Chapter 1

INTRODUCTION

Man is basically an intruder in natural landscape. Unprecedented population growth unplanned industrialization have brought the man made and natural environments into conflict to such a degree that not only is sound, economic and social development undangered but also the physical, social, aesthetic and spiritual well being of man is jeopardised.

The industrial society is rapidly approaching a cross road. The human population has expanded three fold in the past ninety years fossil fuel consumption has increased thirty times and industrial production risen fifty fold. Obviously this pattern can not continue indefinitely. What kind of industrial society do we want? This has been an area to think today.

Never before in the history of mankind man has faced such a severe crisis of self-destruction as he faces today. Though man had been on this planet for a short period he had caused great damage by unplanned industrialization and harnessing of natural resources for his needs, while forgetting his own interaction with nature. Trigger happy men had destroyed the natural balance. The environmental pollution has poisoned the earth with large dozes of chemicals, garbage, noxious fumes, noise, heat, sewerage, and the rest of it. All this is the product of industrialization.
Urban over crowding and just too many people are attempting to survive on this planet of limited resources.

If human society has to endure not just for another century but for thousands - thousands of years, the rapid strides made by the country towards industrialization should not lead to a catastrophic situation.

In the industrialized countries for technological progress, affluent life styles, comfort and for having the best of everything that is causing the crisis. In the industrialized countries the crisis appears in the form of the so-called the "Green-House Effect". The effects are caused by excess emission of CO₂, CO, SO₂, C.F.C. etc. by factories and cars and callously dumping of household garbage into rivers and streams. The last Gulf-war has a major contribution to this effect. No one can escape from the consequences as they all share the same planet and breath the same air.

Industrialization is enforcing in changing the regional ecology, socio-economic status and political influences too. This realization made the largest meeting and global gathering of 143 - heads of various states and Governments and other various personnels at Rio Conference at Rio-de-Janeiro on June 5, 1992 which is widely known as the "Earth Summit."
Five programme areas here had been specified one of which important most was "Reducing health risks from environmental pollution and hazards."

According to the scientists, a 1°C increase of global temperature per ten thousand years is normal but evidence says that during the last 300 years world temperature has got increased by 1°C and if the rate continues the global temperature will increase more 3°C in the coming century which is 30,000 times greater than normal. The ozone gas layer on the earth that protects, saves the living organisms from the ill effects of ultraviolet ray of the sun has seriously been damaged and decayed by the green-house gases and C.F.C. i.e. Choloro-Fluoro-Carbon gases resulting maximum penetration of the ultra-violet ray on earth and leading to innumerable problems, diseases like cancer tuberculosis etc.

The primary pollutants which together contribute more than 90 per cent of global air pollution are mainly of following types.

1. Particulate matter i.e. floating matters of air. These again are of following types - (a) viable or living types like bacteria, pollen grains, fungal and other pores (b) non living type

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like dust, smoke, fume, mist, fog, aerosol, smog etc.

2. Gases and vapours, different kinds of which are (a) sulphur compounds like SO₂, SO₃, H₂S, H₂SO₄ etc. (b) Nitrogen compounds like NO, NO₂, NO₃, N₂O, NH₃, HNO₃ etc. (c) carbon compounds like C₁-C₅ compounds, aldehydes, ketones, acids etc. (d) Oxides of carbon like CO, CO₂ and (e) Halogen compounds like HF, HBR, HCl etc.

3. Toxic and chemical substances like lead combined with chlorine, bromine, including arsenic, cadmium, vanadium, zinc, chromium, manganese, and their various compounds.

Industrialization has got a number of influences on social impact, economic impact, ecotoxicological impact, impact on flora and fauna, impact on occupation, and finally the impact on health of the inhabitants to which we are mostly concerned and interested.

Vital statistical figures indicate that industrial areas are characterized by high morbidity and mortality from certain diseases. The incidence of chronic bronchitis, cancer, tuberculosis, and specially the cardio-vascular and cardio-respiratory diseases are much higher in industrialized areas than in rural areas.

