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Literature Review on Ergonomics Risk Aspects Association to the Power Loom Industry

Somnath Kolgiri [1], Rahul Hiremath[2], Sheelratan Bansode[3]
[1]*Research Scholar, Mechanical Engineering Department, Solapur University, India.*
[2]*Assistant Professor, SCMHRD, Pune*
[3]*Research Scholar, Mechanical Engineering Department, Solapur University, India.*

Abstract: *The purpose of this paper is to examine and overview the issue of workspace for efficient and safe working environment, also enhance the awareness of the ergonomics venture circumstances in relation of human and their nature of work which may occur in the power loom industry and to make recommendations for quality criteria in ergonomic interventions research. To avoid ambiguity in terminology a list of definitions of the ergonomic is highlighted. Based on the literature, the most significant ergonomic risk aspects are awkward posture in handling job task, force and repetition of specific movement including vibration and noise. Other ergonomics risk aspects includes uncomfortable static position, contact stress of muscles and tendon and also extreme temperature and environment conditions, this increase stress level which is significantly related with musculosketal disorders, effective ergonomic interventions for improved musculoskeletal health in the workplace. This study will enhance the awareness of the risk aspects related to working postures, system layout and working environment which may occur in the power loom industry.*

Keywords: *power loom industry; ergonomics risk aspects; working postures; work layout; work environment.*

I. Introduction

Ergonomics typically is familiar to be kin to being furthermore their employment. In larger extension ergonomics inspects human behavioral, mental, further physiological capabilities moreover limitations. Experts in the area of ergonomics typically devise plan modern practice terrains or innovation established process worlds or change conventional process surroundings based on the studies on the being capabilities besides limitation. The inherent postulate of ergonomics is that job demands should not exceed workers' capabilities and limitations to ensure that they would not be exposed to work stresses that can adversely affect safety and health as well as the industry's productivity. Consequently, the aim of an ergonomics bill is to give a secure furthermore fruitful workplace to the doer's, encourage to finish the intentions also just of the constitution. The focus of ergonomics implementation should extracts moats to element, productivity moreover unharmed primate matinee by happy outgrowths, projects, besides elements to persons rather of forcing the being to arrange to the process. In standing to evaluate the outburst amid a creature moreover their process, ergonomists pleasure study the laborer, the workplace moreover the vacancy motive .Ergonomics is a large skill accompanying far genus of busy statuss that can touch doer's console moreover fitness, including constituents such as lighting, uproar, temperature, flutter, fat lifting, repetitive action, workstation architecture, instrument purpose, apparatus object, preside motive besides footwear moreover additionals.

Therefore, the objective of an ergonomics program is to provide a safe and productive workplace to the worker's comfort to fulfill the goals and objectives of the organization. The focus of ergonomics implementation should remove barriers to quality, productivity and safe human performance by fitting products, tasks, and environments to people instead of forcing the person to adapt to the work. In order to assess the fit between a person and their work, ergonomists will consider the worker, the workplace and the job design .Ergonomics is a broad science with wide variety of working conditions that can affect worker's comfort and health, including factors such as lighting, noise, temperature, vibration, heavy lifting, repetitive motion, workstation design, tool design, machine design, chair design and footwear and others. Job design also gives a great impact with such factors such as shift work, breaks, and meal schedules. These factors can result in injuries or related problems involving the tendons, muscles, or nerves which most of the problems may develop to musculosketal disorders (MSDs). MSDs, or musculoskeletal disorders, are injuries and disorders of the soft tissues (muscles, tendons, ligaments, joints, and cartilage) and nervous system. They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently involve the arms and back. According to Yelin et al. [1], 90% of disabled older workers had MSDs. The treatment of the MSDs problems will cost tens of billions of dollars as stated by Praemer et al. [2].These statements shows that studies on ergonomics is really important to develop the best prevention method of the MSDs which can benefits the employer and also their workers. Ergonomists, contribute to the planning, design and evaluation of tasks, jobs and products in industries. These also include environments

and systems in order to make them compatible with the needs, abilities and limitations of peoples. Physical ergonomics is concerned with human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity. The ergonomic process is practical and efficient approach to the design of work systems that engages employees, management and administrators to impact the organization at the macro and micro ergonomics level, resulting in a powerful return on investment through increased productivity, employee work health satisfaction, and significant cost savings. Ergonomics has spread in various sectors, including academics, defense, agriculture, design, industry and so on. A variety of Ergonomic evaluation tools have been applied universally in various sectors of different industries. But still there is a little awareness about these tools and their uses amongst Indian industries. Thus a lot of research is required with context to Indian industries, so that injuries can be avoided.

