

II REVIEW OF LITERATURE

The review of literature pertaining to the present study entitled, “**Ergonomic Interventions to Promote Occupational Health and Safety among Workers Employed in Garment Industries**”, comprises of the following headings:

- A. Meaning and importance of ergonomics
- B. Occupational health and safety
- C. Health hazards of garment workers
- D. Measures to prevent occupational health hazards
- E. Studies conducted

A. Meaning and Importance of Ergonomics

Ergonomics can be defined as the branch of science that is concerned with the achievement of optimal relationships between workers and their work environment. It deals with the assessment of the human’s capabilities and limitations (biomechanics and anthropometry), work and environmental stresses (work physiology and industrial psychology), static and dynamic forces on the human body structure (biomechanics), vigilance (industrial psychology), fatigue (work physiology and industrial psychology), design simulation and training, and design of workstations and tools (anthropometry and engineering). Therefore, ergonomics draws heavily from many areas of science and engineering (Tayyari and Smith, 1997).

The term ergonomics has its roots in Ramazzini’s study of the ill-effects of poor posture and poorly designed tools on the health of workers in the early 1700s (Bayers et al., 1978). The word ergonomics was coined from Greek words ‘ergon’ - work, ‘nomos’ - natural laws. Ergonomics has been defined ‘as a study of anatomical, physiological and psychological aspects of human beings in their working environment with the purpose of maximizing human safety, health, comfort and efficiently’. The basic objective of ergonomics is to ensure that the work, the equipments used for work and the workspace and environment are so designed as to fit the job to the man rather than man to the job (Veena et al., 2005).

Ergonomics can be defined simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically

forcing the worker's body to fit the job. Adapting tasks, workstations, tools and equipment to fit the worker can help reduce physical stress on a worker's body and eliminate many potential serious, disabling work related musculo-skeletal disorders (MSDs). Ergonomics draws on a number of scientific disciplines, including physiology, biomechanics, psychology, anthropometry, industrial hygiene and kinesiology (Khedkar and Pawar, 2015).

The two terms 'ergonomics' and 'human factors' are essentially synonymous. Ergonomics and human factors are concerned with the 'fit' between the user, equipment and their environments. It takes account of the user's capabilities and limitations in seeking to ensure that task, functions, information and the environment (Narayanan et al., 2013).

The field of human factors covers a broader subject area since it involves not only the design of work tools and equipments but also the design of consumer products. The term ergonomics is becoming more universally accepted as demonstrated by the recent (1993) name change of the Human Factors Society to the Human Factors and Ergonomics Society.

Dula et al., (2012) stated that Ergonomics or human factors is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and over-all system performance. Therefore, ergonomics and human factors is a multidisciplinary field incorporating contributions from psychology, engineering, industrial design, graphic design, statistics, operations research and anthropometry. In essence it is the study of designing equipment and devices that fit the human body and its cognitive abilities.

Proper ergonomic design is necessary to prevent repetitive strain injuries and other musculoskeletal disorders, which can develop over time and can lead to long-term disability. Introduction of ergonomic principles improves quality, operation and productivity (Ashrafi and Khan, 2005). So a study of ergonomic factors or facilities affecting workers in an industry is important. In an industry, ergonomics plays a key role; if proper ergonomic facilities are not provided, it will not only affect the

performance and health of the workers but also indirectly affects the performance of the Industry as well as the GDP of the country.

B. Occupational Health and Safety

The joint ILO and WHO committee on occupational health defined occupational health as that occupational health should aim at the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention among workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; placing and maintenance of the worker in an occupational environment adapted to his physiological and psychological equipment and to summarize: the adaptation of work to man and of each man to his job (WHO, 1950).

A joint definition of occupational health endorsed by the ILO and WHO (as revised in 1995) states that: *“Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the workers in an occupational environment adapted to their physiological and psychological capabilities; and, to summarize : the adaptation of work to man and of each man to his job”* (ILO, 2009).

Preventive medicine and occupational health have the same aim - the prevention of disease and maintenance of the highest degree of physical, mental and social well-being of workers in all occupations. The levels of application of preventive measures are health promotion, specific protection, early diagnosis and treatment, disability limitation and rehabilitation. The tools used are epidemiologic approach, statistics, health screening and health education (Rao and Lundgren, 1955). Occupational health, therefore, is the application of preventive medicine in all places of employment.

Globally 2.3 million deaths take place due to occupational injuries (318,000 deaths) and work-related diseases (2,022,000 deaths) annually. The biggest killers

are work-related cancer (32%); work-related circulatory diseases (23%), cardiovascular and stroke; communicable diseases (17%), in particular, in developing countries and farming, and occupational accidents (18%). The last two causes, however, are less common in the established market economy countries. The main reason for the difference is that the overall number of communicable diseases has been relatively low in high-income countries, and that pattern seems to continue also in rapidly developing countries such as China (ILO, 2014).

The WHO estimates occupational health risks as the tenth leading cause of morbidity and mortality. The new work order has introduced changing job patterns, working relationships, rise in self-employment and outsourcing of work and this has brought about problems in the management of occupational safety and health risks the world over (Anshu, 2008).

Occupational health and safety in India is a fairly new field. In fact, even worldwide, it has been neglected by social scientist for long, and occupation related health, risks and injuries have not adequately been researched. Some of the key problems faced in occupational health and safety issues are:

- Deficiency of specific laws: Agnihotram, (2005) stated that health and safety statutes for regulating occupational health and safety of persons at work exist only in four sectors, namely factories, mining, ports and construction. The major legal provisions for the protection of health and safety of the working populations are the Factories Acts Mines Act. The Factories Act, 1948, for example, deals with occupational health and safety, as well as welfare of workers employed in a factory. But more than 90 per cent of the Indian labour force does not work in factories; hence they fall outside the purview of the Act.
- Deficiency of policies and enforcement: In India, occupational health is not integrated with primary health care. In fact, occupational health is the mandate of the Ministry of Labour, not the Ministry of Health, hence does not factor in public health policy. Further, enforcement agencies operate mostly in the organized sector and unorganized sector gets neglected.
- Lack of thorough studies and poor research sharing: It is true that some studies like Huselid, 1995 and Hurst et al., 1996 have focused on occupational risks but the most of them suffer from small sample sizes,

dependency on self-reporting, flawed interview procedures etc. Further the data is often not adequately analyzed and shared.

