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Module 10: Ergonomics

Module Description

Employees who work in non-office environments are routinely required to carry out tasks that involve movement and physical exertion. These forceful exertions associated with such tasks may lead to fatigue, musculoskeletal disorders, and other serious injuries.

This module is designed to help employees identify work-related problems and learn to apply the principles of ergonomics in order to make their jobs less physically demanding, thereby increasing their overall efficiency.

Module Learning Objectives

At the completion of this module, you should be able to:

- Discuss what is meant by ergonomics.
- Name the factors that may contribute to problems in a non-office work environment.
- Identify the causes of musculoskeletal disorders.
- Apply effective ergonomic principles at your workplace.

Lesson 1: Ergonomics in the Workplace

Lesson Focus

This lesson focuses on the following topics:

- Introduction
- Musculoskeletal Disorders (MSDs)
- Risk Factors

Introduction

Many workers across the United States have to carry out physically demanding tasks each day while on the job. If these tasks are not carried out in proper postures, they may cause fatigue or discomfort.

Musculoskeletal Disorders (MSDs)

Carrying out such tasks for prolonged periods may cause severe damage to muscles, ligaments, tendons, blood vessels, and nerves. Such injuries include musculoskeletal disorders (MSDs). MSDs not only affect individual workers but also increase the cost of business in terms of higher workers' compensation premiums, increased employee turnover, absenteeism, and decreased efficiency. Overall productivity can also be greatly affected.

In order to reduce the costs associated with MSDs and avoid the problem of work-related injuries, employers must implement the principles of ergonomics in their workplaces.

Why Are MSDs a Problem?

Many reasons exist for considering MSDs a problem, including the following:

- MSDs are among the most prevalent lost-time injuries and illnesses in almost every industry [Bureau of Labor Statistics 1995, 1996; National Safety Council 1995; Tanaka et al., 1995].
- MSDs, specifically those involving the back, are among the most costly occupational problems [National Safety Council 1995; Webster and Snook 1994; Guo et al., 1995; Frymoyer and Cats-Baril 1991].

- Job activities that may cause MSDs span diverse workplaces and job operations (see Table 1; see also Tray 1-A of the Toolbox).
- MSDs may cause a great deal of pain and suffering among afflicted workers.
- MSDs may decrease productivity and the quality of products and services. Workers experiencing aches and pains on the job may not be able to do quality work.
- Because musculoskeletal disorders have been associated with non-work activities (e.g., sports) and medical conditions (e.g., renal disease, rheumatoid arthritis), it is difficult to determine the proportion due solely to occupation. For example, in the general population, non-occupational causes of low back pain may be more common than workplace causes [Liira et al., 1996]. However, even in these cases, the musculoskeletal disorders may be aggravated by workplace factors.

Medical Conditions Associated with Musculoskeletal Symptoms

- Conditions associated with MSDs include:
- Muscle strain or fatigue
- Tendonitis
- Epicondylitis or "tennis elbow"
- Carpal tunnel syndrome
- Other "pinched" nerve entrapment syndrome
- Nerve injury/irritation from external compression
- Arthritis and other rheumatological disorders

Ergonomics, also known as human engineering, is the practice of designing machines, products, and places to better accommodate people. The principles of ergonomics are geared towards adapting the design and engineering of products and workplaces to people's sizes and shapes, physical strengths and limitations, biological needs, ability to handle information and make decisions, as well as their capacities for dealing with such psychological factors as isolation and stress.

Risk Factors

Risk Categories

There are certain aspects of tasks that can increase the risk of fatigue, musculoskeletal disorder (MSD) symptoms and injuries, or other types of problems. These risk factors

can be found in a variety of tasks that an employee is required to carry out and can be divided into two categories: physical factors and environmental factors.

Physical factors

These are fundamentally the interactions between the work area and the worker, and include:

- Awkward postures
- Forceful exertions
- Repetitive tasks or motions
- Pressure points
- Recovery time
- Vibration

Awkward Postures

The position of the body while performing a task is known as posture. The muscle groups used while performing a task are affected by the worker's posture. An awkward position can make the task more physically demanding by overexerting small muscle groups and not using larger muscle groups. This can increase the likelihood of poor blood-flow, which can lead to fatigue and injury.

