

COMMUNITY MEDICINE

8th
Edition

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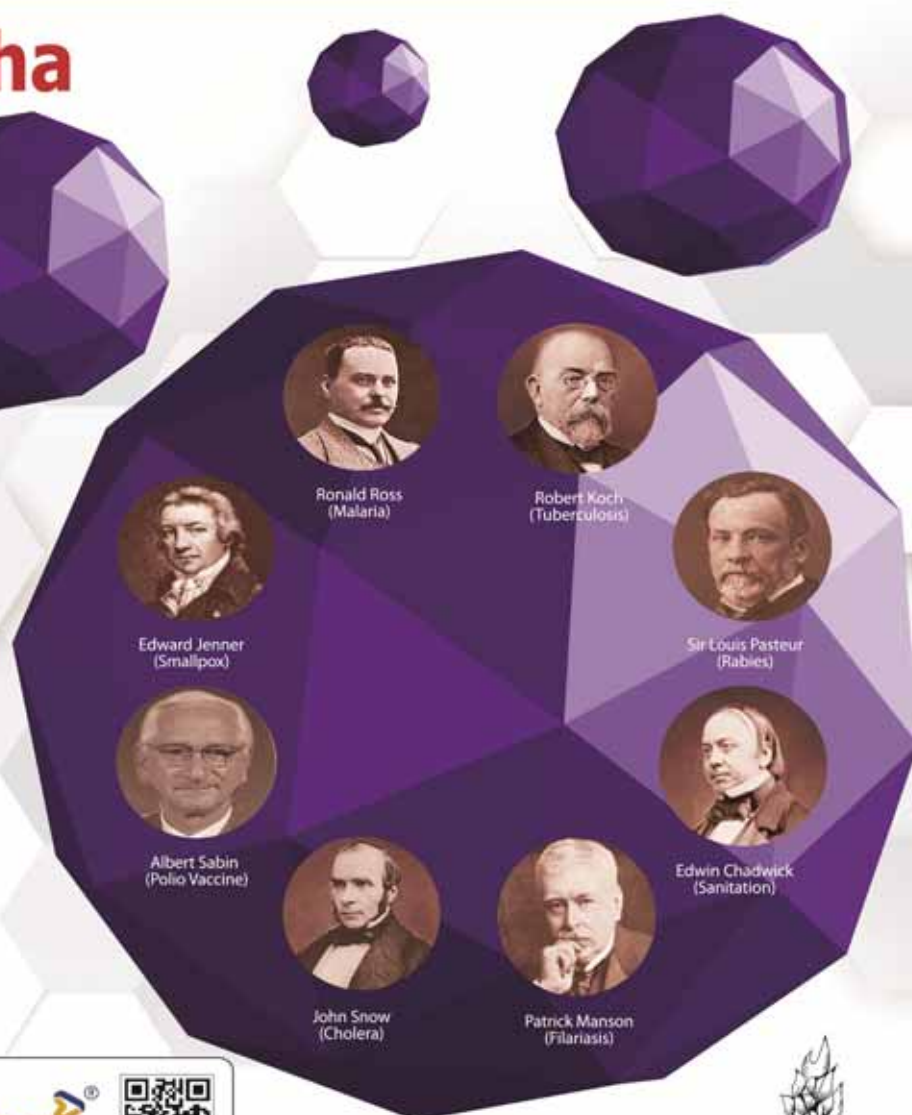
Recent Advances

As per the Competency Based Medical Education Curriculum (NMC)

AH Suryakantha

Highlights

- Artificial Intelligence in Health Care
- Indigenous System of Medicine in India
- Slow Viral Diseases
- Rights of the patients in India
- Health Services Research
- Health budgeting
- Obesity among school children
- Social mobilization
- Novel BPaL Regimen
- Six Pillars of Lifestyle Diseases



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Occupational Health

INTRODUCTION

Working population constitutes the major portion of the community. They determine the progress and development of the country. In other words, their health status is considered as a sensitive indicator for the development of the country.

Just like home, the place of work is also an important environment for an earning person. Such a person spends nearly 6–8 hours a day in the working place till the retirement for about 3 decades. Not only the worker should be healthy but also the working environment should be healthy, safe and free from harmful agents. It is becoming more complicated as man is becoming more ingenious because of industrialization and urbanization. So a worker in all occupations needs special healthcare delivery.

Industrial health is different from occupational health. Industrial health deals with workers in industries and mines, whereas occupational health is concerned with man in any occupation. So it is with reference to all types of employment such as industries, mines, agriculture, forestry, service trades, offices, schools, colleges, mercantile and commercial enterprises, etc. Thus, industrial health is a component of occupational health.

According to Joint ILO/WHO Committee, occupational medicine is defined as that branch of community medicine, which deals with the study of health promotion, health protection and maintenance of highest degree of physical, mental and social well-being of workers in all occupations. Thus, occupational health/medicine is application of preventive medicine in all places of employment. But industrial workers are given special attention by the government, because they work in hazardous environment and are exposed to special risks. If the working environment is healthy, it is not only beneficial for the worker (employee) but also for the employer. There will be mutual benefit for both because there will be increased efficiency, increased production and decreased accidents. The subject envisages health, safety and welfare of all workers.

Bernardino Ramazzini (1633–1714) of Italy was the first person to stress the importance of taking occupational history of a patient. He wrote on occupational diseases. He is considered as ‘Father of Occupational Health’.

BURDEN OF OCCUPATIONAL DISEASES

There are 100 million occupational injuries causing 0.1 million deaths in the world according to WHO. In India, it is estimated that 17 million (17% of global burden) occupational nonfatal injuries and 45,000 fatal injuries occur each year. Out of 11 million cases of occupational diseases in the world, 1.9 million cases (17%) are contributed by India and out of 0.7 million deaths in the world, 0.12 million (17%) is contributed by India.

Aims

- To increase the efficiency
- To increase the production
- To decrease the accidents.

Objectives

- To promote the health of the workers.
- To maintain the highest degree of physical, mental and social well-being of the workers.
- To prevent the diseases by elimination of factors which are inimical to their health (to protect the health).

ERGONOMICS

The term ergonomics is derived from Greek words, ‘Ergon’ meaning work and ‘Nomos’ means law. It is the science that deals with the workers in their working environment. In other words it is matching the job to the worker. That means placing the worker in a job, depending upon his/her physical and psychological capacity. Thus, it simply means ‘fitting the job to the worker’.

The main object of the ergonomics is to achieve the best mutual adjustment between the man and the machine, which are complimentary to each other, so that there is increased efficiency, increased production, decreased muscular skeletal disorders and decreased accidents, as well as it improves health, safety and comfort.