- Lack of consciousness amongst employers: Many large industries/public sector units provide medical services but concentrate on the curative, neglecting occupational health. This is because most entrepreneurs are not sensitized about the importance of occupational safety in their industries. This has led to insufficient budgetary allocations towards providing a safe working environment . (Reber and Wallin (1984))
- Lack of consciousness amongst employees: Trade unions are not informed about occupational health and safety issues and its importance and therefore do not disseminate information. Often, due to lack of knowledge, the workers themselves are unwilling to take precautionary measures like using protection gear because they have become used to working in a particular way for years, and hence resist change.
- Deficiency of trained medical staff: Indian doctors and nurses are very poorly trained to deal with occupation health related morbidity. Neither are many medical schools specialized in this faculty nor do they offer specialized training. The occupational health physician, where employed, also takes up mostly curative work and liaison work giving insufficient attention to occupational health. As a result, there is under-diagnosis and under-reporting of occupational diseases (<http://Europe-solidaire.org/spip.php?article13690>).

In a nutshell Purnawati, (2007) said that occupational health and safety primarily seeks to maintain the working ability of the labour force as well as to identify, assess and prevent hazards within the working environment. And ergonomics, on the other hand, combines all of these issues to improve workers efficiency and well being and maintain industrial production through the design of an improved workplace. Occupational health and safety and ergonomic applications therefore work together to satisfy the needs of changing local people's attitudes, local work methods and traditional ways of doing things. These issues are important for many developing countries because the effects of poor health and lack of safety facilities, and non-ergonomics conditions exist in various workplaces are a hindrance to the national economy and social progress. Since implementing the full concept of

occupational health and safety and ergonomics application is a priority, understanding the meaning of the terms related to occupational health and safety and ergonomics applications is a major source of workplace improvement. It is therefore important for both foreign and local investors to investigate workplaces, to know how a tool, machinery and production process would match the local workers' physical and mental capabilities of the local population.

Occupational health and safety and ergonomics issues have a connection with various components in the regional economy since the provision of health, hygiene and safety in the workplace contributes to economic growth processes in a number of ways (Takala, 1992). Occupational health and safety and ergonomic issues are also related with the production economy and social progress, and thus, important components of gross domestic product (GDP) which are considered as inputs into the national economy through industrial development. OHS/ergonomics is also treated as the principal factor around which workplace improvement efforts are to be planned in spite of various obstacles in DCs (Ahasan, M.R. 2002).

Knowledge, Attitude and Practice

“KAP” study measures the Knowledge, Attitude and Practices of a community. The KAP study is undertaken to assess the current knowledge, attitudes, and behaviour towards a particular aspect and the expectations of the target audiences, and develop a baseline to assess the effectiveness of interventions to be taken and recommend what needs to be done in order to change the existing situation (www.unicef.org).

Safe practices depend on having an appropriate attitude towards the health risks associated with exposure, which in turn depends upon knowledge about the dangerous and harmful effects related to its exposure (Yu, 2005). On the contrary, some studies have highlighted a wide gap between knowledge level and practices regarding the use of protective equipment, (Parimalam, et al., 2007) thus indicating factors other than knowledge and attitude influencing the adoption of safety practices in these workers. Many studies have been published on KAP few listed such as among salt workers (Haldiya, et al., 2005), College students (Torabi, et al., 2002), medical doctors (Nagarakanti et al., 2013) and many more.

C. Health Hazards of Garment Workers

The workers are the driving forces of the national economy, and thus their working lives should be protected from occupational hazards (Knutsson, 2003).

Gutberlet and Baeder (2008) opined that occupation is the one in which a person not only earn his daily bread but also spend one third of average adult life. It involves individual and collective technical skills for the manufacture of particular goods through highly specialized processes. In whole, industrialization means a social and economic revolution in the culture of a nation such revolution is bound to carry with it some associated hazards which is otherwise known as occupational health hazards.

The garments industry in India is one of the best in the world. An extremely well organized sector, garment manufacturers, exporters, suppliers, stockists and wholesalers are the gateway to an extremely enterprising clothing and apparel industry in India. There are numerous garments exporters, garments manufacturers and readymade garments exporters both in the small scale as well as large scale (www.indiangarmentexporters.com).

Garment work is characterized by long hours, and a lack of health and welfare benefits, minimum wages or job securities. Production targets are harsh and verbal and sexual abuses are widespread (Roychowdhury, 2005).

A garment worker may be exposed to six types of hazards, depending upon his/her section in the garment industry:

- **Mechanical hazards**

The mechanical factors of importance in illness and injury in industry are definitive design of machinery, defective procedures, unguarded machinery, protruding and moving parts, falling heavy objects and poor ergonomics. The health effects are such as cuts, wounds, loss of fingers, hands, bruises, sprains, fractures and in extreme cases, death (Trajkovic, 2000).

In cutting sections of garment industries, the most frequent way of cutting is mechanical. Depending on the character of cutting, all mechanic ways of cutting can be divided into four groups:

- simple cutting
- complex cutting
- cutting in pair
- combined cutting

Simple cutting is when materials are cut with a cutting element that has one sharp edge suitable working speed. Cutting with shaped knives for punching machines belongs to this group. Depending on the number of piles that are punched, constructive characteristics of textile materials, size of shaped knives and its sharpness, smaller or bigger hydraulic or pneumatic pressures are applied. When working wrongly or carelessly, injuries such as cuts, squeezes, strikes etc. can appear. Something similar as to the machine for punched in the metal industry. When cutting elements make complex movements consisted of working and additional movements normally on the surface of cut materials, it is a complex cutting. As cutting instruments the following things can be used a knife, indented knife, band knife and fluid steam. (Trajković and Djordjević, 2000)

The way of mechanical cutting when a material is cut from both the sides at the same time is called cutting in pair. For cutting with such cutting means manual and mechanical scissors of different types are used, but workers can still be injured (a cut or squeeze as the result of big resistance that materials make while being cut). Combined cutting presents the combination of two previously mentioned ways of cutting (Blader, et al., 1991).

Sewing is a process consisted of series of pin-pricks meant for making a suitable seam with a purpose of connecting two or more material (parts) decorating or both. Since every machine has its mobile and immobile parts, many injuries can happen.

When sewing parts of dressing products there are, most frequently, injuries of fingers and hands. In most cases, these injuries happen because of incorrect movements performed by a worker during a technological procedure. Thus, for example, if a worker clumsily put the pedal down and not previously removing his hand that is under the pedal, some injury or squeeze can happen. What the intensity of the injury will depend on the quantity of pedal pressure on the textile material and regulation of its height. Depending on the applied means of inner transports

(movable stands, circling transport lines, hanging-on transporters, etc) injuries caused by strikes with these means can happen. (Delleman and Dul, 1990)

Rahman and Hossain, (2010) stated that one of the most common findings in garment industries is poor housekeeping i.e. untidiness, disorder, poor storage of materials and stock. Such disorder and clutter not only reduces productivity by “blocking” the smooth flow of materials through the factory, it often represents a fire hazard as boxes, thread, trimmings and other combustible material is left everywhere. It also can encourage vermin and their associated health hazards.