II. Definition Of Ergonomics

Reviews of numerous researches of ergonomics are using a variety of definitions to describe the concept. Below are the definitions of ergonomics stated by previous authors; the term ergonomics comes from two Greek words. Ergon, which means work, and nomos, which means natural laws. Thus, ergonomics may be defined by Authors as follows:

- Te-Hsin & Kleiner [3]. Ergonomics is a combination of the words ergo, a Greek word meaning "work" and nomics, meaning "study" - the study of work. An applied science that co-ordinates the design of devices, systems and physical working conditions with the capacities and requirements of the workers
- Tayyari & Smith [4]. A branch of science that is concerned with the achievement of optimal relationships between workers and their work environment.
- Lee [5]. Promoting compatibility between humans and systems
- Fernandez [6]. The design of the workplace, equipment, machine, tool, product, environment and system, taking into consideration the human's physical, physiological, biomechanical and psychological capabilities and optimizing the effectiveness and productivity of work systems while assuring the safety, health and wellbeing of the workers. In general, the aim in ergonomics is to fit the task to the individual, not the individual to the task.
- Brooks [7]. A system of interacting components which includes the worker, the work environment both physical and organizational, the task and the workspace.
- Grzybowski [8]. For evaluating complex work systems four main factors are considered. These include Physical working environment factors, Physical strain factors, Psychological strain factors and Technological and organizational factors.
- Mital, [1995]. ergonomics may be defined as a disciplined concerned with the application of natural laws governing human work.
- Singleton (1972) defines ergonomics as the technology of work design.
- Chapanis (1995) defines ergonomics with the following:

➢ Ergonomics and human factors use knowledge of human abilities and limitations
➢ To the design of systems, organizations, jobs, machines, tools, and consumer products
➢ For safe, efficient, and comfortable human use.

- The word ergonomics was coined by a Polish scholar, Wojciech Jastrzębowski, in 1857 became widely known when his book in Polish was reprinted with English translation in 1897. In his paper published in the journal Nature and Industry (1857), Jastrzebowski divided work into two main categories:

➢ Useful work, which brings improvement for the common good, and
➢ Harmful work that brings deterioration (discreditable work).

- Common Definitions

➢ "Ergonomics is essentially fitting the workplace to the worker. The better the fit the higher the level of safety and worker efficiency." Fitting the Task to the Human - Grandjean 1990
➢ "Ergonomics removes barriers to quality, productivity and human performance by fitting products, tasks, and environments to people." ErgoWeb.com

Despite diverse definitions, the goal of ergonomics is to fit the task to the human in order to eliminate or minimize ergonomics hazards and consequently enhancing the effectiveness of human interaction with the work environment. Commonly highlighted view of the definition of ergonomics as stated above is mainly about the relationship between humans, machine systems, job design and the work environment.