There are three types of ergonomics:

1. **Physical ergonomics:** It is the body’s response to workload, e.g., physical strain from vibration, force and posture.

2. **Cognitive ergonomics:** It is mental response to workload, e.g., mental strain from workload, decision making and human error.
3. **Organizational ergonomics:** It deals with organizational structure like shift work, policies, supervision, etc.

Ergonomic Risk Factors

These are the factors which decrease the efficiency, decrease the production and predisposes for musculoskeletal disorders (MSD), injuries and accidents. These are the static loading (i.e., standing or sitting for a long time in the same posture), repetition, force, vibration, awkward posture, stress, extreme temperature and such others.

Principles of Ergonomics

There are ten mitigation principles.

1. **Working in neutral posture:** Adapting proper posture while sitting, standing or lifting any objects. "S" shape of the spine to be maintained. "C" shape of the spine causes strain. There should be proper alignment of neck, back and hands (**Fig. 18.1**) viz., back and neck in erect position, shoulders relaxed, upper arms adducted, feet should be flat on floor or on footrest and wrists in neutral position.
2. **Reducing excessive force:** Excess force while pushing, pulling or lifting can cause injury to the joints and fatigue. So, the load should be lightened by using mechanical devices and carts.
3. **Keeping the required materials within reach:** This prevents unnecessary stretching, strain and fatigue.
4. **Working at proper height:** Working at the right height, especially while doing tablework makes the thing easier. This can be done adjusting the height of the chair.

5. **Reducing unnecessary movement/motion:** This is done by using power tools to reduce overuse injuries.
6. **Reducing static load:** Holding the same position for a long time creates fatigue, discomfort and can interfere with work. This can be prevented by taking breaks between the works.
7. **Minimizing contact stress:** Minimizing contact of the pressure points with hard surface or sharp edges by using antifatigue mats, to prevent discomfort.
8. **Move, exercise and stretch:** Staying in one position for a long-time is not good for health. Change the position during intervals and maintain fitness.
9. **Maintenance of comfortable environment:** This is with reference to lighting, temperature, vibration and noise.
10. **Provision of enough clearance in the work area:** There must be sufficient space around the body to move.

The term 'ergonomics' was coined in a conference at Stockholm in 1961, conducted by International Ergonomics Association. Ergonomics has made a significant contribution in reducing the industrial accidents and in overall health and efficiency of workers.

Working (Occupational) Environment

It is the environmental conditions prevailing in the working place, which have a bearing or influence on the health of the worker, by three types of interactions. In other words, there are three types of working environment (**Fig. 18.2**):

1. **'Man with machine':** This is the interaction between man and machine (mechanical). In almost all the industries, the machines are driven by power. Poor installation of machines, the unguarded, protruding moving parts,



Fig. 18.1: Neutral posture (correct sitting posture).

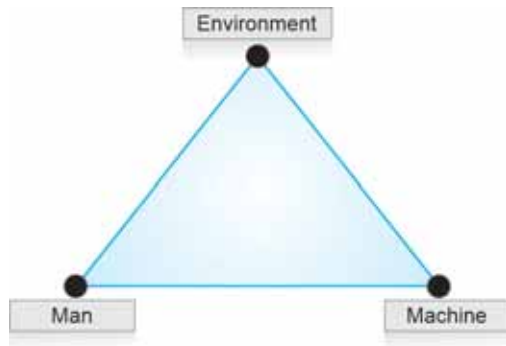


Fig. 18.2: Working environment.

poor maintenance, etc., result in accidents. Working for long hours results in fatigue, discomfort and decreased efficiency.

2. **'Man with environment'**: The interaction between the worker and his external environment, such as physical, chemical and biological agents, which have an influence on the health of the workers.
3. **'Man with man'**: This is the interaction (relation) between the worker and his co-workers and the employer. This depends upon many psychosocial factors like nature of the work, service conditions, job satisfaction, payment, welfare conditions, incentives, union activities, etc., which have an influence on the safety and welfare of the workers. This constitutes psychosocial environment.

Domestic Environment

Working environment and domestic environment are complimentary to each other. The disturbances, the stress, the strain and such others occurring at working place, disturbs his sleep. Similarly, the stress and strain, worries such others occurring at home disturbs his work. Such things when continued over a long period result in serious physical and mental illness, ultimately decrease the efficiency, production and increase accidents.

Social Security and Welfare Measures

This consists of provision of minimum income and other such amenities to the worker during the time of crisis such as accident, major illness or retirement, as a security measure. They also contribute to health or happiness of the workers.

All the factors related to workers operate simultaneously on human health and are interlinked. Thus, occupational health represents a dynamic equilibrium between the workers and the occupational environment.

■ OCCUPATIONAL HAZARDS

An industrial worker is exposed to the following five types of hazards (physical, chemical, biological, mechanical and psychosocial hazards), depending upon the nature of the occupation:

Physical Hazards

These are the hazards occurring due to following physical agents:

- **Heat**: The effects are heat syncope, heat cramps, heat exhaustion, heat stroke, heat hyperpyrexia, prickly heat, burns, etc.
- **Cold**: Frost bite, Raynaud's disease, erythromelalgia, erythrocyanosis, chilblains, trench foot, gangrene, etc. All because of cutaneous vasoconstriction.

Note: *Heat syncope*: It is fainting attack due to pooling of blood in lower limbs.

Heat cramps: It is painful and spasmodic contractions of muscles due to loss of sodium and chloride.

Heat exhaustion: It means loss of salt leading on to circulatory failure.

Heat hyperpyrexia: It is characterized by failure in heat regulating mechanism without the features of heat stroke. Temperature is about 106°F. It may proceed to heat stroke.

Heat stroke: There will be failure in the heat regulating mechanism, resulting in high temperature of the body, delirium, convulsions, partial or total loss of consciousness. Skin is dry and hot. Death may occur due to hyperpotassemia, cause of which is not known, probably due to release of potassium from RBCs, which are injured by heat. Treatment is by rapid cooling in ice-water bath.

- **Light**: Effects occur either due to inadequate light or excessive light.

Inadequate light: Headache, eye strain, and eye fatigue (visual fatigue). Chronic effect is 'Miner's nystagmus'.

Excessive light: Bright light results in glaring, visual fatigue, blurring of vision, discomfort and accidents.

- **Radiation**:

- *Ionizing radiation*: X-rays, radioactive isotopes like Cobalt-60, Phosphorus-32

- ◆ *Acute effects*: Acute radiation syndrome

- ◆ *Chronic effects*:

- *Somatic effects*: Leukemia, aplastic anemia, cancer, tumor induction, and pancytopenia.