- **Physical hazards**

This hazard is sub-divided into the following:

Heat: The common physical hazard in most industries is heat. The direct effects of heat exposure are burns, heat exhaustion, heat stroke and heat cramps; the indirect effects are decreased efficiency, increased fatigue and enhanced accident rates. Many industries have local “hot spots” – ovens and furnaces, which radiate heat. Radiant heat is the main problem in foundry, glass and steel industries, while heat stagnation is the principal problem in jute and cotton textile industry (Rao and Lundgren, 1955).

Many garment workers experience hot, humid conditions, especially those in the ironing section. According to ILO, 2003, for workers in the garment industry, too much heat can result in the following health and safety problems:

Safety	Health
Fatigue and dizziness	- Heat stress/strain (distress)
Sweating palms (become slippery)	- Heat cramps
Fogging of safety glasses	- Heat exhaustion/stroke
Possible burns	- Heat rash (prickly heat)
Lower performance/alertness	- Fainting (syncope)

Mukund et al., (2013) opined that the safety problems tend to be more obvious than the health issues. For example, there is always the risk of burns for workers in the ironing section through accidental contact with hot objects. There also tends to be increased frequencies in accidents as workers lose concentration, get more fatigued, and become more irritable. Tools/equipment can also slip through sweaty palms and fingers thereby adding to the safety problem. The health problems

associated with hot working environments tend to be more insidious and affect workers more slowly.

- **Cold:** Important hazards associated with cold work are chilblains, erythrocyanosis, immersion foot, and frostbite as a result of cutaneous vasoconstriction. General hypothermia is not unusual (Tierney et al., 1995).

Cold temperatures are rarely a problem for workers in garment factories. Occasionally, workers in the computer design rooms experience cold temperatures. Such environments are optimal for the computer and not for the workers.

Light: Another important health problem the workers face in garment industries is strain on their eyes. As they are to work for long time and need a keen concentration to their work, an extra pressure is created on their eyes which also affect on the visual comfort (Ahmed and Raihan, 2014).

The workers may be exposed to the risk of poor illumination or excessive brightness. The acute effects of poor illumination are eye strain, headache, eye pain, lachrymation, congestion around the cornea and eye fatigue. The chronic effects on health include “miner’s nystagmus”. Exposure to excessive brightness or “glare” is associated with discomfort, annoyance and visual fatigue. Intense direct glare may also result in blurring of vision and lead to accidents (Chakraborty, 1967).

Bhatia, (2006) that a common problem found in many garment industries is either too much or too little light. In both cases, this can lead to a reduction in quality and productivity as workers either struggle to see their work or find the glare too much for their eyes. For example, it is recommended that workers undertaking fine work need adequate lighting (in the order of 1000lux), but what they do not need is for the bright light to be shining directly into their eyes. They need the light to shine directly onto the exact area where the fine work is being carried out. Often there are no shades may be present but the light reflects off a shiny surface and into the worker’s eyes.

Noise: Noise is a health hazard in many industries. The effects of noise are of two types: (i) Auditory effects which consist of temporary or permanent hearing loss i.e. noise induced hearing loss (NIHL) (ii) Non-auditory effects which consist of nervousness, fatigue, interference with communication by speech, decreased efficiency and annoyance. The degree of injury from exposure to noise depends

upon a number of factors such as intensity and frequency range, duration of exposure and individual susceptibility (Basner et al., 2012).

Atmaca et al., (2005) stated that effect of noise on the human beings have been studied since long and all medical authorities agree that excessive and protracted industrial noise cause fatigue, irritation, general depression, high blood pressure, strength of grip, reaction times and psychological intelligence are like wisely affected. Because of the harmful effects of noise on the operatives, a drop in efficiency, higher absenteeism rate, cause accidents by interfering with communication and warning signals, increased errors and low occupancy result.

In textile mills, this problem is frequent. The problem is more acute in spinning and weaving factories where older equipments is present because it operates much higher level of sound than does new, poor design and construction and crowding of the workplace. Also if sewing machines are old or mounted incorrectly, they are also likely to provide high noise levels.

Vibration: Vibration, especially in the frequency range 10 to 500 Hz, may be encountered in work with pneumatic tools such as drills and hammers. Vibration usually affects the hands and arms. Vibration can cause changes in tendons, muscles, bones and joints, and can affect the nervous system. Collectively, these effects are known as Hand-Arm Vibration Syndrome (HAVS). After some months or years of exposure, the fine blood vessels of the fingers may become increasingly sensitive to spasm (white fingers). Exposure to vibration may also produce injuries of the joints of the hands, elbows and shoulders (WHO, 1962).

Many machines in garment industries are mounted incorrectly or are in need of servicing and, as a result, vibrate and cause a noise problem. Hence vibrations can cause detrimental effects on human performance. Vibrations of high amplitude and low frequency have especially undesirable effects on body organs and tissues.

Electricity: Exposure of workers to the electrical current is another threat. The health effects are burns, electric shock and sometimes even death. Many workers are unaware of the potential electrical hazards present in their work environment, which makes them more vulnerable to the danger of electrocution (Awan, 2001).

It is all too common to see frayed wiring, broken plug sockets and wires dangling close to workers in many parts of a garment industry. Not only is there the

danger of electrocution, there is the possibility of starting a fire. When considering the poor housekeeping in many industries with combustible materials all over the floors and workbenches, it is easy to see how industry fires can start if the electrical wiring is in poor condition and not maintained on a regular basis (Ashokkumar, 2013).

- **Chemical hazards**

Kant (2012) stated that there is hardly any industry which does not make use of chemicals. The chemical hazards are on the increase with the introduction of newer and complex chemicals. Chemical agents act in three ways: local action, inhalation and ingestion. The ill-effects produced depend upon the duration of exposure, the quantum of exposure and individual susceptibility.

Local action: Jaganathan et al.,(2013) said that some chemicals cause dermatitis, eczema, ulcers and even cancer by primary irritant action; some cause dermatitis by an allergic action. Some chemicals, particularly the aromatic nitro and amino compounds such as TNT and aniline are absorbed through the skin and cause systemic effects. Rao and Banerji (1952) were the first to draw attention in India to the prevalence of occupational dermatitis due to machine oil, rubber, x-rays, caustic alkalies and lime.

