the environment and exert health impact to exposed resident population in urban setting (Kinney and Lippmann 2000). Inhalation of particles with a mass median aerodynamic diameter of 10μm or less is associated with increase hospitalization for asthma,
bronchiolar irritation and lower respiratory tract infections, while exposure to particles of size equal to 2.5µm and smaller including common cored pollutants from diesel exhausts, exhibit a stronger epidemiological link to death from cardiopulmonary and respiratory disease.

Since the industrial age began, pollution has become a byproduct of our advancement. The most common effects of air pollution are poor visibility, irritated eyes, upper respiratory infections, unpleasant odours. Emissions of various pollutants from mobile and stationary sources affect the quality of life and public health. Motor vehicle engines emit many types of pollutants including nitrogen oxides, volatile organic compounds (VOCs), carbon monoxide and sulphur dioxide and lead, leading to poor air quality, posing environmental and health risks all over the world. Diesel exhaust is a complex mixture of both particulate and gaseous phase. The size of the particles in diesel exhaust is so small that they can deposit in the airways and alveoli. The particles consist of a carbonaceous core with a large surface area to which various hydrocarbons such as Polycyclic Aromatic Hydrocarbons (PAHs) and nitro-PAHs can be adsorbed. These PAHs compounds are potent mutagens and carcinogens.

Urban areas exhibit both the highest level of pollution and largest target of impacts on human health (Goyal and Sidhartha, 2003). Many urban areas of this world have high concentrations of air pollution sources resulting from human activities; sources such as motor vehicle traffic, power generation, residential heating and industry. Urban air pollution not only represents a threat to human health and urban environment, but it also contributes to serious regional and global atmospheric pollution problems. Air pollution is experienced in most urban areas and is therefore a world-wide problem and an issue of global concern. It has been estimated by WHO that globally about 500000 people die
prematurely each year as a consequence of exposure to ambient pollution of suspended particulate matter.

The health of our lungs and entire respiratory system is affected by the quality of the air we breathe. In addition to oxygen, this air contains other substances such as pollutants, which can be harmful. Exposure to chemicals by inhalation can negatively affect our lungs and other organs in the body. The respiratory system is particularly sensitive to air pollutants because much of it is made up of exposed membrane. Lungs are anatomically structured to bring large quantities of air (on average, 400 million litres in a lifetime) into intimate contact with the blood system, to facilitate the delivery of oxygen.

NO₂ is an irritating gas that is absorbed into the mucous membrane of the respiratory tract. The most adverse health effect linked to NO₂ occurs at the junction of the conducting airway and the gas exchange region of the lungs. The upper airways are less affected because NO₂ is not very soluble in aqueous surfaces. Exposure to NO₂ is linked with increased susceptibility to respiratory infections, increased airway resistance in asthmatics, and decreased pulmonary function. Short-term exposure to NO₂ has been associated with a wide range of lower respiratory illnesses in children (cough, runny nose, and sore throat are among the most common), as well as increased sensitivity to urban dust and pollen. Benzene has toxic and carcinogenic effects. Polycyclic aromatic hydrocarbons absorbed in the lungs and intestine are metabolized in the human body are mutagenic and carcinogenic.

SO₂, an irritating gas that is absorbed in the nose and aqueous surfaces of the upper respiratory tract, is associated with reduced lung function and increased risk of mortality and morbidity. Short-term O₃ inhalation first modifies the ciliary cells, which seem to be the most sensitive. The clara cells
then undergo degranulation and destruction, while the reorganisation of the epithelium takes place over 7 days. O₃ is a very strong oxidant, which has the ability to overwhelm the natural defenses of the lungs. It induces lipid peroxidation and inactivation of biomolecules. SO₂ can affect the respiratory system and the functions of the lungs and causes irritation of the eyes. Inflammation of the respiratory tract causes coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes people more prone to infections of the respiratory tract. Hospital admissions for cardiac disease and mortality increase on days with higher SO₂ levels. When SO₂ combines with water, it forms sulfuric acid; this is the main component of acid rain which is a cause of deforestation. Lung tissue cells can be injured directly by air pollutants such as ozone, metals and free radicals. Ozone can damage the alveoli or air sacs in the lung where oxygen and carbon dioxide are exchanged. More specifically, airway tissues which are rich in bioactivation enzymes can transform organic pollutants into reactive metabolites and cause secondary lung injury.