- *Genetic effects*: Stillbirths, congenital defects, neonatal deaths, sex chromosome aneuploidy, and sterility.

- *Nonionizing radiation*:

- ◆ *Ultraviolet radiation*:

- *On the skin*: Darkening of the skin, thickening of the skin, erythema, and cancer of the skin.

- *On the eyes (Example: Welding)*: Photophobia, conjunctivitis, keratitis, corneal ulcer, blindness (Welder's flash), and snow blindness.

- ◆ *Infrared radiation*: Cataract

- ◆ *Microwaves*: Microwave sickness

- ◆ *Laser radiations*: Thermal burns, cataract, and retinal burns.

- **Atmospheric pressure:**
 - *High atmospheric pressure (as in mines):* Caisson disease (compressed air illness), syncope, aches and pains in joints, air embolism, cardiorespiratory distress, and paralysis.
 - *Low atmospheric pressure (as in high attitudes):* Deafness (due to blocking of Eustachian tubes), pain in the ears, rupture of eardrums, expansion of gases in the sinuses and body cavities, headache, pulmonary edema, dyspnea, etc.
- **Electricity:** Electric shock, burns, and ventricular flutter.
- **Noise:**
 - *Auditory effects:* Deafness (temporary or permanent), tinnitus (buzzing in the ears), degeneration of cochlea and eighth nerve.
 - *Nonauditory effects:* Fatigue, irritability, nervousness, interference with speech and communication, annoyance, increased intracranial tension, hypertension, peptic ulcer, and higher environmental stress.
- **Vibration (working with pneumatic tools like drills and hammers):** Numbness, white fingers, and injuries.

Chemical Hazards

These result from irritants, inhalants, ingestants and allergens.

- **Irritants (such as dyes, acids and alkalis):** Occupational dermatoses, e.g., dermatitis, folliculitis, eczema, ulcerations, and cancer.
- **Inhalants:** Dusts, fumes and gases.
 - *Dusts:* Pneumoconioses.
 - *Fumes:* Metal fume fever (this chemical intoxication results from inhalation of fumes of molten metals like arsenic, antimony, beryllium, cadmium, cobalt, lead, zinc, etc.)
 - *Gases:*
 - ◆ *Asphyxiating gases:* CO, SO₂, Cl₂, H₂S, methyl isocyanide gas, etc.
 - ◆ *Anesthetic gases:* Ether, chloroform, trichloroethylene.
- **Ingestants:** Toxic hazards occurring from the metals like lead, arsenic, mercury, cadmium, manganese, chromium, etc.
- **Allergens:** Allergic rhinitis, bronchitis, asthma, dermatitis, urticaria, etc.

Biological Hazards

These are from the animals and soil. These are common in agricultural industry.

- **From the animals:** They are called 'zoonotic diseases', e.g., Anthrax, bovine tuberculosis, salmonellosis, Japanese encephalitis, rabies, plague, Kyasanur forest disease, etc.
- **From the soil:** Tetanus, ankylostomiasis, gas gangrene, malignant edema, anthrax, aspergillosis, coccidioidomycosis, mycetoma.

Mechanical Hazards

These are mainly accidents.

Psychosocial Hazards

These are due to failure of the worker to develop a healthy relationship with his co-workers, employers, management, supervisors, etc. They are divided into two groups:

1. **Psychological (behavioral) changes:** Such as hostility, aggressiveness, anxiety, depression, frustration, tardiness, alcoholism, drug addiction, sickness absenteeism, etc.
2. **Psychosomatic ill health:** Such as neurosis, fatigue, propensity to develop peptic ulcer, hypertension, asthma, etc.

Other Hazards

- **Occupational cancers:** Cancers of the skin, lungs, bladder and blood forming organs (i.e., leukemia)
- **Occupational dermatoses:** Dermatitis, eczema, folliculitis, urticaria, ulcers, etc.

■ PNEUMOCONIOSES

(Pneumons = lungs; Konion = dust; Pneumoconiosis is singular).

These are also known as dust diseases.

Pneumoconioses are a group of lung diseases occurring out of the specific occupation, caused by inhalation of insoluble dust, over a prolonged period of exposure.

Pathologically, it is characterized by fibrosis of the lung parenchyma followed by its complications. Once a pathology, it is usually progressive, permanent, pulmonary pathology.

Clinically, it is characterized by persistent cough, progressive breathlessness, gradually cripples the person by reducing the working capacity due to fibrosis of the lungs followed by the features of complications such as tuberculosis, emphysema, chronic obstructive pulmonary disease (COPD), pulmonary hypertension, cor-pulmonale and even carcinoma in some cases.

There is no treatment or cure for pneumoconioses. Prevention is the only intervention. Therefore, it is essential to prevent these diseases from arising.

Factors influencing pneumoconioses are:

- **Concentration of the dust in the air:** Higher the concentration, greater the health hazards. The permissible limit is 200 µg (µ) per cu meter of air.
- **Composition of the dust:** More complicated the composition of the dust, greater the health hazard.
- **Size of the dust particles:** This is the most important determining factor. Smaller the size of the dust particle, greater the tissue reaction.
 - Particles more than 10 µ, settle down on the ground and become soil dust.
 - Between 10 and 5 µ, the particles are caught in the upper respiratory passage.
 - Between 5 and 3 µ, they are caught in mid respiratory passage.

TABLE 18.1: Common pneumoconioses, their causative agents and the industries of the occurrence.

Dusts	Disease	Industries
Inorganic (mineral) dusts		
Silica	Silicosis	Sand stone industry, stone quarrying and dressing, granite industry, pottery and ceramic industry, gold, silver, mica and steel industry
Asbestos	Asbestosis	Asbestos cement factory, fireproof textiles, brake lining gaskets
Iron	Siderosis	Iron ores and mines, iron and steel industries
Coal dust	Anthracosis	Coal mines
Aluminum	Aluminosis	Aluminum industries
Barium	Baritosis	Photography, printing, barium diagnostic works
Beryllium	Berylliosis	Beryllium mining, manufacture of alloys
Stone	Lithosis	Stone industries
Organic (vegetable) dusts		
Cotton dust	Byssinosis	Textile industries
Sugar cane dust (bagasse)	Bagassosis	Cane sugar factories, paper and cardboard factories
Tobacco dust	Tobaccosis	Tobacco factories (<i>Beedi</i> , Cigar, Cigarette)
Moldy hay (grain dust)	Farmer's lung	Agricultural industry

- Between 3 and 0.5 μ , they reach the alveoli and cause tissue reaction (fibrosis). They are most dangerous.
- Less than 0.1 μ , they are harmless because of Brownian movements they exhibit and they are absorbed.
- **Duration of exposure:** Longer the duration of exposure to the dust, greater the health hazard. Nearly 10–15 years of exposure is necessary for the development of tissue reaction. However, there are cases on record in which extensive fibrosis has occurred within 2 years following exposure to high concentration of dust.
- **Individual susceptibility (health status):** Better the health and nutritional status, lesser the chances of development of pneumoconiosis early.