Inhalation

Dusts: Dusts are finely divided solid particles with size ranging from 0.1 to 150 microns. They are released into the atmosphere during crushing, grinding, abrading, loading and unloading operations. Dusts are produced in a number of industries – mines, foundry, quarry, pottery, textile, wood or stone working industries. Dust particles larger than settle down from the air rapidly, while the smaller ones remain suspended indefinitely. Particles smaller than 5 microns are directly inhaled into the lungs and are retained there. This fraction of the dust is called “respirable dust”, and is mainly responsible for pneumoconiosis. Dusts have been classified into inorganic and organic dusts; soluble and insoluble dusts. The inorganic dusts are silica, mica, coal, asbestos dust, etc; the organic dusts are cotton, jute and the like. The soluble dusts dissolve slowly, enter the systemic circulation and are eventually eliminated by body metabolism. The insoluble dusts remain, more or less, permanently in the lungs. They are mainly the cause of pneumoconiosis. The most common dust diseases in India are silicosis and anthracosis (Parvathi, 2009).

Gases: Exposure to gases is a common hazard in industries. Gases are sometimes classified as simple gases (eg., oxygen, hydrogen), asphyxiating gases (eg., carbon monoxide, cyanide gas, sulphur dioxide, chlorine) and anesthetic gases (eg., chloroform, ether, trichloroethylene). Carbon monoxide hazard is frequently reported in coal-gas manufacturing plants and steel industry (Jones et al., 2010).

Metals and their compounds: A large number of metals, and their compounds are used throughout industry. The chief mode of entry of some of them is by inhalation as dust or fumes. The industrial physician should be aware of the toxic effects of lead, antimony, arsenic, beryllium, cadmium, cobalt, manganese, mercury, phosphorus, chromium, zinc, and others. The effects depend upon the duration of exposure and the dose or concentration of exposure (Järup, 2003).

Ingestion: Occupational diseases may also result from ingestion of chemical such as lead, mercury, arsenic, zinc, chromium, cadmium, phosphorus, etc. Usually these substances are swallowed in minute amounts through contaminated hands, food or cigarettes. Much of the ingested material is excreted through faeces and only a small proportion may reach the general blood circulation (Christopher, et al. 2007).

From the perspective of the garment industry, the main chemical problem comes from the high dust levels in certain sections of the industry (eg. the cutting section). According to Bouhuys (2012), Prolonged exposure to cotton dust can lead to the chronic respiratory disease known as byssinosis characterized by wheezing, chest tightness and a shortage of breath amongst the affected workers (particularly noticeable after the weekend break).

The smallest of textile fibres are breathed in by the workers and, over the long term, cause a variety of respiratory problems. According to Wasnik (2012) Chronic obstructive pulmonary disease (COPD) is defined as a disease state characterized by progressive airflow limitation that is not fully reversible. COPD develops most often as a result of active and passive cigarette smoking, but can also occur from long term inhalation of irritants into the lungs, such as air pollution, chemical fumes, or dust. Johncy et al. (2011) indicate that reduction in lung function has been reported not only in cotton workers but also in coal mines, grain and flour mill workers, workers exposed to tobacco dust, barley dust, talc dust, quarry workers and construction workers. Alderson (1986) reported that the exposure of workers to dusts

from material such as silk, cotton, wool, flax, hemp, sisal, and jute can occur during weaving, spinning, cutting, ginning, and packaging. Division of tasks along gender lines may mean that women are exposed to organic dusts more than men, with respiratory diseases being diagnosed more often in women than men. Exposure to fibres and yarns may cause nasal or bladder cancer.

Resin treated fabrics used in permanent press clothing may release formaldehyde. Exposures are greatest during cutting, because off-gassing is greatest when fabric bolts are first unrolled; during pressing, as heating promotes the liberation of formaldehyde from residual amounts of resins; in production areas in which large quantities of formaldehyde from residual amounts of resins; in production areas in which large quantities of fabric are being used; and in warehouse and retail areas. Many garment shops are poorly ventilated and afford poor control of ambient temperatures. With increased temperature, off-gassing is greater; with poor ventilation, increasing ambient concentrations of formaldehyde can accumulate. Formaldehyde is a well-recognized acute irritant of the eyes, nose, throat and upper and lower airways. Formaldehyde may be a cause of occupational asthma due to either irritative effects or allergic sensitization (Ng et al., 1994).

Other chemical problems relate to the use of various spot cleaning agents in the finished section of garment industries. Whilst some industries are switching to the safer option of using soap/water mixtures for the cleaning process, others are using various organic solvents such as perchlorethylene, trichorethylene and 1,1,-trichlorethane for stain removal. Workers and managers often have little awareness of the dangers of such chemicals as they are not provided with the requisite Material Safety Data Sheet (MSDSs). Health effects due to such as exposures to organic solvents may include central nervous system depression, peripheral neuropathy, dermatitis and, less commonly, liver toxicity. Dimethyl formamide (DMF) is a particularly hazardous solvent which has been employed to waterproof fabric. Its use in one such setting resulted in an outbreak of occupational hepatitis among exposed garment workers. DMF use should be avoided both due to its hepatotoxicity and because it has been found to be associated with testicular cancer in two distinct occupational settings. Similarly, benzene may still be used in some clothing industry settings. Its use should be scrupulously avoided (Redlich et al., 1988).

- **Biological hazards**

Workers may be exposed to infective and parasitic agents at the place of work. The occupational diseases in this category are brucellosis, leptospirosis, anthrax, hydatidosis, psittacosis, tetanus, encephalitis, fungal infections, schistosomiasis and a host of others. Persons working among animal products (eg., hair, wool, hides) and agricultural workers are specially exposed to biological hazards (Park, 2002).

In some activities, such as carding and willowing, textile workers may be exposed to biological agents such as anthrax, clostridium tetani (the causative agent for tetanus) and coxiella burnetti (which causes Q fever). Exposure to biological agents can result in allergies and respiratory disorders (Babel and Tiwari, 2013).

Rim and Lim (2013) opined that Biological hazards have little impact in the garment industry. Although some of the raw materials may need treating with chemicals that kill off any biological hazards, most of the problems are associated with the provision of first aid, the state of the washroom facilities and the removal of waste from the industry.