Some other worth notable acute problems of industrial areas are loss in visibility, eye, and throat irritation, temporary
deafness, increased blood pressure, heart rate, muscular contraction, affects digestion, flow of saliva, and gastric juices, creates E.N.T. problems, not only that it threatens the health greatly. Impairs efficiency of work, also disturbs psychologically in many ways like irritability, tenseness, moodiness fear etc. Insomnia is the greatest evil in industrial area.

Suspended particulate matters can result from natural and man made sources. The former is beyond control of man while the latter include mainly emissions from fuel combustion, incineration, burning dumps and industrial processes like loading, unloading, crushing, grinding, mixing, smelting, flowing etc. and other various industrial operations.

Sulphur containing pollutants like $\text{SO}_2$, $\text{SO}_3$, $\text{SO}_4$, $\text{S}_2\text{O}_3$ and $\text{S}_2\text{O}_7$ are produced mainly from burning of inorganic sulphides, and sulphur bearing organic compounds. Combustion of fossil fuel, coal based thermal power plants, automobiles etc. are thought to be the major contributors of $\text{SO}_2$.

$\text{SO}_2$ is a major contributor to lung diseases. It causes acute and chronic asthma, bronchitis and emphysema a disease of air sacs of the lungs.\(^2\)

Oxides of nitrogen are collectively called as $\text{NO}_x$ and the familiared mosts are $\text{NO}$, $\text{NH}_3$, $\text{NO}_2$, $\text{N}_2\text{O}$ etc. $\text{N}_2\text{O}$ is very irritative and toxic. Delayed pulmonary edema and sudden collapse are found to be the prominent most symptoms in acute cases. Inhalation of nitrous oxide in-activates Vitamin $\text{B}_12$ by oxidation which may lead to impaired synthesis of DNA in the bone marrow.\(^3\)

The common pollutants of carbon compounds or oxides of carbon in the air are $\text{C}_2 - \text{C}_5$ compounds, aldehydes, ketones, $\text{CO}$, $\text{CO}_2$ etc. originate from unplanned and inefficient combustion of fossil fuels and solid wastes, industrial processes, from gasoline combustion in motor vehicles etc.

$\text{CO}$ harms the body by interfering with oxygen transport from the lungs to the body cells. When $\text{CO}$ passes into the blood stream 80 per cent combines with haemoglobin and forms carboxy haemoglobin.\(^4\) The remaining 20 per cent reacts mostly with myoglobin. It reduces the oxygen carrying capacity of blood.

It has been established that exposure to high concentration of $\text{CO}$ produces headache, dizziness, lassitude, flickening of eyes, ringing of ears, nausea, vomiting, palpitations, pressure on chest,

\(^3\)Ibid., p. 126.

difficulty in breathing, muscular weakness, collapse, un-consciousness and finally death.\textsuperscript{5}

The toxicity symptoms of lead are very acute, and chronic involves even motor nerve paralysis. In industrial environment automobiles are the largest contributor of lead.

In this context a great industrial hazard i.e. a review of Methyl Isocyanate toxicity by Union Carbide Plant in Bhopal, India on December 3, 1984 is worth mentionable.

The raw materials that are used normally to produce cement are lime, silica, alumina, iron oxide etc. and coal furnace oil etc. are used as fuels.

Various plant operations, conveying and transportation of cement give rise to various pollutants like noise, SO\textsubscript{2}, NO\textsubscript{x} particulate emissions, cement dust, etc. These all agents represent the greater problem in the local area. Submieron particles lead to various bronchial and pulmonary problems.

Jute is the only raw material used in a jute industry and for finished products the auxiliary agents used are fuel i.e. coal, H.S.D. and coke.