The common pneumoconioses, their causative agents and the industries of the occurrence are as described in **Table 18.1**.

Silicosis

It is an age old occupational disease. It is the most common, major and the most serious of all the pneumoconioses. It was first reported in India in 1947 from Kolar Gold Mines (Fields; KGF) of Karnataka state, described by Kaplan and Burden. Ever since its occurrence has been uncovered from other industries also. Its prevalence is 34% in mica mines and 15% in ceramic and pottery industries.

Importance

Silicon contributes to about 28% of earth's crust. Silicon being very reactive, does not remain in the elemental form but combines with oxygen alone to form silicon dioxide (SiO_2 , i.e., free silica), which constitutes 12% of earth's crust or with oxygen and other elements to form silicates, e.g., asbestos (i.e., combined silica). Silica and silicates constitute the bulk of most kinds of rocks, clay and sands. The other form, i.e., crystalline silica is known to be carcinogenic.

The term 'silicosis' is reserved for the lung disorder caused by inhalation of free silica, which is an untreatable, progressive, pulmonary disease and is the most common and most widespread of all pneumoconioses. Exposure to large amount of silica can pass unnoticed because silica is odorless, nonirritant, insoluble and inorganic. It does not cause any immediate noticeable effect and hence is confused with ordinary dust. Chronic exposure predisposes to tuberculosis, which is still a major public health problem.

Pathology and Pathogenesis

Inhalation of free silica (i.e., SiO_2) over prolonged period causes major fibrogenic damage in the lungs. Dust particles between 0.5 and 3 μ in diameter are most dangerous, because they reach the alveoli. Thus, the most important biological characteristic of free silica dust is fibrogenicity.

The free silica particles in the alveoli are phagocytosed by the macrophages in which they exert cytotoxic effect. Eventually, macrophages undergo autolysis and death. While dying, the macrophages release fibrogenic factor (i.e., macrophage fibrogenic factor; MFF), which causes fibrogenic reaction in the pulmonary interstitium, viz the fibroblasts proliferate resulting in the deposition of collagen and formation of fibrosis. Later there is hyalinization of collagen. Thus, first there is cytotoxic reaction followed by fibrogenic reaction.

The essential pathology is the typical 'nodular fibrosis' in the lungs, each nodule varying from 3–4 mm in diameter, hard, grayish, more frequent in the apex and posterior border of the lungs (fibrosis is diffuse, basal in location and peribronchial in asbestosis). As the pathology progresses, contiguous, adjacent nodules may fuse to form 'massive conglomerate fibrosis' (i.e., progressive massive fibrosis). This conglomeration is precipitated by associated infection such as tuberculosis. Thus, silicotics are prone to develop pulmonary tuberculosis, a condition called 'silicotuberculosis'.

But in recent years, there is doubt whether silicotics really develop tuberculosis, because their sputum is negative for AF bacilli and contacts do not develop tuberculosis (sputum is negative for AFB because the silicotic fibrosis prevents the discharge of *Tubercle bacilli* in the sputum). Thus, many cases of tuberculosis remain undiagnosed during life but observed in postmortem studies. Only radiologically it is similar to pulmonary tuberculosis.

X-ray chest shows 'snow storm' appearance of the lung fields (ball of wool appearance).

Radiological changes occur in four stages as follows:

1. **Latent stage (radiologic latency):** In the initial stage, there is reticulation of lung fields due to thickening of perivascular and intercommunicating lymphatics. This latent stage lasts till the nodules reach the optimum size.
2. **Early stage:** Once the nodules reach the optimum size, they look like 'Lace' plus there is enlargement of hilar opacity. The silicotic nodules are 2–5 mm in diameter, homogenous in density and usually bilaterally symmetrical.
3. **Late stage:** There is coalescence of the nodules, giving rise to 'snow-storm' appearance in the lung fields.
4. **Complicated stage:** Large opacities with cavities indicates silicosis with tuberculosis (silicotuberculosis).

Latent period: It is the period between initiation of the disease process and detection of the disease. This varies from few months to few years, depending upon the concentration of the dust, composition of the dust, size of the dust, period of exposure and susceptibility of the individual.

Clinical Features

These are almost same in all types of pneumoconioses. The person will have chronic cough, progressive, exertional dyspnea, loss of weight and emphysema. Occasionally, productive cough is associated with hemoptysis. Symptoms resemble chronic bronchitis. Chest pain and hemoptysis indicate the possibility of complication like tuberculosis.

Diagnosis

Features of chronic bronchitis, history of exposure to silica dust, X-ray chest showing 'snow-storm' appearance.

Complications

Tuberculosis, COPD, emphysema, pulmonary hypertension, cor-pulmonale, Caplan's syndrome (i.e., silicosis with rheumatoid arthritis).

Management

There is no treatment for silicosis. Once a pathology is a permanent pathology. The fibrotic changes cannot be reversed. Treatment is given for the complications of the disease. Research is going on to find out treatment for silicosis. Silicosis is a notifiable disease under the Factories Act, 1948 and the Mines Act, 1952.

Anthracosis (Coal Workers' Pneumoconiosis)

This is due to the inhalation of coal dust over a long period of time. It is also called 'coal workers' pneumoconiosis (CWP)' or Miners' black lung.

Pathology

The coal dust particles accumulate just before the bronchioles open into the alveoli. The aggregation of coal dust is known

as 'coal macule', which looks like nodular opacities (or reticulation) in the X-ray of chest.

Pathogenesis

The disease occurs in two stages or phases:

1. **Phase I:** This is called 'simple pneumoconiosis.' This stage is characterized by little ventilatory impairment. It requires about 10–12 years of exposure for its development (i.e., the period between the date of exposure and initiation of fibrosis). The atrophy of bronchial smooth muscles and dilatation of bronchioles gives rise to focal emphysema.
2. **Phase II:** This is characterized by 'progressive massive fibrosis (PMF)'. This leads to pulmonary hypertension and cor-pulmonale. There is severe respiratory disability followed by congestive cardiac failure and premature death. Once simple pneumoconiosis occurs in a coal worker, a progressive massive fibrosis may develop out of it, even without further exposure to it. Predisposing factors are tuberculosis, smoking, nonspecific respiratory infections and autoimmunity.