- **Ergonomic hazards**

Berberoğlu and Tokuç, (2013) stated that Ergonomic hazards are common throughout the garment industry. Obsolete machinery, inadequate seating and standing arrangements for workers and the improper lifting/movement of heavy loads all lead to stresses and strains on the body with a result that workers are often off sick or their productivity is drastically reduced.

Garment production involves the performance of monotonous, highly repetitive and high speed tasks, often requiring non-neutral and awkward joint postures. These exposures place garment workers at risk of developing work related musculoskeletal discomforts (WMSDs), of the neck, upper extremities, back and lower extremities (Andersen and Gaardboe, 1993; Schibye et al., 1995). It is not uncommon for garment workers to develop multiple WMSDs, often with both soft-tissue disorders, such as tendinitis, and concomitant nerve entrapment syndromes, such as carpal tunnel syndrome. Work-related MSDs are also known as Repetitive Strain or Stress Injury (RSI), Repetitive Motion Injury (RMI), Cumulative Trauma

Disorder (CTD), Overuse Syndrome or Activity-related Pain Syndrome (Punnett et al., 1985; Schibye et al., 1995).

Lu (2011) stated that MSDs can cause a number of conditions, including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. These painful and often disabling injuries generally develop gradually over weeks, months, and years. MSDs usually result from exposure to multiple risk factors that cause or exacerbate the disorder, not from a single event or trauma such as a fall, collision, or entanglement.

Work-related MSDs occur when the physical capabilities of the worker do not match the physical requirements of the job. Prolonged exposure to ergonomic risk factors can cause damage a worker's body and lead to MSDs.

Conditions that are likely to cause MSD problems according to OSHA (www.osha.gov) include the following:

- Exerting excessive force;
- Excessive repetition of movements that can irritate tendons and increase pressure on nerves;
- Awkward postures, or unsupported positions that stretch physical limits, can compress nerves and irritate tendons;
- Static postures, or positions that a worker must hold for long periods of time, can restrict blood flow and damage muscles;
- Motion, such as increased speed or acceleration when bending and twisting, can increase the amount of force exerted on the body;
- Compression, from grasping sharp edges like tool handles, can concentrate force on small areas of the body, reduce blood flow and nerve transmission, and damage tendons and tendon sheaths;
- Inadequate recovery time due to overtime, lack of breaks, and failure to vary tasks can leave insufficient time for tissue repairs;
- Excessive vibration, usually from vibrating tools, can decrease blood flow, damage nerves, and contribute to muscles fatigue;
- Whole body vibration, from driving trucks or operating subways, can affect skeletal muscles and cause low-back pain; and

- Working in cold temperatures can adversely affect a worker's coordination and manual dexterity and cause a worker to use more force than necessary to perform a task.

Ahmad et al., (2013) stated that these risk factors, present for a sufficient duration, frequency or magnitude, either alone or in combination, can subject workers' shoulders, arms, hands, wrists, backs, and legs to thousands of repetitive twisting, forceful, or flexing motions during a typical workday.

Examples of Musculoskeletal Disorders

Body Parts Affected	Possible Causes	Possible Causes	Workers Affected	Disease Name
thumbs	pain at the base of the thumbs	Twisting and gripping	butchers, housekeepers, packers, seam stresses, cutters	De Quer, Vain's disease
fingers	difficulty moving finger, snapping and jerking movements	repeatedly using the index finger	meat packers, poultry workers, carpenters, electronic assemblers	trigger finger
shoulders	pain, stiffness	working with the hands above the head	power press operators, welders, painters, assembly line workers	rotator cuff tendinitis
hands, wrists	pain, swelling	repetitive or forceful, hand and wrist motions	core making, poultry processing, meat packing	tenosynovitis
fingers, hands	numbness, tingling; ashen skin; loss of feeling and control	exposure to vibration	chain saw, pneumatic hammer, and gasoline powered tool operators	Raynand's syndrome (white finger)
fingers, wrists	tingling, numbness, severe pain; loss of strength, sensation	repetitive and forceful manual tasks without time to recover	meat and poultry and garment workers, upholsterers, assemblers, VDT operators, cashiers	Capal tunnel syndrome
back	low back pain, shooting pain or numbness in the upper legs	whole body vibration	truck and bus drivers, tractor and subway operators; warehouse workers; nurses aides; grocery cashiers; baggage handlers	back disability

Source: OSHA 3125 (2000)

- **Psychosocial hazards**

Kirsten, (2012) stated that the psychosocial hazards arise from the workers' failure to adapt to an alien psychosocial environment. Work-related stress has been

defined as being experienced when the demands of the work environment exceed the workers' ability to cope with or control them. Frustration, lack of job satisfaction; insecurity, poor human relationships, emotional tension, excessively long working hours, boring or repetitive work, bullying or sexual harassment are some of the psychosocial factors which may undermine both physical and mental health of the workers. The capacity to adapt to different working environment is influenced by many factors such as education, cultural background, family life, social habits, and what the worker expects from employment.

He further adds that the health effects can be classified in two main categories: (a) Psychological and behavioural changes including hostility, aggressiveness, anxiety, depression, tardiness, alcoholism, drug use, sickness absenteeism;(b) Psychosomatic ill health: including fatigue, headache, pain in the shoulders, neck and back; propensity peptic ulcer, hypertension, heart disease and rapid ageing.

Reports from various parts of the world such as Van et al. (2005), Niedhammer et al. (2004) & Hall, et al. (2010) indicated that physical factors (heat, noise, poor lighting) also play a major role in adding to the precipitating mental disorders among workers. The increasing stress on automation, electronic operations and nuclear energy may introduce newer psychological health problems in industry. Psychological hazards are therefore assuming more importance than physical or chemical hazards.

D. Measures to prevent occupational health hazards

The following safety measures can be adopted to prevent occupational health hazards prevailing in garment industries.

- **Mechanical hazards**

The control measures for mechanical hazards in garment industries suggested by Malik et al., (2010) are as follows:

- Old stock, scrap material and all obsolete machines should be removed
- A better layout/production flow should be planned
- Placing materials on the floor should be avoided
- Multi-level racks to gain productive space should be used
- Containers for materials to be used and for all waste should be provided

- Mobile storage eg. racks on wheels (these only work well if the floors are in good condition and have non-slip surfaces as necessary) should be used
- Marked aisles should be kept clear at all times

- **Physical hazards**

Heat: Exposure to high or low ambient temperatures while working in hot/cold indoor climate or while working outdoors is a common occupational hazard. The Indian Factories Act has not laid down any specific temperature standard. However, the work of Rao and Mukerjee et al. (1953) indicate that a corrected effective temperature of 69 to 80⁰F is the comfort zone in India and temperatures above 80⁰F cause discomfort (Park, 2002).