III. Literature Review

Workplaces traditionally have been designed to move products or support machines efficiently. Since people have always seemed so adaptable, how they fit into the workplace has received less attention. The increasing number of injuries caused by repetitive motion, excessive force and awkward postures, ergonomics has become a critical factor in workplace safety. According to Hagberg et al. [9], ergonomics and human factors are often used interchangeably in workplaces. Both describe the interaction between the worker and the job demands. The difference between them is ergonomics focuses on how work affects workers, and human factors emphasize designs that reduce the potential for human error. While Bongers et al [10] stress that by addressing traditional and environmental risk factors, it can keep workers injury free. Risk and risk factors are common concepts used in safety and applied ergonomics literature. Risk includes a component of how likely or what the probability of an event is and the seriousness of the consequence or what the severity is if something does occur. Risk is often defined on how many injuries or accidents resulted for a given exposure. At the extremes, injury risk can be viewed as very low probability but extremely high consequence (e.g.: multiple fatalities) or higher probability but less severe consequence (e.g.: a worker slipping and tripping. Risk is also intuitively relative within and across work settings. Risk implies a probability for injury, and the odds of an injury are a function of the level of risk and worker exposure time. It is possible for workers at a site not to have injuries for a period of time. The absence of injuries does not imply the absence of risk .Risk factors are defined as actions or conditions that increase the likelihood of injury to the musculoskeletal system. Applied ergonomics literature recognizes a small set of common physical risk factors across many occupations and work settings [11]. The relationship between risk factor exposures and the level of musculoskeletal injury risk is not easily defined. Although physical risk factors are important first-line risk factors, there are other plausible factors such as organizational and psychosocial factors that may provoke a disorder or indirectly influence the effect of physical risk factors. Three categories of risk factors are identified which are biomechanical exposures, psychosocial stressors and individual risk factors. Biomechanical exposures include factors such as poorly designed workplaces and biomechanical exposures such as repetitive motion, high forces and deviations from neutral body alignments [12]. Psychosocial stressors at work include factors such as high-perceived workplaces stress, low-perceived social support, low perceived job control, and time pressure [13].Individual factors include gender (female), age, negative stress reactions-especially stomach reactions, and unsatisfactory leisure time and/or additional domestic workload.Ergonomics hazards are workplace conditions and physical stressors that cause a risk of injury or illness to the worker's musculoskeletal system (NIOSH, 1995). Of specific interest are those hazards that pose a cumulative effect on the workers and which are called cumulative trauma disorders (CTD) or work-related musculoskeletal disorders (WMSDs). They are also known as repetitive strain injury (RSI) in Canada and the United Kingdom and cervicobrachial syndrome or occupational cervicobrachial disorder in Japan and Sweden. Yassi (1997) gives the following list of disorders commonly attributed to repetitive strain injury:

Tendon related disorders:

- Tendonitis
- Tenosynovitis
- Peritendonitis
- Gangilion cyst
- Epicondylitis (lateral or medial)

Peripheral-nerve entrapment:

- Carpal tunnel syndrome
- Guyon tunnel syndrome
- Radial tunnel syndrome
- Pronator teres syndrome
- Cubital tunnel syndrome

Neurovascular/vascular disorders:

- Hand-arm vibration syndrome (raynaud's syndrome)
- Ulnar-artery thrombosis

Muscular disorders:

- Focal dystonia
- Fibromyositis
- Tension-neck syndrome
- Myositis
- Myalgia

Joint/joint-capsule disorders:

- Osteoarthritis

- Bursitis
- Synovitis
- Adhesive capsulitis

Also, NIOSH (1997) defines the term musculoskeletal disorders as describing:

- Disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs
- Disorders that are not typically the result of any instantaneous or acute event (such as a slip, trip, or fall) but reflect a more gradual or chronic development (nevertheless, acute events such as slips and trips are very common causes of musculoskeletal problems such as low back pain)
- Disorders diagnosed by a medical history, physical examination, or other medical tests that can range in severity from mild and intermittent to debilitating and chronic Disorders with several distinct features (such as carpal tunnel syndrome) as well as disorders defined primarily by the location of the pain (i.e., low back pain)

The ergonomic risk factors that can lead to MSD include: repetitive and forceful motions, static muscle load, mechanical stress, vibration, temperatures extreme, and awkward postures (Yassi, 1997). There are also psychosocial and physical factors to consider. These include cognitive and emotional stress relating to work task, social relationships, individual psychological factors, administrative concerns, lighting, noise and indoor climate (Westgaard and Winkel, 1997). The previously mention factors present a musculoskeletal hazard independently of mechanical exposure (Bongers et al., 1993; Vasseljen and Westgaard, 1996). In a landmark study (Bigos et al., 1991) it was argued that, in addition to prior back problems, work perceptions and some psychosocial responses were the only factors linked with reporting low back pain during a 4 year follow-up period.