The other health hazards, other than anthracosis, for which coal-mine workers are exposed to are:

- 'Beat-elbow' or 'beat-knee', as a result of their peculiar posture during work, followed by 'bursitis', which subsequently becomes the seat of 'septic cellulitis'.
- 'Miner's nystagmus' because of poor lighting in the mines. X-ray chest shows multiple, nodular densities or reticulation (i.e., black-lung).

Anthracosis is notifiable under Indian Mines Act (1952) and compensable under Workmen's Compensation Act (1959).

Asbestosis

Asbestos is a commercial name given to fibrous, mineral silicate, i.e., silica combined with oxygen and other elements like calcium, magnesium, iron, sodium or aluminum. Asbestosis is a pneumoconiosis resulting from inhalation of asbestos dust over a long period of time.

Asbestos is used in the manufacture of asbestos cement, sheets, pipes, gaskets, fire-proof textiles, etc. Exposure to this dust occurs in mining, milling and in the manufacture of asbestos products.

Asbestos is of two types, namely:

1. Serpentine or chrysolite (white asbestos) type (i.e., hydrated magnesium silicate)
2. Amphibole type (hydrated silicate of iron, calcium and sodium)

The latter type occurs in different forms like crocidolite (or blue form) and amosite (or brown form). The blue form is more hazardous. However, 90% of world's production of asbestos is of the serpentine variety, a safer one.

Like other mineral dust, asbestos is also insoluble in the lungs. It results in the following types of reactions in the lungs:

- **Fibrosis:** There is fine, interstitial, diffuse fibrosis, around the terminal bronchioles, involving the walls of air spaces,

tissue reaction being mainly due to mechanical irritation, usually in the lower half of the lungs (in contrast to silicosis in which fibrosis is nodular in character and in the upper part of the lung). Pleura is thickened. Fibrosis is followed by bronchiectasis and emphysema.

X-ray chest shows 'ground-glass' appearance of lower two-thirds of the lungs and heart shows 'shaggy' appearance (i.e., without clear-cut cardiac margins). Sputum shows 'asbestos bodies' (asbestos fibers coated with fibrin). Shaggy radiological characteristic appearance is due to thickening of the pleura.

Pathology may progress even after cessation of exposure to asbestos dust.

- **Pleural calcification:** Calcified pleural plaques are seen, usually bilateral.
- **Neoplasms:** Common malignant lesion is bronchogenic carcinoma. Less common is malignant mesothelioma of pleura or peritoneum, often associated with effusion or ascites respectively. Smoking is an additional synergistic factor in the development of bronchogenic carcinoma and not mesothelioma. Thus, asbestos predisposes to cancers of lung, pleura and peritoneum.
- **Asbestos corns of the skin:** This is not due to inhalation of asbestos dust but due to local effect on the skin of the hands. Spicules of asbestos penetrate the skin and result in corns. It requires excision. It occurs among those who are bagging the fiber.

Clinical Features

These are the same type as in any other pneumoconiosis.

Byssinosis

This is due to inhalation of cotton-dust over a long period of time. Therefore, it is common among those workers who are working in textile industries. Some industrial scientists believe that the cause is '*Aerobacter cloacae*' which contaminates the cotton fibers in hot and humid climates. It affects 7–8% of textile workers.

Acute symptoms are tightness in the chest and altered respiratory function, within hours after beginning the exposure, especially on Mondays or after holidays. With continued exposure over several years, irreversible impairment may develop, manifested by chronic cough, progressive dyspnea, later leading on to emphysema.

No characteristic X-ray changes are seen in the lungs. 'Mill fever' which resembles metal fume fever also occurs as a result of exposure to cotton dust.

Bagassosis

This is due to inhalation of cane-sugar dust (bagasse). Cane-sugar dust is utilized in the manufacture of paper, cardboard and rayon. Therefore, this condition is seen not only in sugar factories but also in paper, cardboard and rayon factories.

Bagassosis was first reported from Kolkata in 1955, by Ganguly and Pal, in a cardboard industry.

The bagasse, after extraction of juice from cane-sugar, is baled when it remains moist. The storage of such bales in hot environment for long time predisposes to the growth of certain fungi called *Thermoactinomyces sacchari*. When the bales are broken for use in the industries, the fungus enters the respiratory tract of workers and sets the disease process.

Incubation period is 2–4 months.

Clinical features are the same as in other pneumoconiosis. X-ray of the chest shows 'mottling' appearance in lung fields. If treated early and prevented from further exposure to the dust, there will be resolution of the lungs.

Farmer's Lung

This is a chronic disease of lungs, due to inhalation of mouldy hay or grain dust, in the agricultural fields.

During winter season, in the grain-dust with a moisture content of over 30%, bacteria grow rapidly and produce heat of about 45°C. The heat encourages the growth of certain thermophilic actinomycete fungi of which *Microspora (Micropolyspora faeni)* is the main cause of Farmer's lung.

This condition is considered to be an allergic (hypersensitivity) reaction to the inhalation of antigen (dust) with the development of antibodies.

The clinical features are the same as that of bronchial asthma (eosinophilia) (allergic bronchitis). First acute attacks are noticed. Repeated attacks cause pulmonary fibrosis and lung damage (cor-pulmonale).

X-ray chest shows 'fine nodular density'.

Since agricultural industry is the major industry in our country, this is one of the major public health problems of our country.

Different pneumoconioses and their radiological changes are depicted in **Table 18.2**.

Prevention and Control of Pneumoconioses

Health Promotion

By the following measures:

- **Preplacement examination (pre-employment examination):** This consists of thorough examination of the individual before giving the job. This includes not

TABLE 18.2: Different pneumoconiosis and radiological changes.

Pneumoconiosis	Radiological changes in chest X-ray
Silicosis	Snow-storm appearance (upper part of lungs)
Anthracosis	Black-lung (multiple nodular opacities)
Asbestosis	Ground-glass appearance (lower part of lungs) and shaggy appearance of heart
Byssinosis	No characteristic changes
Bagassosis	Mottling appearance
Farmer's lung	Fine nodular opacity

TABLE 18.3: Different conditions in prevention of pneumoconioses and their contradictions.