Some examples of awkward postures include repeated or prolonged reaching, bending, twisting, kneeling, holding fixed positions, or squatting. Several areas of the body can be affected due to these postures including shoulders, arms, wrists, hands, knees, neck, and back. Awkward postures are often caused by poorly designed work areas, equipment, and tools along with poor work practices.

Postures to Avoid:

- Prolonged or repetitive flexion or extension of the wrist
- Prolonged or repetitive bending at the waist
- Prolonged standing or sitting without shifting your position
- Suspending an outstretched arm for extended periods of time
- Holding or turning your head consistently to one side
- Any posture that is held repeatedly or for a prolonged time

Motions to Avoid:

- Repeated motion without periods of rest
- Repeated motion with little or no variation
- Repeated motions done with force
- Resting or compressing a body part on or against a surface
- Lifting heavy objects away from the body
- Frequent reaching or working above shoulder height

The following types of employee behavior may indicate the presence of ergonomics-related problems:

- Employees shaking arms and hands or rolling shoulders due to discomfort.
- Employees voluntarily modifying workstations and equipment to increase comfort.
- Employees bringing in ergonomic products to the worksite (such as wrist braces).

Forceful Exertions

The amount of muscular effort required to perform a task is called force. Exerting more force than a body can sustain can cause severe damage to muscles and ligaments. The amount of force required for tools or machinery depends upon various factors, including those that follow:

- Load weight, shape, and bulkiness
- Grip type
- Amount of pressure required to accelerate, or decelerate, the load
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The degree of risk generally increases with increasing force. Various parts of the body can be affected due to high force, including shoulders, neck, lower back, forearm, wrist, and hands.

> **Note:** The risk of injury due to forceful exertions may increase if other risk factors such as awkward posture, repetitive tasks, and extended duration are also present.

Repetitive Tasks or Motions

Repetitive tasks require workers to perform the same task over and over again, using the same muscles, ligaments, and tendons. Repetitive motion may cause severe

damage, injury, and discomfort to the worker. The risk of injury increases if the worker fails to take any breaks to relax his or her muscles.

Pressure Points

Exerting pressure on different parts of the body by pressing them against hard or sharp surfaces may cause injury. Some body parts are at a greater risk as nerves, blood vessels, and tendons are present just under the skin in certain areas. Fingers, wrists, palms, elbows, forearms, and knees are examples of such body parts.

Recovery Time

Recovery time is the amount of time allocated to rest the muscles and tendons in any strained part of the body. It is very important for workers to take pauses between tasks that require forceful exertions. These breaks not only provide relief to workers but also enhance their performance. Employers must assess the duration of breaks according to the workload along with the risk factors present.

Vibration

Exposure to continuous vibration can cause damage if uncontrolled. Exposure to vibration can occur with the use of vibrating tools such as sanders, chippers, chain saws, drills, grinders, routers, and impact guns. Vibrations can cause fatigue, numbness and pain in the exposed area. It may also cause decreased sensitivity to touch and increased sensitivity to cold.

Environmental Factors

Heat Stress

Heat stress is the amount of heat that a body is exposed to while performing a task. Heat stress can be attributed to the worker's environment and also his or her own internal metabolism.

Exposure to excessive heat can cause various disorders, including heat exhaustion, heat cramps and heat stroke. The symptoms of heat stress may include headaches, thirst, nausea, muscle cramps, dizziness, and weakness. Due to the severity of the consequences of heat stress, employees must regularly monitor the workplace and take appropriate preventive measures.

Cold Stress

Cold stress occurs when a worker is exposed to cold temperatures. Cold stress results in the decrease of the worker's body temperature and may cause shivering, unconsciousness, pain, and inadequate circulation of the blood. Cold stress may also cause the worker to lose the ability to grasp due to the decrease in body strength. Cold temperatures combined with the risk factors above may increase the risk of musculoskeletal disorders.

Noise

Continuous sound at levels above 80-85 dB in the workplace can cause severe damage to a worker's hearing. Continued exposure to high noise levels may also result in impaired hearing or permanent deafness, tinnitus, or speech misperception. Furthermore, high levels of noise may also affect the worker's ability to concentrate on his or her work.

Lighting

Improper lighting in the workplace may cause eye fatigue and may result in headaches and a loss of focus. A worker's ability to perform tasks efficiently depends greatly on the proper lighting of the work area.