Various operations like softening, carding, drawing, spinning, weaving etc. all are the major sources to produce the various

\textsuperscript{5}Ibid., p. 80.
pollutants like highly hazardous fine dust, jute fibres, particulates, \( \text{SO}_2 \), \( \text{NO}_x \), \( \text{CO} \), \( \text{HC} \) etc. and transported to the aerial environment either by natural air flow or by the forced ventilation mechanism.

All those agents do possess inherent qualities to affect the physiological health of the local inhabitants. Jute fibres and jute dusts penetrate into the lungs to produce various respiratory problems.

'Byssinosis' a kind of chest tightness leads to serious respiratory problem and very common in an jute industrial area both in inhabitants and workers.

In a coal industry mining operations and quarrying involve operations like drilling, blasting, shovelling and conveying. Other operations like open cast mining, transportation of coal and sand, conversion of low grade coking coal into soft coke, manufacture of hard coke, dumper movement, open burning of coal, coal washeries other dependable and ancillary units, unplanned housing, thick population, automobile and vehicular load and over all the active fires all these are the major sources to produce various pollutants in an around the coal industry.

All these operations and activities give rise to various pollutants like dusts, particulates, smoke, hydrocarbons, \( \text{NO}_x \), carbon and organic effluents, sulphur compounds, ammonia, lead etc.
All those agents and industrial activities posing a serious health hazard and threaten the very economical balance of nature in coal fields. In several cases pollutants are beyond threshold limit values.

All these ailments lead to catastrophic situations like damaging to the respiratory system and respiratory diseases of high incidence like lung T.B., Cancer, Bronchitis, Asthma, Cardio-vascular diseases, Gastro-intestinal problem, Lachrymation i.e. burning sensation and watering of the eyes, irritation of nasal and other mucous membranes and sneezing are very common in coal field areas. Pneumoconiosis is an worth mentioned phenomenon here.

In a steel plant various units that produce and release various pollutants in the local aerial environment are such:

* Raw Material Yard dust of various sizes.
* Coal washery and coke ovens. Coal dust, gases and toxic substances.
* Blast Furnace Dust fumes and gases.
* Power Plant and sinter plant. Toxic gases and dust
* Steel melting shop Dusts and gas emissions.

Above all noise and heat from all the units.

Effects of the above pollutants on the local inhabitants result suffocations, irritation of eyes, throat, lung, and respiratory
tracts, poisoning, increases accident liability, bronchitis; oedema of lungs, respiratory diseases of lungs, cancer etc.

A rural area by its noble characteristics is relatively less polluted and free from industrial hazards, various toxic and chemical substances originated due to industrial sources. Transportation and population load here is relatively less, normally covered with greenbelt, the source of fresh oxygenated air, and is with a normal climatic condition.

Naturally the problems and diseases caused by industrial pollution here are proportionately less.

The breath holding capacity of an individual indicates the tolerance capacity of CO₂ and lactic acid with or without oxygen. This largely depends on the capacity of the lungs and the cardio-respiratory system or the oxygen transport system.

Vital capacity reflects the respiratory efficiency of an individual. It is affected seriously when the other lung parameters are affected due to some obstruction thereby.

Air flow rate indicates the overall functioning capacity of lung that depends upon the expandibility of thoracic cavity due to activity of various respiratory muscles. Peak expiratory flow rate indicates the pulmonary, ventillary efficiency when the rate of expiration is highest. It depends on the lung capacity and respiratory muscles strength.
Resting heart rate is one of the most important factors that indicates ones efficiency of the cardio-vascular system. A relatively low heart rate in general indicates an efficient circulatory system.

Endurance is a distinguishing characteristics and is measured by the ability of the circulatory system to withstand the strain of heavy and prolonged muscular activity. It denotes ones aerobic capacity. Cardio-respiratory endurance refers to the efficiency with which oxygen is taken into the lungs transportated by the circulatory system and utilize in the working muscle, whereby haemoglobin in the blood also plays a vital role.