Organizational factors may also increase the risk of CTD's. These factors include: excessive work rates, duration of work, externally paced work, inadequate work breaks or rest periods, monotonous work, and job insecurity (NIOSH, 1995; Chatterjee, 1987; Gerr, Letx and Landrigan, 1991). Also, if two or more risk factors are present then the risk for CTD increases significantly (Silverstein, Fine and Armstrong, 1986). Individual risk factors could also contribute to the occurrence of CTDs. For example, obesity can contribute significantly to the occurrence of CTDs (Nathan et al., 1992b). Athletic activity and hobbies have also been associated with these disorders. Athletic activities such as racket sports have been associated with the development of tendinitis, tenosynovitis, degenerative joint disease, and peripheral nerve entrapments. Knitting, sewing, or the playing of musical instruments as hobbies, have also been associated to these disorders (Armstrong and Chaffin, 1979). Ergonomic investigations and epidemiological studies conducted thus far have concentrated on the association between occupational risk factors and the development of musculoskeletal disorders in the back, neck, shoulders, and arms (Winkel and Westgaard, 1992; Kilbom, 1994). Also, the prevelance of work-related musculoskeletal problems of the lower extremity is not as frequently reported as those of the upper-body (Li and Buckle, 1999).
Constrained working postures are one of the most important risk factors associated with various occupational musculoskeletal disorders (Hunting et al., 1980; Westgaard and Aaras, 1984), but these risk factors are not the only factors of concern. Force, frequency, and duration are also believed to be important (Kilbom, 1994; Winkel and Mathiassen, 1994). Therefore, when evaluating occupational risk factors, all factors should be considered and measured. Here is where the problem resides, little is known about the relative importance of each risk factor (Li and Buckle, 1999). As a consequence, there is no agreement on how different exposure variables can collaborateto provide a specific dose (Hagberg, 1988). The "biological injury mechanism" involved in cumulative trauma disorders is poorly understood. The "injury mechanism" is likely to be multicasual. New risk factors can unintentionally be introduced when ergonomics interventions are implemented against known risk factors (Westgaard and Winkel, 1997). In some instances, there has been argument over the actual relationship between CTD and risk factors. This viewpoint argues that cumulative trauma disorders are only common to a certain population of the workforce. This particular population is characterized by either smaller or larger.

3.1 The table below summarizes the different types of ergonomics risk factors:

Risk Factors	**Examples**	**Author/s**
Mechanical Hazards	Repetitive motions Static muscle load Awkward postures Mechanical stress Vibration Temperature extreme	Yassi, 1997
Psychosocial and Physical	Cognitive stress Social relationships Psychological factors Administrative concerns Lighting Noise	Westgaard and Winkel, 1997 Bongers et al., 1993 Vasseljen and Westgaard, 1996

Organizational Factors	Excessive work rates Duration of work Externally paced work Inadequate work breaks Monotonous jobs Job insecurity	NIOSH, 1995 Chatterjee, 1987 Gerr, Letx and Landrigan, 1991
Individual Risk Factors	Obesity	Nathan et al., 1992b
Athletic Activities/Hobbies	Racket sports Knitting and sewing Musical instruments	Armstrong and Chaffin, 1979