There are a number of basic approaches to tackling heat hazards in garment industries as suggested by Gandotra et al. (2005) All involve reducing exposure by keeping heat away from workers through:

1. Engineering controls include:

- the use of increased general ventilation throughout the industry by opening windows, by ensuring that air bricks, doors etc are not blocked;
- the use of “spot cooling” by the use of fans to reduce the temperature in certain sections of the industry;
- the use of local exhaust ventilation systems in hot spots such as the ironing section to directly remove the heat as close to the source of the heat as possible;
- the use of air conditioners/coolers

2. Changing work practices include:

- Increasing the number and duration of rest periods;
- Introducing job rotation so that workers are not always doing so called “hot work”;
- Doing “hot work” in the coolest part of the day;
- Providing more workers to reduce the work load so that workers spend shorter times in hot environments

3. Use of personal protective equipment

Personal protection of heat stress exposures means providing a microenvironment around the worker that allows a greater loss of heat, types are; circulation of air system, liquid cooling system and ice cooling garments.

Whatever method is used to reduce workplace temperature, it is important that adequate supplies of drinking water are made available to workers. The drinks could be cool, diluted fruit juices or lemon tea.

Light: Poor lighting usually means weak luminosity. The following variables determine a good visual work environment: well-balanced luminance distribution, suitable illumination value, absence of glare, correct direction of light, high colour rendering index of the luminaries, suitable choice of the colour appearance of a lamp, absence of flicker and availability of daylight (Helland et al., 2008). Also all lights (and reflectors) in the industry should be well maintained and cleaned on a regular basis (especially when it is considered how much dust is released into the atmosphere during each shift). According to Khanna (2001), one simple way to improve the lighting levels in the industry is to paint the walls and ceilings with light, pale, matt colours - the use of matt paint avoids reflection of light which can lead to problems of glare. The colour of equipment such as sewing machines, workbenches, etc., should normally be matched with that of the walls and again avoid black, shiny paints. Hence colours improve the environmental conditions of the workers by providing more visual comfort. Brightening up the workplace thereby helps to produce a more pleasant place to work which impacts on workers' well-being and, ultimately, productivity.

Demis, (1997) pointed out that It is also essential for the light to focus on the work and not to the workers' eyes. The more detailed the task, the more light that is needed for the workers to carry out the job efficiently. All lights should be positioned in the correct place so that workers do not have to adopt poor working postures to see the task in hand. Also there should be adequate lighting near any potential hazards such as steps, ramps, etc., and outside the industry for security at night.

Glare can be avoided or reduced in the workplace as suggested by Brier, (2009) from

1. Windows

- use blinds, curtains, louvers, or shades;
- replace clear glass with opaque/translucent materials-paint glass with whitewash;
- change the layout of workstations.

2. Lamps

- ensure that no naked lights are in direct view of workers;
- raise the light fittings (if suspended) providing this does not reduce the overall level of lighting;
- use shades or shields but ensure that the work area is well lighted.

3. Reflected glare

- change position of the light source and reduce its brightness;
- cover reflecting surfaces with opaque, non-glossy materials;
- change the layout of the workstations.

Noise: Occupational exposure to excessive noise is commonly encountered in a great variety of industrial processes. Noise-induced hearing loss is often the cause of an occupational disease. Workplace noise can be controlled in three ways as suggested by Laird et al., (2012):

1. Controlling the noise at source

- Machines that no longer meet national/international standards have to be replaced with new machines that certify that the noise levels emitted are well below 85dBA and that all possible safety devices etc are included;
- Entire machines or particularly noisy parts of machines should be enclosed with soundproof casing;
- Servicing and maintaining of machines should be done regularly;
- Worn or defective machine parts should be replaced;
- Vibration in component parts and casings should be reduced by ensuring that the machines are mounted correctly on rubber mats or other damping material and that mounting bolts are secured tightly;

- Metal parts should be replaced with others made of sound absorbing materials eg. plastic or heavy duty rubber;
- Mufflers on exhaust should be fitted and directed them away from the working area.

2. Controlling noise along the path between the source and the workers

- Sound absorbing materials should be used on the walls, floors and ceilings wherever possible;
- Sound absorbing screens should be placed between the source of the noise and workers;
- Sound absorbing panels should be hung from the ceilings to capture some of the sound waves and reduce the overall noise level;
- Sound-proof areas and rest rooms should be built;
- The distance between a worker and the source of the noise, if possible should be increased.

3. Bedi, (2006) added Controlling the noise at the worker

- The most common form of noise control is the use of personal protective equipment in the form of hearing protectors such as ear plugs and ear muffs;
- Ear plugs are worn in the internal part of the ear and they are made of a variety of materials including rubber, mouldable foam, coated plastic or any other material that will fit tightly in the ear. Ear plugs are the least desirable type of hearing protection from an efficiency and hygiene perspective;
- From a health and safety perspective, ear muffs are more efficient than ear plugs provided they are worn correctly. They must fit over the whole ear and seal the ear from the sound waves.

Vibration

Vibration is undesirable for several reasons. The vibrations may be minimized as suggested by Tint et al., (2012) as given below:

- Machine foundations should be separated from adjoining floors;
- Machine foundations should be designed using accepted criteria and not by using rule of thumb;

- Vibration producing machines such as hammers, presses, etc. should be located away from the general working area;
- Vibration absorbers and impact dampers should be used;
- Machines should be mounted on springs, rubber or felt, etc.

Electricity

Tooley, (2007) stated that safe wiring connections for supplying electricity to equipment should be ensured.

- Insulate or guard electrical connections. Ensure that all wirings are appropriate;
- Provide a sufficient number of socket outlets in order to minimize contacts of workers with cables. If necessary, use multi-plug sockets or overhead outlets;
- Make it a rule to replace frayed cables quickly;
- Provide proper grounding for machines and equipment;
- Train all workers about how to work safely with electrical circuits and connections.