Lesson Summary

Repetitive tasks require workers to perform the same task over and over again, using the same muscles, ligaments, and tendons. Repetitive motion may cause severe damage, injury, and discomfort to the worker. The risk of injury increases if the worker fails to take breaks to relax his or her muscles.

Recovery time is the amount of time allocated to rest the muscles and tendons in any strained body part. It is very important for workers to take adequate pauses between tasks that require exertions. These breaks not only provide relief to workers but also enhance their performance.

High or continuous vibrations can cause fatigue, numbness, and pain in the exposed area. It may also cause decreased sensitivity to touch and increased sensitivity to cold. To prevent the consequences of heat stress, employers must regularly monitor the workplace and take the appropriate measures to ensure that all employees are adequately protected. In short, in order to reduce the costs associated with

musculoskeletal disorders and to avoid the problem of work-related injuries, employers must implement principles of ergonomics in their workplaces.

Lesson 2: Improving the Workplace

Lesson Focus

This lesson focuses on the following topics:

- Introduction
- Engineering Improvements
- Administrative Improvements
- Use of Protective Equipment
- Training

Introduction

Employers can adopt various ergonomic improvements in their workplaces in order to improve the working environment for their employees. Ergonomic improvements can be divided into three categories:

- Engineering Controls
- Administrative Controls
- Use of Protective Equipment

Engineering Controls

Employees can make engineering controls in their workplaces by redesigning, rearranging, modifying or replacing tools, equipment, workstations, products, or actions that increase the risks of injury. Implementing effective engineering controls can greatly reduce the risk factors. The engineering controls that follow are recommended.

Install work tables with work surfaces that can be raised or lowered according to the employee's body size and position. This can reduce bending, reaching, and awkward postures that can contribute to body damage.

Cutout work surfaces may be appropriate to allow employees to adjust their distance from the work table. This can help reduce awkward postures.

By allowing employees to reposition their work, their bending and reaching efforts can be reduced.

Modifying the work surface according to the task can reduce the effort needed to complete the task. For example, to deliver packages from one area to another, workers

can slide and roll the packages on the surface rather than lifting and carrying them manually.

Ladders, scaffolds, steps or work platforms must be provided to employees who are required to reach a surface high off the ground to retrieve packages or containers.

If employees are required to place packages and containers on surfaces high off the ground, certain mechanical lifting devices can be used to lift them. This can reduce stress to shoulders, neck, back, and other body parts. This can also reduce force, repetition, and awkward postures in tasks related to lifting or handling heavy objects.

Certain jobs, such as loading and unloading packages from delivery trucks, may require workers to bend their torsos repeatedly. This can again increase the risk of damage to a variety of body parts. This type of operation can be improved significantly by implementing lifting devices, altering the work site, and adopting a wide range of ergonomic solutions.

Employers should provide adjustable equipment that allows employees to accomplish tasks in a comfortable, upright working posture.

All materials, products, and tools that have to be used frequently must be stored in a place that can be accessed easily without requiring the worker to reach high or adopt awkward postures.

Materials should be transported around the workplace using mechanical aids when possible and appropriate. This may reduce the force required, repetition of motions, and awkward postures, while increasing workers' efficiency.

Unnecessary repetitive reaching, twisting, bending, and forceful exertions can be avoided by properly organizing the equipment and materials stored by grouping stored items by container size or shape.

Installing proper lighting systems in the workplace, including all storage facilities, can help reduce eye strains and headaches.

By utilizing good design and carrying out proper maintenance of all machinery and equipment, employees can ensure pressure points on the hands and wrists, awkward postures, and forceful exertions are minimized or avoided.

Exposure to vibration may be reduced by routine maintenance of vibrating equipment, covering handles with vibration-dampening wraps, operating the tool from a distance when possible, using vibration-dampening gloves, using alternate tools that produce less vibration, utilizing vibration isolators for workers who are seated, employing cushioned floor mats for tasks that have to be carried out while standing, or using vibrating tools at low speeds.