IV. Discussion

Ergonomic Risk Factor (ERF) is situations that exist or created intentionally or unintentionally that could or might contribute to results contravene or against the principles or philosophy of ergonomics that could or might harmful to the health and well-being of workers or users at work or after work [14]. Understanding and aware on the negative aspects of ERF are critical and essential for counter measures to take before solutions to the problems could be found. The primary ERF are repetition, force, awkward posture, vibration, contact stress, static loading and extreme temperature. Risk factor exposure is an early warning of progressively more serious problems -physical signs and symptoms that can lead to serious injury. Long-term exposure to risk factors will reduce the quality of life. Every job carries risk. The key issue is relative risk. Organizations and individuals can become better informed to reduce MSD injury risk by being aware of risk factors, becoming skilled in recognizing and categorizing these factors, and examining options to reduce the frequency or duration of exposure to the risk factors. Reducing exposure to risk factors should make the task smoother and more predictable in its outcome. Reducing risk factor exposure should make task performance less variable. Although the causes of any particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies. Musculoskeletal disorder (MSD) is a condition or disorder that involves the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs. These disorders are not typically the result of a distinctive, singular event, but are more gradual in their development. Thus, MSDs are cumulative-type injuries. It is essential to understand just what a risk factor is, or rather is not. A risk factor itself is not necessarily a caution factor for any particular MSD. Many times it is not simply the presence of a risk factor, but the degree to which the risk factor is expressed that may lead to MSD. Similarly, to the extent a MSD case is attributable to a risk factor, often it will be a combination of multiple risk factors, rather than any single factor, which contributes to or causes an MSD [15]. Some work activities can strain our bodies. This may lead to injuries to our muscles, tendons, ligaments and joints [16]. This type of injury is called a musculoskeletal injury or MSI. Parts of our job that may strain our bodies or increase the risk of injury (MSI) are called risk factors. Risk factors may be experienced by the affected individual during non-occupational activities. In addressing any ergonomic issue, it would be a mistake to focus solely on the workplace. The major work-related risk factors are repetitive work, exerting a force, awkward and static postures, contact stress or pressure [17]. The factors that contribute to the risk of MSI are called risk factors. A risk factor is something that may cause or contribute to an injury. Two or more risk factors can be present at one time, increasing the risk of injury. Workers may not always be able to identify all the risk factors in a task. However, it is important for workers to recognize situations when they are at higher risk. Further, not every person exposed to any or all of these risk factors will develop a MSD. Nor, for that matter, will any two people who are exposed to the same combination of risk factors and in the same degree, respond to them in the same way. Nevertheless, these are common factors that may give rise to a MSD in some combination and in some people.

The Ergonomics Risk Factors (ERF) that are discussed in this study are listed below:

1. Awkward Posture
2. Force
3. Repetition
4. Vibration
5. Static Loading
6. Contact Stress
7. Extreme Temperature
8. Sound

4.1 Awkward Posture

Posture refers to the position of different parts of your body. Muscles, tendons, and ligaments must work harder and can be stressed when you are in an awkward posture. Awkward posture occur when any joint of

your body bends or wrists excessively; outside a comfortable range of motion various work activities can result in awkward postures:

- Leaning sideways, such as when reaching into a low drawer to one side (awkward back posture)
- Bending down to work at a low level (awkward back posture)
- Reaching overhead (awkward shoulder posture)
- "Flaring" the elbows out to the side (awkward shoulder posture)
- Bending the wrist when moving objects or keyboarding (awkward wrist posture)
- Bending the neck down, such as looking at small components in poor lighting conditions (awkward neck posture)
- Twisting part of the body, such as twisting the neck to view documents while keyboarding for a long time (awkward neck posture)

If the position is held long enough for you to feel aches and pains, then your muscles have been held in one position for too long. A posture held for a long time is called a static posture. Posture is the position of a part of the body relative to an adjacent part as measured by the angle of the joint connecting them. Postural stress is assuming an extreme posture at or near the normal range of motion. Posture is one of the most frequently cited occupational risk factors [16]. There is a neutral zone of movement for every articulating joint in the body. For each joint the range of motion is defined by movements that do not require high muscular force or cause undue discomfort. Injury risks increase whenever work requires a person to perform tasks with body segments outside their neutral range in a deviated posture. Awkward posture include repeated or prolonged reaching, twisting, bending, kneeling, squatting, working overhead with your hands or arms, or holding fixed positions. For the upper arm and shoulder area neutral posture is relaxed with the shoulders down and on the same plane, with arms at the side. Working with the arms abducted away from the body, overextended and shoulders hunched places these joints at the end of their normal range of motion, requires higher muscular force and greatly increases the risk for injury. Strained sitting positions, such as tilting sideways, twisting the vertebral column, bending forward or slumping begin in response to compensation for specific work relationships but can become habit over time. Posture and positioning profile factors such as torso twist, tipped shoulders, head tilt/rotation, raised elbows (dominant, non-dominant, or both) and operating with hands close to the face are associated with increased risk of musculoskeletal symptoms. Awkward posture is associated with an increased risk for injury. It is generally considered that the more a joint deviates from the neutral (natural) position, the greater the risk of injury. Posture issues can be created by work methods (bending and twisting to pick up a box; bending the wrist to assemble a part) or workplace dimensions (extended reach to obtain a part from a bin at a high location; kneeling in the storage bay of an airplane because of confined space while handling luggage). Specific postures have been associated with injury such as wrist, shoulder, neck, and low back.