Tests in these parameters are used clinically to monitor individuals with asthma, pneumonia, pulmonary congestion, T.B. and other lung diseases and in the diseases of heart. There are evidences that these variables may improve in their functional capability following a carefully prepared conditioning programme.

The effects of air pollution on personal or community health are:

a) Acute sickness or unt ime death and decay.

b) Chronic diseases, shortening of life or impairment of growth or development.

c) Alteration of physiiological functions, such as ventilation of lungs, transport of oxygen by haemoglobin, sensory acuity time
interval estimation or other function of the nervous system.

d) Impairment of performance such as in athletic activities, or complex task such as learning.

e) Untoward symptoms such as sensory irritation which in the absence of is an obvious cause.

f) Storage of potentiality harmful material in the body and

g) Discomfort order which impairs the visibility.

Physiological systems are highly adoptable to exercise. Involvement in systematic and scientific programmes of conducting the training will bring about desired changes in physical and physiological variables.

Regular intensive physical training or exercise has got a number of physical and physiological benefits. It improves the efficiency of circulatory system, respiratory system and the efficiency of oxygen transport and its utilization by the tissues.

Shortness of breath limits the activity of patients with chronic obstructive pulmonary disease and the resultant lack of activity leads to an unfit state and increased dyspnea, a vicious cycle.

Other adoptive mechanism through training that relate to cardio-vascular capacity are increases in the total haemoglobin
of blood and increases in plasma volume. Haemoglobin\textsuperscript{6} increases under the stress of vigorous exercise. Athletes in training show not only an increase in haemoglobin but also an increase in total blood volume.

No emphasis is needed to state that the aerial environments of the selected industrial zones are loaded with various pollutants, dust particulates and gases. On the other hand the rural area is relatively free from those industrial hazards.

A survey of literature shows that a very little work has been done in the direction of industrial pollution and physiological health of the inhabitants.

Here the selected four viz. cement, jute, coal and heavy industrial zones and the rural zone present a unique opportunity for the study on pollution effect on the selected variables of the inhabitants. Not only that it leaves a chance to conduct a training and conditioning programme in the selected industrial and the rural zone and provides scope to see the effects on the selected cardio-respiratory variables. Keeping all these views in aspect this study was accepted by the author.

Statement of the Problem

The present work was undertaken to study the effect of industrial pollution on the selected cardio-respiratory variables of industrial inhabitants. And to compare the cardio-respiratory variables of the industrial inhabitants with those of a rural area.

A sub-purpose of the problem was to study the effect of a training and conditioning programme on the selected cardio-respiratory variables on the inhabitants in an industrial zone.

Delimitations

From the convinient and plausible point of view the study was delimited to the followings.

1. The study was confined into four cement, jute, heavy and coal industrial zone and also in a rural zone.

2. The study was delimited to the following cardio-respiratory variables:

a) Breath holding capacity (both positive and negative).
b) Vital Capacity
c) Air Flow Rate
d) Peak Expiratory Flow Rate
e) Resting Heart Rate
f) Haemoglobin Percentage in the blood(gm./100 ml.)
g) Cardio-vascular endurance.
3. Subjects were of male sex, 200 in number from each industrial and rural zone of 20-25 years of age group.

4. To study the effect on training and conditioning programme the training zones selected were coal industry and the rural zone.

5. Duration of training and conditioning programme was delimited to 8-weeks.

Limitations

1. Unavailability of sophisticated instruments were a limitation for the study.

2. The pollution effect on particular area due to the presence of some other unavoidable polluting agents (vehicle, transport, coal gas etc.) both in terms of quality and quantity that might not be controlled been considered as the limitation for the study.

3. The quantum of physical activities beyond regular training and conditioning programme to which the subjects selected for training and conditioning were involved were impossible to assess and control which was recognised as limitation for the study.