Metals are notable for their wide environmental dispersion from such activity; their tendency to accumulate in select tissues of the human body; and their overall potential to be toxic even at relatively minor levels of exposure. Some metals, such as copper and iron, are essential to life and play irreplaceable roles in, for example, the functioning of critical enzyme systems. Other metals are xenobiotics, i.e., they have no useful role in human physiology (and most other living organisms) and, even worse, as in the case of lead and mercury, may be toxic even at trace levels of exposure. Even those metals that are essential, however, have the potential to turn harmful at very high levels of exposure, a reflection of a very basic tenet of toxicology “the dose makes the
poison.” Metals may be inhaled as dust or fume (tiny particulate matter, such as the lead oxide particles produced by the combustion of leaded gasoline). Some metals can be vaporized (e.g., mercury vapor in the manufacture of fluorescent lamps) and inhaled. The toxicity of metals most commonly involves the brain and the kidney, but other manifestations occur, and some metals, such as arsenic, are clearly capable of causing cancer. An individual with metals toxicity, even if high dose and acute, typically has very general symptoms, such as weakness or headache. Lung tissue has an abundant blood supply that can carry toxic substances and their metabolites to distant organs. In response to toxic insult, lung cells also release a variety of potent chemical mediators that may critically affect the function of other organs such as those of the cardiovascular system. This response may also cause lung inflammation and impair lung function. Breathing heavy metal particles, even at levels well below those considered nontoxic, can have serious health effects. Virtually all aspects of animal and human immune system function are compromised by the inhalation of heavy metal particulates. In addition, toxic metals can increase allergic reactions, cause genetic mutation, compete with “good” trace metals for biochemical bond sites, and act as antibiotics, killing beneficial bacteria. Much of the damage produced by toxic metals stems from the proliferation of oxidative free radicals they cause. Heavy metals can also increase the acidity of the blood. The body draws calcium from the bones to help restore the proper blood pH. Further, toxic metals set up conditions that lead to inflammation in arteries and tissues, causing more calcium to be drawn to the area as a buffer, contributing to hardening of the artery walls with progressive blockage of the arteries and osteoporosis. The most common adverse health effect of nickel in human is an allergic reaction. People can become sensitive to nickel when things containing it are in direct contact with the skin, when they eat nickel in
food, drink it in water, or breathe dust containing it. Once a person is sensitized to nickel, further contact with it will produce a reaction. The most common reaction is a skin rash at the site of contact. Less frequently, allergic people have asthma attacks following exposure to nickel. Lung effects, including chronic bronchitis and reduced lung function, have been observed in workers who breathed large amounts of nickel. Current levels of nickel in workplace air are much lower than in the past, and today few workers show symptoms of nickel exposure. The acute toxicity of nickel carbonyl by inhalation is high. Acute toxic effects occur in two stages, immediate and delayed. Headache, dizziness, shortness of breath, vomiting, and nausea are the initial symptoms of overexposure: the delayed effects (10 to 36 h) consist of chest pain, coughing, shortness of breath, bluish discoloration of the skin, and in severe cases, delirium, convulsions, and death. Zinc is an essential element in our diet. Too little zinc can cause health problems, but too much zinc is also harmful. Acute toxicity: Inhalation of fumes may result in sweet taste, throat dryness, cough, weakness, generalized aching, chills, fever, nausea and vomiting. Zinc chloride fumes have caused injury to mucous membranes and pale gray cyanosis. Ingestion of soluble salts may cause nausea, vomiting and purging. Breathing large amounts of zinc (as dust or fumes) can cause a specific short-term disease called metal fume fever. This is believed to be an immune response affecting the lungs and body temperature. Skin irritation will probably occur in people. Copper inhalation may cause a red, dry throat, metallic taste in mouth, congestion of nasal and pharyngeal, sneezing, headache, excitability, dizziness and difficult breathing. Acute copper toxicity may cause: fever, tachycardia, hypotension, hemolytic anemia with intravascular hemolysis, oliguria, uremia, coma and cardiovascular collapse. Chronic copper toxicity may cause: nausea,
vomiting, epigastric pain, yellow watery diarrhea, dizziness, general debility, jaundice, and green stools.