• Chemical hazards

Exposures to chemicals are considered hazardous to workers. The given control measures can be followed in the workplace:

- Material Safety Data Sheets (MSDSs) should be provided to the workers with the proper procedures for handling or working with particular substances by the management. MSDS includes information as physical data (melting point, boiling point and flash point), toxicity, health effects, reactivity, required storage conditions, disposal methods, protective equipment, first aid, and spill or leak procedures;
- Green industry can be developed to prevent adverse health effects associated with exposure to formaldehyde and other fabric treatments. Apparel and other finished textile products can be sewn from natural rather than synthetic fibre-based materials which are not treated with crease-resistant and other finishing agents (Eyayo, (2013);
- Appropriate personal protective equipments (PPEs) such as face masks, respirators, chemical goggles, chemical resistant gloves, safety shoes/boots, etc. should be provided to the workers;

- Spirometry test should be performed among workers to detect pulmonary disease especially COPD in its earlier stages when corrective measures are more likely to be beneficial;
- Cessation of cigarette smoking should be encouraged among smokers who are employed in the industry (Kelloway and Day, 2005).

- **Ergonomic hazards**

Employers can prevent ergonomic hazards by properly designing the job or workstation and selecting the appropriate tools or equipment for that job. Dubey, (2013) stated that based on information from the job analysis, an employer can establish procedures to correct or control risk factors by using:

- Appropriate engineering controls, such as workstation, tool and equipment design or redesign;
- Work practices, such as proper lifting techniques and keeping work areas clean;
- Administrative controls, such as worker rotation, more task variety, and increase rest breaks.
- Personal protective equipment, such as knee pads, vibration gloves, and similar devices.

The National Institute for Occupational Safety and Health recommends using the following guidelines in jobs requiring manual handling:

- Minimize the distance between the load and the body;
- Lift loads from knuckle height;
- Keep the travel distance for the lift to less than 10 feet ;
- Provide good handles for grasping loads

It is also important that work tools and equipment be ergonomically designed. Soytas, (2006) pointed out that most hand tools are designed for only occasional use, not for repetitive use over prolonged periods. When acquiring tools for regular use in an industrial setting, an employer should consider the following ergonomic feature:

- Tools should be light weight and handles designed to allow a relaxed grip so the wrists can remain straight;
- Tools should be designed for use with either hand and be of various sizes so they are appropriate for all workers;

- Tool handles should be shaped so that they contact the largest possible surface of the inner hand and fingers. Avoid tool handles with sharp edges and corners;
- Use power tools to reduce the amount of human force and repetition required;
- Purchase low-vibration tools to reduce tool vibration, and, if necessary, fit absorbent rubber sleeves over the tool handle.

Maintenance of tools and equipment also is essential in preventing or reducing ergonomic hazards. Keep tools sharp and maintain them according to the manufacturer's specifications. Proper maintenance also can help reduce vibration resulting from prolonged equipment operation (www.dir.ca.gov).

- **Psychosocial hazards**

According to Kompier and Cooper (1999), solutions that management can introduce to deal with psychosocial hazards are as follows:

- Opportunities for staff to participate in planning and organizing their own work should be provided;
- Communication channels should be set up for workers to talk to management without prejudice;
- Workers should be ensured to have the skills, training and experience to carry out their tasks;
- The way of doing job should be changed or tasks should be rotated wherever possible so as to avoid boring, repetitive work;
- Regular training should be provided to all workers;
- Excessive working hours should be reduced and inclusion of a number of rest periods should be provided.

E. Studies Conducted

Various studies have been done in this field. Some of the relevant studies were reviewed and grouped under:

1. Occupational health and safety

Akhter et al. (2010) in their study "Health and Occupational Safety for Female Workforce of Garment Industries in Bangladesh" discussed in brief the problem of health and safety issues of female workforce of garment industries in Bangladesh

based upon the industry environment, their residential environment, working condition, age, problem of health, causes of diseases, causes of fire accident and their medical facilities.

Reinhold et al. (2009) carried out a study in Estonia entitled “Risk Observatory - A Tool for Improving Safety and Health at the workplace” to assess the working environment, the employers’ possibilities and willingness to carry out risk assessment, ways to manage risks and the steps being taken towards progressive improvement in occupational health and safety.

In a study titled “Livelihood Pattern of Rural Women Garment Workers at Dhaka City” by Ali et al. (2008) analyzed the economic, social and health conditions of women garment workers as well as their livelihood pattern.

A study “Workers’ Active Involvement in the Improvement of Occupational Safety and Health in a Textile Enterprise - A Case Study” carried out by Szczecinska (2006) aimed at implementing and improving effective health and safety management with workers’ active involvement at all levels of the textile enterprise.

2. Occupational health hazards

Mehta (2012) in her study “Major Health Risk Factors Prevailing in Garment Manufacturing Units in Jaipur” analyzed the types and extent of occupational health hazards of the garment workers in cutting, stitching and finishing section.

A study “Evaluation of Upper Limb Musculoskeletal Loads due to Posture, Repetition, and Force by Rapid Upper Limb Assessment in a Textile Factory” were conducted by Moussavi Najarkola and Mirzaei, 2012 to assess risk factors for upper limb musculoskeletal disorders on workers performing various tasks in a textile factory. Ergonomic interventions and solutions were developed on the basis of the assessment results.

Kulkarni et al. (2012) in their study “Health Problems and Lung Function Tests among Cotton Textile Workers - A Cross Sectional Study at a Textile Mill” studied health problems among cotton textile workers and assessed lung function by using computerized, portable ‘MEDSPIROR’ in textile mill workers.

Nahar et al. (2010) conducted a study titled “Occupational Health Hazards in Garment Sector” to analyze the type and extent of occupational health hazards of

the garment workers as well as the relationship of various health hazards with the age of the workers and the length of work in garment factories.

Shi et al. (2010) in their study “Chronic Lung Function Decline in Cotton Textile Workers: Roles of Historical and Recent Exposures to Endotoxin” examined temporal aspects of the exposure-response relationship between airborne endotoxin exposure, longitudinal change in FEV₁ and respiratory symptoms in a cohort of Chinese cotton textile workers.

Ghasemkhani et al. (2006) in their study “Cotton Dust Exposure, Respiratory Symptoms and PEFR in Textile Workers” measured cotton dust levels in air workplace, determined prevalence of respiratory symptoms and changes in Peak Expiratory Flow Rate (PEFR) before and after during workday among textile workers.

A study “Occupational Related Accidents in Selected Garment Industries in Bangalore City” were carried out by Calvin and Joseph (2006) identified the common accidents that occurred in garment industries and also to identify any factors that were associated in order to recommend preventive steps.

Sokas et al. (2007) carried a survey in a study “Self-Reported Musculoskeletal Complaints among Garment Workers” in which 144 sewing machine operators answered questionnaires concerning occupational history and musculoskeletal symptoms adapted from the National Health and Nutrition Examination Survey.