Conditions	Disqualifying job
Color blindness	Railway engine or motor driver
Hernia	Lifting of heavy objects
Respiratory illness	Dusty atmosphere
Skin disease	Handling of dyes, acids and alkalis

only thorough physical examinations but also routine investigations including X-ray of the chest. Then suitable job is given depending upon the physical and mental abilities, i.e., 'fitting the job to the worker' (i.e., placing the right person in the right job). This is called ergonomics. The object is to increase the efficiency, increase the industrial production and decrease the accidents.

The different conditions and their contradictory jobs are discussed in **Table 18.3**.

- **Health education:** Employees at a risk of pneumoconioses are educated about the hazards of dust inhalation over long period. They are also educated about the hazards of smoking as a precipitating factor and prevention of those hazards.
- **Provision of healthy physical environment:** Improvement in the sanitation such as cleanliness, adequate ventilation and good housekeeping (wet mopping of floors and walls) are mandatory in the industries.
- **Control of dust:** This includes—
 - Prevention of formation of dust at the point of origin by water sprays, e.g., wet drilling of rock. Similarly oil or steam can also be used. Thus, 'wet method' is useful in the control of dust.
 - *Prevention of escape of dust into the atmosphere:* If it is not possible to prevent the formation of dust completely, at least the escape of dust into the atmosphere can be prevented by special enclosures or cabinets or hood for the machinery at the point of origin of dust. Such enclosures are usually combined with exhaust ventilation. The dust is drawn into the hood and conveyed through ducts into collecting units.
 - Keeping moisture content below 20% and spraying 2% propionic acid (fungicide) controls bagassosis.
 - Use of safer type of asbestos like chrysotile (white form) and amosite (brown form) reduces hazards of asbestosis.
 - *Removal of dust:* Dust can also be removed by special ventilatory arrangements.

Specific Protection

The workers should protect themselves by using 'face-masks'. Other protective devices are respirators and gas masks.

Early Diagnosis and Treatment

The workers should undergo periodical medical examinations including X-ray of chest, so that the cases of respiratory diseases can be detected early and removed from the

TABLE 18.4: Differences between preplacement and periodical examination.

Preplacement examination	Periodical examination
This is done before placing the worker to the job	This is done after placing the worker to the job
This is done only once	This is done periodically
This is called ergonomics	This is for early diagnosis and treatment of health hazards
This is done to assess the physical and psychological capacity of the individual	This is done to assess the physical and pathological aspects in the individual
Helps to detect 'high-risk' group	Helps to detect the group who is going to develop high-risk
The objective is to increase the efficiency, to increase the production and to decrease the accidents	The objective is to protect the individual from further complications
This is primary level of prevention (health promotion)	This is secondary level of prevention (early diagnosis and treatment)

offending occupation and are given some other job. If detected before the formation of fibrosis of the lungs and changed the job, resolution of the lungs can occur, except in asbestosis and anthracosis.

Disability Limitation

This consists of limiting the further disability of the worker by detecting even the slightest degree of disability and immediately assigning some other suitable job.

Rehabilitation

This is required for those workers who have become handicapped due to the development of fibrosis of the lungs. They require physical, psychological, social and vocational rehabilitation (**Table 18.4**).

LEAD POISONING (PLUMBISM)

It is the most common toxic metal poisoning occurring in the industries, as a silent epidemic, because of its wide usage. It is widely used because of its properties like low boiling point, easy mixability with other metals to form alloys, easy oxidation and anticorrosiveness.

Most dangerous (toxic) lead compounds are lead arsenate, lead carbonate and lead oxide. Lead sulfide is least toxic.

Sources of Lead

There are two sources: (1) occupational and (2) nonoccupational:

1. **Occupational type of plumbism:** It is common in the following industries:
 - Mines of lead ores
 - Industries of glass, paint and storage batteries
 - Printing and potteries
 - Plumbing works (pipe fitting).

2. **Nonoccupational sources:** The greatest source is gasoline (leaded petrol). Being a heavy metal, lead is not burnt in the engine and comes out in solid form. Thousands of tonnes of lead is exhausted from automobiles every year. Thus, lead is present abundantly in the environment.

Thus, from the environment lead poisoning can occur by inhalation of dust and fumes and also by ingestion through contaminated food and water.

(Lead is added to petrol for raising octane rating.)

The other nonoccupational type of lead poisoning can occur by drinking water conveyed through lead pipes or by drinking wine contaminated with lead because the lid of the bottle is made up of lead.

- By eating fruits sprayed with insecticides containing lead.
- Among children, it can occur through the habits of pica (eating mud), chewing lead-paint by nibbling of toys coating with lead paint, chewing on window sills, keeping lead-pencils in the mouth, etc.
- Through contaminated hands also, lead ingestion can occur.

Absorption, Storage and Elimination

Lead poisoning occurs mainly by inhalation and often by ingestion. It can also occur by absorption through the skin. Only organic compounds such as alkyl lead (tetraethyl lead) can penetrate the skin.

Normal adult ingests about 0.2–0.3 mg of lead per day largely from food and beverages. Ninety percent of ingested lead is excreted in the feces. Only 10% is absorbed. But regular intake can increase the amount of lead in the body. Lead is mainly stored in the bones and to some extent in the liver and kidneys. It is a cumulative poison. Unabsorbed lead is excreted in the stools and absorbed lead is excreted in the urine.

Lead exerts its toxic action by combining with 'SH' group of certain enzymes involved in porphyrin synthesis in RBCs and suppresses it. It also suppresses carbohydrate metabolism in the liver and also causes chronic nephritis.

Clinical Features of Plumbism

The features are different in inorganic and organic type of lead poisoning. Normal blood level of lead is 25 mg/100 mL. Toxic features appear when the level exceeds 70 mg/100 mL.

Inorganic Lead Poisoning

This is characterized by involvement of mainly alimentary system. But lead can affect almost every system of the body. No other disease is having signs and symptoms related to each of the alphabet.

These are:

- Anemia, anorexia, arthralgia, amenorrhea.
- Blue (or black) line on the gums (known as Burton's or Burtonian line, due to deposition of lead sulfide granules in the gums, 1 mm from the gingival margin, more in the upper jaw, specially over the incisors. Lead combines with hydrogen sulfide and forms lead sulfide).

- Colic abdomen (cramps)
- Diarrhea
- Encephalopathy
- Fatigue
- Giddiness, growth failure among children
- Headache
- Insomnia, irritability
- Joint pains
- Kidney damage (Fanconi syndrome, chronic nephritis)
- Lassitude
- Myalgia, mental retardation
- Nausea, nervousness
- Oliguria
- Paralysis (lead palsy: Wrist drop due to paralysis of extensor muscles of hand, i.e., Teleky's sign).
- Pallor, pica
- Restlessness
- Seizures, sterility
- Tremors
- Vertigo, vomiting
- Weakness, wrist drop.