Structure and Function of the human respiratory system

The human respiratory system is dominated by our lungs, which bring fresh oxygen (O₂) into our bodies while expelling carbon dioxide (CO₂). The oxygen travels from the lungs through the bloodstream to the cells in all parts of the body. The cells use the oxygen as fuel and give off carbon dioxide as a waste gas. The waste gas is carried by the bloodstream back to the lungs to be exhaled.

The lungs accomplish this vital process - called gas exchange - using an automatic and quickly adjusting control system. This gas exchange process occurs in conjunction with the central nervous system (CNS), the circulatory system, and the musculature of the diaphragm and the chest.

Air ways of the lungs beyond the trachea that contain cartilage are called bronchi and those lacking cartilage are called bronchioles. These lead into hollow spaces called alveoli. The conducting airways are lined by cells with cilia. Cilia are small motile surface projections. Interspersed between these cells are mucous secreting cells. Secreted mucous spreads over the cilia and direct it upwards to the larger airways by the rhythmic undulating movements thus helping to clear deposited ducts. The alveoli and the smallest bronchioles called respiratory bronchioles are responsible for the exchange of gases. These are lined with flat extremely thin cells, which permit easy diffusion of oxygen through them from the air in the alveolar spaces to the blood in the capillaries and easier diffusion of CO₂ in the opposite direction.
The acute effect of particulate air pollution results in changes in respiratory health status and depicts several respiratory symptoms. The symptoms are often recorded into upper respiratory symptoms such as stuffy or runny nose, sinusitis, sore throat, wet cough, head cold, hay fever and burning or red eyes. The lower respiratory symptoms include wheezing, dry cough, phlegm, shortness of breath (dyspnoea), chest discomfort and pain. The cough is most frequently reported symptoms due to continuous exposure in high particulate matter laden ambient air.

Certain air borne particles like arsenic and its compound, chromates, particle bearing polycyclic aromatic hydrocarbons (PAHs), nickel bearing dust, radioactive particles may act on lung tissue and cause carcinoma. These may be transported from lungs to other parts of body, if particles are soluble carcinogens.

The individual or combined effects of air pollutants on the respiratory system are not completely understood, but they do constitute a source of irritation to pulmonary mucous membranes leading to lowered resistance to pathologic organisms, various forms of pulmonary obstruction, and in some cases death.

Air pollution has both acute and chronic effects on human health. Health effects range anywhere from minor irritation of eyes and the upper respiratory system to chronic respiratory disease, heart disease, lung cancer, and death. Air pollution has been shown to cause acute respiratory infections in children and chronic bronchitis in adults. It has also been shown to worsen the condition of people with preexisting heart or lung disease. Among asthmatics, air pollution has been shown to aggravate the frequency and severity of attacks. Both short-
term and long-term exposures have also been linked with premature mortality and reduced life expectancy.

Health impact of air pollution depends on the pollutant type, its concentration in the air, length of exposure, other pollutants in the air, and individual susceptibility. Different people are affected by air pollution in different ways. Poor people, undernourished people, very young and very old, and people with preexisting respiratory disease and other ill health, are more at risk. In cities, for instance, poor tend to live and work in most heavily polluted areas, and in rural areas poor are more likely to cook with dirtier fuels. In some countries, air quality standards tend to be more lax around industrial areas in cities, where many poor tend to live in squatter settlements. Poor also tend to be more malnourished, more likely to suffer from ill health and disease, and have less access to health care.