Administrative Controls

Administrative controls involve developing work practices and methods that best protect the worker. These are often focused towards devising and implementing new practices and policies in order to allow employees to carry out their jobs effectively and efficiently and avoid any on-the-job injuries, illnesses, and accidents. Administrative controls rely on communication and training, as well as feedback from management and employees on the effectiveness of the controls. Administrative controls may include:

- Job Rotation
- Adjusting Work Schedules and Work Pace
- Allowing More Frequent Breaks
- Modifying Work Practices
- Regular Housekeeping and Maintenance
- Encouraging Regular Exercise

Job Rotation

Adopting a job rotation system may be one effective measure to reduce damage caused to employees by using the same muscle groups every day. With a properly designed and implemented system, employees are rotated through different jobs, thus increasing job and muscle-use variety. Another system through which employees can increase job variety is through job enlargement. Through this system, employers combine two or more jobs or add different tasks to an existing job.

These systems aim to prevent overuse and overexertion of muscles and body parts, by reducing the amount of repetition, altering the pace of work, reducing the physical exertion required, and controlling visual and mental demands.

Adjusting Work Schedules and Work Pace

Employers must be careful not to assign too heavy of a workload to employees. They also must limit the amount of time that an employee spends performing a particularly challenging job in awkward positions even when physical improvements have been incorporated.

Allowing More Frequent Breaks

Breaking work into smaller tasks allows employees to take adequate breaks between them. These breaks may help employees relax their muscles, thus preventing fatigue and injury.

Modifying Work Practices

Supervisors and managers should regularly observe how workers perform their jobs. When employees perform all jobs while in a neutral posture, the body is less susceptible to injury. Employees may be able to adopt this posture by sitting or standing upright and not bending any joints into extreme positions; they should keep their necks, backs, arms, and wrists in a neutral position. Supervisors should encourage employees to work in a comfortable position and shift their positions or stretch often.

Other work practices:

- Minimize distances for carrying, pushing, and pulling
- Manage an equal amount of weight in each hand
- Avoid unnecessarily twisting of the body
- Use smooth and even motions, avoiding jerking
- Utilize legs to accomplish tasks rather than using the upper body or back
- Ensure that all paths are free from obstacles and even-surfaced
- Organize tasks to provide a gradual increase in the amount of force required
- Ensure shoes worn are slip-resistant.

Regular Housekeeping and Maintenance

Employers must devise a system to carry out regular housekeeping and maintenance of workspaces, equipment, machinery, and tools. There should be no cluttering in the workspace, as clutter can force employees to reach, bend, or twist their bodies while handling different objects. Additionally, employers must ensure that workspaces comply with the following points:

- All floor surfaces must be kept dry and free of any obstacles when possible. This can minimize hazards associated with slipping or tripping in the work area. Problems related to overexertion can often be minimized by carrying out regular maintenance of all tools and equipment.
- Ensure that handles and padding on vibrating tools are well maintained to help reduce vibration and awkward postures while tasks are being performed.
- All moving or mechanical parts on carts and pulleys are properly lubricated and maintained so as to reduce the amount of force required to move them.

Encouraging Regular Exercise

Regular exercise is very important to one's well-being. It not only keeps the body fit, it reduces the risk of injury. Individuals who are in good physical condition are more productive and sustain fewer injuries.

Employers may encourage their workers to increase their energy levels, coordination, and alertness by exercising regularly. Regular exercise can also increase the efficiency of their joints and improve blood circulation.

Some organizations allow and encourage employees to warm up and engage in proper stretching before beginning work and while taking a break from work.

Use of Protective Equipment

Personal Protective Equipment (PPE) includes all protective equipment, such as gloves, footwear, knee and elbow pads, eye protection and other equipment that employees wear according to the type of task they are involved in.

Gloves

Properly selected gloves help to protect hands from sustaining injuries, improve grip, and avoid contact with chemicals. However, if gloves do not fit properly or are not made of the proper materials, they can restrict hand movement and make it harder for employees to grip things.

Footwear

Choosing the proper footwear according to the nature of the job can greatly reduce the risk of slipping. Some soles are designed to reduce fatigue for employees who are required to stand for long hours while performing a task.

Knee and Elbow Pads

Knee and elbow pads can protect body parts that are pressed against hard or sharp surfaces. These aim to minimize the risk of negatively affecting pressure points until proper engineering improvements can be made.

Back Belts

OSHA does not recognize back belts as effective engineering controls to prevent back injury. While they may be accepted by individual workers because they feel as if they provide additional support, the effectiveness of back belts in the prevention of low back injuries has not been proven in the work environment.