4.2 Force

Force is the mechanical or physical effort to accomplish a specific movement or exertion. Force can be defined as the amount of physical effort required to perform a task (such as lifting) or to maintain control of equipment or tools. Exerting a force on a person or object may overload our muscles and tendons. The force may come from gripping, lifting, pushing or pulling. The force that a worker exerts on an object is a primary risk factor. Muscles and tendons can be overloaded when you apply a strong force against an object. Holding a lighter object (such as a mouse) for long periods can also expose workers to a risk of MSI. There are three types of activity that require force such as force involved in lifting, lowering, or carrying, force involved in pushing or pulling and grip force. In other word, force is the amount of physical effort required by a person to do a task or maintain control of tools or equipment. A pinch grip produces 3-5 times more force on the tendons in the wrist than a grip with the whole hand. With excessive force the muscles are contracting much harder than normal, this can lead to stress on the muscles, tendons and joints. The amount of force depends on the type of grip, the weight of an object, body posture, the type of activity and the duration of the task. Using hands instead of a clamp to hold an object while performing a task shows that force occurs. The amount of force required by an activity can sometimes be magnified causing even more muscular fatigue. Task forces can be viewed as the effect of an exertion on internal body tissues (e.g. compression on a spinal disc from lifting, tension within a muscle/tendon unit from a pinch grasp), or the physical characteristics associated with an object(s) external to the body (e.g. weight of a box, pressure required to activate a tool, pressure necessary to snap two pieces together). Generally, the greater the force causes the greater the degree of risk. High force has been associated with risk of injury at the shoulder, neck low back, forearm, wrist and hand. It is important to note that the relationship between force and degree of injury risk is modified by other work risk factors such as posture, acceleration/velocity, repetition, and duration.

4.3 Repetition

Repetition rate is defined as the average number of movements or exertions performed by a joint or a body link within a unit of time or performing similar motions with the same body part with little rest or recovery. Repetition could also be defined as performing the same motion or group of motions excessively. Repetition involves doing a task that uses the same muscles over and over with little chance for rest or recovery. This applies to both large muscles and small muscles. Repetition put workers at a higher risk of injury when other risk factors are also present (such as an awkward posture or heavy force). Repeated identical or similar motions performed over a period of time could cause over-extension and overuse of certain muscle groups, which could lead to muscular fatigue. Interestingly, symptoms often relate not to the tendon and muscle groups involved in repetitive motions, but to the stabilizing or antagonistic tendon and muscle groups used to position and stabilize the extremity in space. Sometimes, by varying tasks, muscle groups have periods of activity alternated with periods of rest, which may be beneficial in reducing the possibility of injury. Repetition also is the time quantification of a similar exertion performed during a task. A warehouse worker may lift and place on the floor three boxes per minute; an assembly worker may produce 20 units per hour. Repetitive motion has been associated with injury [16, 17] and worker discomfort. Generally, when more number the number of repetitions, then the greater degree of risk. However, the relationship between repetition and degree of injury risk is modified by other risk factors such as force, posture, duration, and recovery time. No specific repetition threshold value (cycles/unit of time, movements/unit of time) is associated with injury.

4.4 Vibration

Vibrations occur when an object oscillates or rapidly moves back and forth about its stationary point, like a swinging pendulum. Vibrations are defined by the frequency (how fast the object is moving) and the magnitude or amplitude (the distance of the movement).Vibration may be defined simply as any movement which a body makes about a fixed point. This movement can be regular, like the motion of a weight on the end of a spring, or it can be random. Vibration has been found to be an etiological factor in work environments utilizing tools vibrating in the frequency band of 20 to 80 Hz. For example, use of a chain saw or powered wood working tools for extended periods of time [18, 19]. Vibration gives effects such as damage caused to body organs as a result of their being buffeted by high vibration levels at relatively low frequencies and breakdown of body tissues due either to continued resonance or to their absorption of high energy vibration. Vibration applied to the hand can cause a vascular insufficiency of the hands/fingers (Reynaud's disease or vibration white finger). Also, it can interfere with sensory receptor feedback leading to increased hand grip force to hold the tool. Further, a strong association has been reported between carpal tunnel syndrome and segmental vibration. Hand-arm vibration (HAV) is typically associated with operating power tools. Whole-body vibration (WBV) is typically associated with standing or sitting on a vibrating surface. WBV exposure occurs when vibrations are transmitted usually through the feet if standing, or the legs and hips if seated. WBV can affect the entire body, including internal organs. Exposure of the whole body to vibration (usually through the feet/buttocks when riding in a vehicle) has some support as a risk for injury.