Organic Lead Poisoning

This is characterized by the involvement of central nervous system characterized by insomnia, headache, mental confusion, irritability, nervousness, anxiety, convulsions, delirium, coma and death.

Other Epidemiological Features

- Occupational inorganic lead poisoning is common among adults and nonoccupational organic lead poisoning is common among young children.
- Children suffering from pica are at a risk of plumbism.
- Chronic respiratory and intestinal infections predispose to plumbism.
- Pregnancy increases susceptibility to plumbism. Not only the pregnant mother but also the fetus is at risk of 'Small for date' (intrauterine growth retardation) and mental retardation.
- Predisposing personal factors are alcoholism, lack of personal hygiene, nail biting and wearing work uniform outside the factory.
- Children with plumbism will develop growth failure, progressive mental retardation, low IQ, aggressive behavior, lack of concentration, etc.

Diagnosis (Table 18.5)

- History of occupational exposure to lead
- Clinical symptomatology
- Laboratory investigations, such as:
 - *Hemoglobin percentage:* This is done to know the severity of anemia. Pallor is out of proportion to anemia.
 - *Peripheral blood smear:* Shows 'microcytic-hypochromic' picture and 'basophilic stippling' of RBCs.
 - RBC count is decreased.

TABLE 18.5: Diagnosis of lead poisoning.

Material	Normal level	Dangerous level
Blood lead	25–40 µg/100 mL	>70 µg/100 mL
Urinary lead	0.2–0.8 mg/L	>0.8 mg/L
Urinary aminolevulinic acid (ALA)	6 mg/L	60 mg/L
Urinary coproporphyrin*	<150 µg/L	>250 µg/L

*In plumbism, coproporphyrin is excreted in the urine because lead combines with Sulfhydryl (SH) group of the enzymes concerned with the synthesis of RBCs, releasing coproporphyrin.

- Reticulocyte count is increased.
- Blood level of lead.
- Urinary level of lead, coproporphyrin and aminolevulinic acid.

Management

- Prevention of further exposure to lead absorption by change of job.
- Saline purge helps in the removal of unabsorbed lead from gut.
- Promotion of lead excretion in the urine from the soft tissues by giving chelating agents such as Ca-EDTA (calcium ethylenediaminetetraacetic) and D-penicillamine.

Prevention and Control

Health Promotion

- Preplacement examination to rule out the presence of contraindications if any such as pallor, blue line of gums, etc.
- Improvement in the sanitation: Good housekeeping (i.e., wet mopping of floors), ventilation and cleanliness are mandatory in the industries.
- Control of dust (explained under pneumoconioses).
- Use of unleaded petrol for automobiles.
- Health education of employees about maintenance of high standard of personal hygiene for plumbers and for those working with paints, to change the work-uniform after leaving the factory. All employees are educated about the risks involved.
- Substitution of lead compounds by less toxic materials wherever possible, e.g., toxic lead oxide is substituted with titanium dioxide.

Specific Protection

- By use of gloves among painters.
- By use of respirators and masks for those exposed to dust and fumes.

Early Diagnosis and Treatment

Plumbism can be diagnosed early by periodical examination of 'at-risk' group of people and when detected, they are treated with chelating agents like Ca-EDTA and D-penicillamine.

Disability Limitation

When the patients (employees) come in the advanced stage, development of further disability can be prevented by giving aggressive treatment followed by change of the job.

Rehabilitation

This is given for those who have developed wrist drop (lead palsy) or neurological deficits following lead encephalopathy.

Plumbism is a notifiable disease under Indian Factories Act, 1948 and a compensatable disease under Workmen's Compensation Act, 1959.

Prevention of Plumbism among Children

- By health education of parents
- By avoiding the use of materials (like toys and cribs) painted with lead paints
- By periodical screening of children living in old houses
- Community awareness with regard to pica reduction may be an important preventive measure.

METAL FUME FEVER (BRASS FOUNDER'S AGUE)

This is a temporary malady resulting from inhalation of heavy concentrations of fresh metallic oxide fumes of mainly zinc and magnesium, which are generated when these metals are burnt and molten. Other metallic oxides also initiate this syndrome. The condition develops some hours after the exposure and resembles the typical sensitization reaction to foreign proteins.

The usual features are rise in body temperature with sweating, chills, dryness of throat, cough, tightness of chest, breathlessness, malaise, and leukocytosis.

Complete recovery occurs in 12–24 hours, when the person is away from the molten metal fumes.

Persons exposed to this develop temporary immunity to this condition. Metal fume fever does not lead to any permanent damage. Since this condition resembles that of respiratory infection, it is often mistaken.

This condition often occurs in galvanizing operations and in welding.

This respiratory hazard can be prevented by the use of air masks or respirators or by proper ventilation of the workplace.

OCCUPATIONAL CANCERS

They are also called as 'industrial cancers.' These constitute another important health problem in the industries because many types of chemicals are employed in the industries, which act as carcinogens. The most common types of occupational cancers are those of skin, lungs, bladder and blood forming organs (like bone marrow).

Agent Factors

These are mainly chemical carcinogens, both organic and inorganic. Organic chemical carcinogens mainly result in lung cancer and inorganic ones mainly result in skin cancer.

TABLE 18.6: Types of occupational cancers, their carcinogens and related industries.

Types of cancer	Carcinogen	'At risk' group in the industry
Skin cancer*	Anthracene, coal-tar, soot, pitch, oils and dyes, acids, U-V rays, X-rays	Farmers, shepherds, fisherman, road-builders oil refiners, dye-stuff makers, radiology department staff, tar distillers, coke-oven workers
Lung cancer	Arsenic, asbestos, beryllium, chromium, uranium, tobacco, coal tar, nickel	Asbestos factory, uranium-mines, nickel-refineries, gas industry, tobacco industry
Bladder cancer [#]	b-naphthylamine, benzidine, auramine, aromatic amines, para-amino diphenyl, hemotoxins	Aniline industry, rubber industry, electric cable industry
Leukemia	Ionizing radiations (X-rays and gamma rays), radioactive isotopes	Radiology department, atomic energy research station

Note: 'Dhoti-cancer' as described by Khanolkar is not an industrial cancer but caused by mechanical irritation (friction) of dhoti over the skin of waist.

*Occupational skin cancers also include Mule spinner's cancer and Chimney sweeper's cancer (cancer of scrotum).

[#]Cancer of the bladder resulting from the infestation of *Schistosoma haematobium* (a biological agent) is not an industrial cancer.