As a result of several decades of tighter emission standards and closer monitoring, levels of certain types of air pollutants have declined in many developed countries. Although, even at much reduced levels, air pollution continues to threaten public health in these countries. On the other hand, the ambient air pollution levels are a growing problem in urban centers in many developing countries.

Several factors contribute to the worsening air pollution levels in developing-country cities, including rapid growth in urban population, increasing industrialization, and rising demands for energy and motor vehicles. Other factors, such as poor environmental regulation, less efficient technology of production, congested roads, and age and poor maintenance of vehicles, also add to the problem.
INTRODUCTION

Of the specific air pollutants, exposure to respirable particulate matter has been shown to induce a systemic inflammatory response involving stimulation of the bone marrow, which can contribute to cardio respiratory morbidity. Other evidence indicates that exposure to polycyclic aromatic hydrocarbons especially benzopyrene can cause immune suppression and can increase the risk of infection and disease. Benzopyrene, a known carcinogen, also can increase the risk of lung and other types of cancers. Acute exposures to oxides of nitrogen and sulfur have been associated with increased bronchial reactivity and susceptibility to bacterial and viral infections.

Toxic air pollutants are substances in the air that, if you are exposed to them, could increase your chances of experiencing health problems. Toxic air pollutants also can also cause ecological impacts. An example of a toxic air pollutant is the chemical benzene which is in gasoline. Inhaling fumes that contain benzene could increase your chances of getting cancer. The amount of pollutants released to the atmosphere by fixed or mobile anthropogenic sources is generally associated with the level of economic activity. Meteorological and topographical conditions affect dispersion and transport of these pollutants, which can result in ambient concentration that may harm people’s structures and the environment. In general, the effects on people are most intense in large urban centers with significant emission sources, unfavorable dispersion characteristics and high pollution densities.

The problem of air pollution is of global concern. Air pollution is something that we cannot really ignore now-a-days. This is evident from the moment we step out of our house and are greeted with black colored smog that
hits us directly reminding us that breathing clean air is more of a distant dream. It is so easy for us to endlessly rant and rave about the causes of air pollution and its ill effects, but little do we realize that each person is responsible for all the causes of air pollution and the situation that we face today. Take a look around you at the dismal state of affairs. The thick smog that is seen in the morning hours is not really due to somebody else but rather due to each and every one of us.

There are evidences that air quality is worsening in the developing countries. Like many other countries of India, the ambient air quality of Rohtak is also being deteriorated. During the last decade, the city of Rohtak has witnessed an exponential increase in vehicles both personal and commercial. Emission from heavily loaded transport very old vehicles and badly maintained automobile contribute significantly to the pollution problems.

Air pollution at Rohtak city is increasing day by day due to vehicular exhausts. There is no data available which could guide us to plan something in response to the air pollution. Patients having respiratory problems are increasing day by day. Not much information on the air quality of Haryana, which has experienced rapid industrial and vehicular growth during last decades, is available. In the present study, an attempt has been made to assess the prevailing concentration of the TSPM, SO₂, NO₂, O₃ and VOCs in the fast growing urban centres of various cities in relation to different anthropogenic activities. The quality of environment is a matter of concern to everyone locally, nationally as well as internationally and in this context it is sensible to follow the policy of “act locally and think globally.” Very little attention has been paid to study the effects of air pollutants on the human beings directly. Therefore, the present research work was conducted to evaluate the effect of air pollution on human beings. The aim of this study was to investigate potentially abnormal
lung function and respiratory symptoms in subjects living in an area with heavy motor traffic and major permanent air pollution, and in a population living in a low pollution area.