4.5 Static Loading

Our body is built to move about, not to remain still. It is uncomfortable and tiresome having to maintain anybody position without change over extended periods. We experience this discomfort while driving a motor vehicle where the location of the trunk on the seat, of the head in order to see, and of the hands and feet on controls constrains us to a nearly immobile posture. Although define in a variety of ways, static loading generally means the performance of a task from one postural position for an extended duration. The condition is a combination of force, posture, and duration. The degree of risk is in proportion to the combination of the magnitude of the external resistance, awkwardness of the posture, and duration [20].

4.6 Contact Stress

Contact stresses are defined as impingement or injury by hard, sharp objects, equipment or instruments when grasping, balancing or manipulating. Contact stresses are encountered when working with forearms or wrists against the edge of a desk or work counter. The muscles and tendons are impinged when pressed into the sharp edge. Using the hand as a hammer to close a lid securely also creates mechanical stresses, especially if the lid has raised surfaces or sharp edges. Local contact stress occurs when a hard or sharp object comes in contact with the skin. The nerves and the tissues beneath the skin can be injured by the pressure. The effects of local contact stress can be made worse if the hard object contacts an area without much protective tissue, such as the wrist, palm, or fingers and also when pressure is applied repeatedly or held for a long time.

4.7 Extreme Temperature

Extreme temperature can be classified into two that are extremely cold and extremely hot. Cold temperature can be define as a low temperature reduces manual dexterity and accentuate the symptoms of nerve-end impairment. Cold stress is the exposure of the body to cold such that there is a lowering of the body's deep core temperature. Systemic symptoms that a worker can present when exposed to cold include shivering, clouded consciousness, extremity pain, dilated pupils, and ventricular fibrillation. Heat stress is the total load the body must accommodate. It is generated externally from environment temperature and internally from human metabolism. Excessive heat can cause heat stroke, a condition that can be life threatening or result in irreversible damage. Less serious conditions associated with excessive heat include heat exhaustion, heat cramps, and heat-related disorders (e.g., dehydration, electrolyte imbalance, loss of physical/mental work capacity) [21].

4.8 Sound

Noise is measured in decibels dB (A). Audible noise greater than 85 dBA or greater is hazardous. Some preventative strategies to consider in countering the effects of noise include avoidance of noise generation, impedance of sound transmission and using adequate protective hearing devices such as sound-isolating helmets, caps or plugs [22].

V. Conclusion

This study was focused on the ergonomics definition and risk factors in the Power loom industry. Through the review, it can be concluded that ergonomics mainly can be defined as the relationship between humans, machine systems, job design and the work environment. Generally, the aim of ergonomics is to fit the task to the individual and not the individual to the task. The study also found the most significant ergonomics risk factors or conditions that may increase the likelihood of injury to musculoskeletal system. The risk factors include working in awkward posture, vibration and force which may come from gripping, lifting, pushing or pulling. Repetition which involves in doing a task that uses the same muscles over and over with little chance for recovery or working in extreme temperature condition either extremely cold and extremely hot also are the main risk factors. Working in uncomfortable static position or contact stress of muscles and tendon also will increase the likelihood of injury. The ergonomics is of prime importance in the area of design of work place, sequence of production, healthy working environment, working procedure, safety at work, personal safety etc. which will consequently helps in reducing fatigue, stress and strain of human, internal strength (capacity), improving efficiency, simplification of work, improvement in the quality of product and services, incorporation of safety, establishing a healthy work culture, etc.

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