Environmental Factors

Physical environment like heat and radiation also result in industrial cancers.

Influencing Factors

The factors influencing the development of industrial cancers are potency (intensity) of the carcinogen, duration of exposure, degree of personal hygiene and availability of preventive measures.

The different types of occupational cancers, their carcinogens and 'at risk' group in the industries are followed in **Table 18.6**.

Features of Occupational Cancers

- They occur in those sites, where the action of carcinogens is constant, most intense and prolonged.
- They appear after a prolonged exposure of about 10–15 years.
- They can occur even after cessation of exposure as in asbestos industry.
- The average age incidence of occupational cancers is much earlier than that for cancers in general.
- It is more among men than women.
- The localization of the tumor is remarkably constant in any one occupation.
- Maintenance of high standard of personal hygiene is very important in the prevention of occupational cancers.

Prevention of Industrial Cancers

By five levels of prevention.

Health Promotion

- **Preplacement examination:** This consists of examination of the individual for assessing his physical and psychological capacity, so as to place him in a suitable job (fitting the job to the worker). This is called 'ergonomics', e.g., person with skin disease is not placed in handling acids, alkalis and dyes.
- **Sanitation in the working environment:** Good house-keeping, ventilation and the cleanliness are mandatory in the industries.
- **Health education:** The workers are educated on the following points:
 - To change their attitude towards cancer
 - To know the 'danger signals' of cancers (cancer education)
 - To know the hazards of smoking as an aggravating factor in the dusty environment
 - To maintain high standard of personal hygiene.
- **Control of dust in asbestos industry.**

Specific Protection

- **Primordial prevention** consists of elimination or avoidance of carcinogens in the industry. This also consists of discouraging the workers from adopting harmful lifestyle such as smoking.
- By the use of protective devices such as—masks in the asbestos industry, lead apron, lead gloves and dark spectacles in radiology department. Use of barrier creams in dyeing section of the industry.
- Safety of the worker by wearing 'pocket dosimeter' for personal monitoring of the radiation dose received.
- Safety of the machine by proper installation and maintenance of X-ray machine, use of efficient filters so that unwarranted radiations are excluded. They are operated on high kilo-voltage with fast films, so that exposure is reduced to minimum dose.

Early Diagnosis and Treatment

This is done by 'periodical examinations' of at-risk group of industrial workers, especially in the cancer clinics to detect lesions of early and curable stage. The periodical examinations should be continued even after cessation of exposure to carcinogen. This screening procedure consists of thorough physical examination followed by procedures like blood examination, urine examination, X-ray of chest, cytology, endoscopy and even biopsy.

Treatment is given by chemotherapy, surgery, radiotherapy, hormonal therapy or immunotherapy depending upon the type.

Disability Limitation

This consists of limiting the development of further disability by giving intensive treatment, when the patients come in the advanced stage.

Rehabilitation

This is given for those who have become handicapped following major surgery such as amputation, lobectomy, etc. They are rehabilitated physically, socially, psychologically and vocationally.

OCCUPATIONAL DERMATOSES

These are the diseases of the skin arising out of the occupation or during the course of employment. These are dermatitis, eczema, folliculitis, urticaria, ulcers and even cancer of the skin.

The occupational dermatoses account for 40–70% of all occupational diseases, depending upon the nature of the occupation. The incidence has been increasing every year due to industrialization and thus constitutes one of the major public health problems in industrial areas.

The occurrence of dermatoses depends upon the nature of the causative agent and the duration of exposure.

The agent factors are grouped under the following groups:

- **Physical agents:** Such as heat, radiation.
- **Chemical agents (Irritants):** Acids, alkalis, dyes, solvents, grease, tar, pitch and minerals like arsenic, chromium. A primary cutaneous irritant is an agent which causes dermatitis by direct action on the normal skin at the site of contact, if it is permitted to act in sufficient intensity and/or sufficient length of time. It acts by dissolving keratin and fat, by dehydrating the tissue, by precipitating the proteins by oxidation/reduction and by keratogenic action.
- **Biological agents:** Such as viruses, bacteria, fungi and certain parasites.
- **Plant products:** Such as leaves, fruits, flowers, vegetables, plants like *Parthenium*, poison ivy, etc.
- **Sensitizing agents:** These act as allergens such as photodeveloping materials, formalin, synthetic resins, insecticides, fungicides, etc. Irritants and sensitizers constitute the important agent factors.

Host Factors

Age: It is more among young adults than older group of persons.

Sex: It is more among men than women because women take better care of their skin.

The factors which influence the development of dermatoses are as follows:

Age: Dermatoses are common among young adults than elderly people.

Sex: It is more among men than women.

Habits: Alcoholism predisposes to dermatoses.

Nature of the skin: Fair skin is more susceptible than dark skin. Allergic diathesis and hyperhidrosis predispose to dermatoses.

Season: Incidence is higher in summer season than in winter season because of sparsity of clothes and excessive sweating.

Personal hygiene: Lack of personal hygiene also predisposes to dermatoses.

Other skin lesions: Presence of other skin lesions impairs the resistance and predisposes to dermatoses.

Prevention

Health Promotion Measures

- Preplacement examination is done for the workers and those suffering from cutaneous disorders should be kept away from those jobs involving a skin hazard.
- Health education of all those who are 'at risk' of dermatoses, about maintenance of personal hygiene, frequent washing of hands, keeping the machines clean, changing the clothes every day. They must also be educated about the correct methods of handling paints, greases, irritants, etc.

Specific Protection

- By avoidance of allergens
- By providing protective clothing, long leather gloves, aprons, boots and application of barrier creams to the hands.

Early Diagnosis and Prompt Treatment

- Periodical examinations are done almost daily among those who are handling acids, alkalis, dyes, etc.
- 'Patch test' is done in the event of dermatoses due to allergens. However, negative test does not rule out the diagnosis.
- The affected person is removed from that job and is placed in another situation till the dermatosis heals up.
- Treatment should be prompt with saline wash of the affected part, KMnO_4 compresses, application of ointments and antibiotics if there is secondary infection of skin lesions.

OCCUPATIONAL HEALTH IN AGRICULTURAL INDUSTRY

Agriculture (farming) is the major and largest industry in our country because 80% of our population live in the rural areas and their main occupation is agriculture. Not only it is largest industry but also the oldest of the industries. Yet, 'occupational health in agriculture' is rather a new concept.

Agricultural occupation includes all activities connected with ploughing the soil, growing crops, harvesting, processing of crops, breeding, raising and caring for animals including poultry and tending gardens and nurseries. It also includes handling of machines, tools, insecticides, pesticides, etc.

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