Hypothesis

It was hypothesised that there will be significant differences in the cardio-respiratory functional status among the
subjects residing in various industrially polluted and relatively less polluted rural areas and there would be significant changes in the selected cardio-respiratory variables as a result of training and conditioning of 8-weeks in the experimental groups.

**Definition and Explanation of Terms**

**Breath Holding Capacity (positive and negative)**

It is the tolerance capacity of CO$_2$ and lactic acid with or without oxygen.

As defined by Mosses$^7$ breath holding time is the duration of time, through which one can hold the breath without inhaling or exhaling.

Breath holding could be positive or negative. It is referred to be positive when breath is hold after forceful inhaling the air, similarly it is termed negative when the breath is hold after exhaling the air forcefully.

**Vital Capacity**

The maximal values of gas that can be expelled from the lungs following a maximal inspiration is called vital capacity.

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It is the volume of air that can be breathed out by forced expiration after taking forced inspiration.\textsuperscript{8}

**Air Flow Rate**

It has been defined as the flow rate of expired air after maximum voluntary inspiration.

**Peak Expiratory Flow Rate**

It has been defined as the flow rate during maximum flow phase of the expired air after maximum voluntary inspiration.

**Resting Heart Rate**

The heart rate (beats per minute) which is derived during the complete resting condition of the organism of the subject.\textsuperscript{9}

**Haemoglobin Content**

Is the oxygen carrying pigment of the blood one principal protein in the erythrocyte\textsuperscript{10}


\textsuperscript{9} Morehouse and Miller, *Physiology of Exercise*, p. 69.

According to Mathew and Fox\textsuperscript{11} Hb. content is defined as the gram percentage of haemoglobin for each 100 ml. of blood in the body.

\textbf{Cardio-vascular Endurance}

It is the ability to continue or persist in strenuous tasks involving large muscle group for long period of time.\textsuperscript{12}

\textbf{Pollutant}

A pollutant can be anything which when introduced into the air either by man or through act of nature reduces its oxygen content or changes its composition. It may occur as a solid particle, liquid droplet or gas or various admixtures of this.\textsuperscript{13}

\textbf{Particulate Matter}

By 'Particulate Matter' we refer to any substance except pure water that exists as a liquid or solid in the atmosphere under normal condition and is of microscopic or sub-microscopic size but larger than molecular dimensions (about 2 Å).\textsuperscript{14}


\textsuperscript{12} Hockey, \textit{Physical Fitness : The Pathway to Healthful Living}, p. 19.


\textsuperscript{14} Ibid.
Dust

Solid particles dispersed in a gas by the mechanical disintegration of material such as handling, crushing, grinding, rapid impact, detonation and decrepitation of organic or inorganic materials such as rock ore, metal, coal, wood grain etc.\textsuperscript{15}

Smoke

Small particles resulting from condensation of super saturated vapour composed of material of low vapour pressure in relatively high concentrations. It mostly consists of soot, flyash and other solid or liquid particles less than 1-micron in diameter.\textsuperscript{16}

Fumes

Small particles formed by condensations, sublimations, or chemical reaction of which the predominant part by weight consists of particles with diameter less than 1-micron and are mostly composed of condensed solid particles consisting of metals and metallic oxides and chlorides from the metal industries.\textsuperscript{17}

\textsuperscript{15} Ibid.
\textsuperscript{16} Ibid.
\textsuperscript{17} Ibid.
Significance of the Study

1. The observations of this study will add new knowledge in the field of physical education, and to various other personnel associated with pollution studies with special reference to pollution effect on health and fitness.

2. The study will be of significant to determine the industrial pollution effect on the selected cardio-respiratory variables.

3. The study will ascertain the comparative cardio-respiratory condition of the inhabitants of various industrial zones as well as the rural zone.

4. The study might lead to identify the causative factor or factors for various pathological conditions linked with the particular area.

5. The study will indicate the promotion if any on the selected variables for attaining a regular training and conditioning programme in an industrially polluted zone as well as in a rural zone.