Wang et al. (2007) carried out a study “Work-Organizational and Personal Factors associated with Upper Body Musculoskeletal Disorders among Sewing Machine Operators” to assess the contribution of work-organization and personal factors to the prevalence of work-related musculoskeletal disorders among garment workers in Los Angeles.

Wang et al. (2005) in their study “A 20-Year Follow-Up Study on Chronic Respiratory Effects of Exposure to Cotton Dust” evaluated chronic effects of long-term exposure to cotton dust on respiratory health, and observed the role of dust and endotoxin, longitudinal changes in lung function and respiratory symptoms prospectively from 1981 to 2001 in 447 cotton textile workers, along with 472 silk textile controls.

Tiwari et al. (2003) carried out a study entitled “Low Back Pain among Textile Workers” in Wardha to assess the risk associated with non-occupational risk factors in development of low back pain.

Wang et al. (2003) in their study entitled “A Longitudinal Observation of Early Pulmonary Responses to Cotton Dust” examined early adverse pulmonary effects of exposure to cotton dust, and identified potential risk factors, including atopy for pulmonary responses to cotton dust.

Zhang et al. (2002) carried out a longitudinal study entitled “Lung Function and Symptoms among Cotton Workers and Dropouts Three Years after the start of Work” among cotton workers to assess the presence of work related medical effects using pulmonary function tests.

Ahasan et al. (2000) in their study titled “Occupational Exposure and Respiratory Illness Symptoms among Textile Industry Workers in a Developing Country” investigated the respiratory health profile of textile mill workers in Bangladesh, aiming to develop workers’ awareness and public attention, and to ensure a proper implementation of health and safety measures.

Niven et al. (1997) in their study “Chronic Bronchitis in Textile Workers” investigated prevalence of chronic bronchitis in cotton workers and compared with a control group of man-made fibre workers. It also determined whether chronic bronchitis was having accounted for the confounding effects of age, sex, ethnic origin, and smoking habits, and which occupational factors significantly affected the prevalence of chronic bronchitis.

A longitudinal study entitled “Musculoskeletal Symptoms among Sewing Machine Operators” was conducted by Schibye et al. (1995) to describe the prevalence and development of musculoskeletal symptoms among sewing machine operators in relation to age and exposure and among former sewing machine operators who changed exposure by changing occupation.

In a study entitled “Ergonomic Challenges in Conventional and Advanced Apparel Manufacturing” carried out by Kelly et al. (1992) surveyed three typical plants mainly apparel manufacturing units in the Southeastern United States to identify musculoskeletal discomfort among sewing operators.

Nag et al. (1992) carried out a study “Work Stress of Women in Sewing Machine Operation” to examine the work stresses of 107 women who were engaged in sewing machine operation in small garment manufacturing units in India.

Brisson et al. (1989) determined in their study “Disability among Female Garment Workers” if garment workers, and particularly those who leave employment, have an increased risk of chronic health problems when compared with women employed in other countries.

Christian et al. (1986) in their study entitled “Respiratory Disease in Cotton Textile Workers in the People’s Republic of China: II Pulmonary Function Results” performed pulmonary function tests pre and post work shift in two cotton mills and one silk mill in Shanghai, The People’s Republic of China.

Punnett et al. (1985) in their study “Soft Tissue Disorders in the Upper Limbs of Female Garment Workers” studied the prevalence of soft tissue disorders of the hands and arms of female garment workers by using a questionnaire and physical examination and the findings were compared with the prevalence of disorders in a group of female hospital employees not required to use repetitive hand motion.

Beck et al. (1984) conducted a cross-sectional study entitled “Cotton Dust and Smoking Effects on Lung Function in Cotton Textile Workers” among active and retired cotton textile workers in Columbia, South Carolina to assess whether smoking and exposure to cotton textile dust have any association with the development of chronic obstructive lung disease.

3. Ergonomics interventions

Megeid et al. (2011) carried out a study entitled “A Study of the Application of Ergonomics in Readymade Garments Factories in Egypt” to raise the efficiency of the performance of the garment industry, by examining the application of human ergonomics engineering which is interested in improving the employment and upgrading the conditions of the appropriate environmental factor (which prevent the stress-causing diseases).

Rampel et al. (2007) determined in their study “A Randomized Controlled Trial Evaluating the Effects of New Task Chairs in Shoulder and Neck Pain among Sewing Machine Operators: The Los Angeles Garment Study” whether a chair with a

curved seat pan leads to improved changes in monthly neck/shoulder pain scores compared with a control intervention.

A study was conducted by Sarder et al. (2006) entitled “Ergonomic Workplace Evaluation of an Asian Garment Factory”. The study reported the results of an ergonomic study in an export garment manufacturing plant in South East Asia to evaluate the working conditions of the plant from an ergonomics/human factors perspective and suggested possible solutions to management for implementation.

Parimalam et al. (2006) carried out a study titled “Ergonomic Interventions to improve work environment in garment manufacturing units” in which garment manufacturing units located in Madurai, India, were analysed using a combination of techniques. It revealed that the units had congested work area, improper ventilation, dust, unergonomic workstations, excessive noise and non-use of personal protective equipment were the major constraints faced by the workers. The study aimed at suggesting interventions to provide better work environment in the garment manufacturing units which could be adopted on a wider scale.

Herbert et al. (2001) evaluated in their study “Impact of a Joint Labor-Management Ergonomics Program on Upper Extremity Musculoskeletal Symptoms among Garment Workers” the effect of an ergonomic intervention program on the prevalence and intensity of symptoms of upper extremity work-related musculoskeletal disorders among 36 garment workers performing an operation called spooling.

Dillard and Schwager (1997) conducted a study entitled “Ergonomic Equipment Investments: Benefits to Apparel Manufacturers” to determine the extent to which companies were investing in ergonomic equipment as a prevention strategy, and whether there was a relationship between such investments and positive results in four areas: increased productivity, increased quality, decreased workers’ compensation costs and improved employee morale.

So far researches have been carried out in different cities of India and other countries with regard to ergonomical studies and occupational health hazards among garment workers. And also studies were mostly on occupational health hazard of single part of the body (such as musculoskeletal problems, lungs problems) rather than overall body parts. Although in Tirupur, garment workers’ researches on

occupational history were carried out but in the perspective of ergonomical concepts and occupational health hazards no such studies are available. The present thesis deals with garment workers overall study and designing and implementation of ergonomical furniture for proper posture to be adopted while workers at work. In addition to that it is always better to educate workers on the benefits of doing exercise and yoga daily for healthy lifestyle and to avoid body pain and later gradual deformity due to occupation. The saying is always remembered "Prevention is better than cure".