OSHA's preferred approach to prevention of injuries and illnesses, including back injuries, is to eliminate the hazardous conditions in the workplace, primarily through engineering controls.

Training

Training is also an important element of the ergonomics process. Training ensures that employees are informed about ergonomic concerns in the workplace and ways to minimize the risk of injury. Training is best provided by individuals who have experience with ergonomic issues in their workplace. Training should be provided annually in a manner and language that all employees can understand.

Training prepares employees for active participation in the ergonomics process, including identifying potential problems, implementing solutions, and evaluating the process. Effective training includes:

- Proper use of equipment, tools, and machine controls
- Good work practices, including proper lifting techniques
- Awareness of work tasks that may lead to pain or injury
- Recognition of MSDs and their early indications
- Addressing early indications of MSDs before serious injury develops
- Procedures for reporting work-related injuries and illnesses

Employees will benefit from orientation and hands-on training received before starting tasks with potential ergonomic risk factors. Employees should also be notified of workplace changes, instructed on using new equipment, and notified of new work procedures.

An effective ergonomics program involves training and education. In order to thoroughly implement the principles of ergonomics, all employees must be trained and provided with guidance about how to use new tools, machinery, equipment, and proper work procedures. An effective training program includes a mix of theoretical and practical ways in which employees can develop their skills to work safely.

An ergonomics training program must include:

- All employees who are exposed to different risk factors
- Supervisors
- Managers
- Appropriate engineers and maintenance personnel

Qualified persons who have a thorough knowledge about the principles of ergonomics greatly improve the quality of training. Additionally, trainers must thoroughly familiarize themselves with the workplace before devising a program.

All supervisors who have to administer an ergonomics program should be provided with special training focusing on how to effectively incorporate sound ergonomic principles and practices into the workplace.

Trainers must consider communication levels before devising the training program. They should adopt a language and style that is easy for all employees to understand and relate to.

Apart from ergonomic principles, the training must also include the risk potential of damage to the body and injuries that can result from the failure to adopt sound ergonomic principles and practices.

Employee training must consist of both general and specific job-related skill sets.

General Training

Employers must provide formal training to all employees who could be exposed to ergonomic hazards to inform them about the hazards associated with their jobs and the tools, machinery, and equipment they use. Information that must be included in the training includes specific risk factors, their causes, recognizing and reporting symptoms, and the prevention of these occurrences.

Job Specific Training

All new employees and those assigned new tasks must be made aware of the specific risks associated with a particular job before they start their work. A practical demonstration should be arranged in order to show the employees how to use all the tools and equipment properly and how to carry out all procedures efficiently. The initial training program should incorporate the following:

- How to use, handle, and maintain all tools, machinery, and equipment that have to be used as a part of the job
- How to use the special tools, if any, associated with a particular job
- How to use safety equipment and guards along with personal protective equipment to ensure safety
- How to properly lift and the proper procedures to follow when an object is too heavy to lift safely without assistance

Training for Supervisors

It is the responsibility of supervisors to ensure that all employees are properly trained to follow safe work practices and that these practices are followed on a consistent basis. In addition to the training received by employees, supervisors should receive additional training that enables them to recognize early risk signs and symptoms, hazardous work practices, how to correct those practices, and how to reinforce the ergonomic program.

Training for Managers

Apart from employees and supervisors, managers must also be made aware of their responsibilities to implement ergonomic principles that ensure the safety and health of all employees. They must also be familiar with the problems and risks associated with all tasks.

Training for Engineers and Maintenance Personnel

On-site engineers and maintenance personnel must also be trained so that they can recommend and implement the best possible machinery, equipment, designs, work practices, and tools to reduce the risk of injury and bodily damage to employees.

Lesson Summary

All supervisors required to administer an ergonomics program should be provided with special training focusing on how to effectively make the workplace safe by adopting sound ergonomic principles and practices. Apart from ergonomic principles, the training must also include the risk potential of damage to the body and injuries that can result from the failure to adopt proper ergonomic practices.

Employers must provide formal training to all employees who could be exposed to hazards to inform them about the hazards associated with their jobs and the tools,

machinery, and equipment they use. New employees and those assigned new tasks must be made aware of the specific risks associated with a particular job before they start their work.

An ergonomics training program must include:

- All employees who are exposed to different risk factors
- Supervisors
- Managers
- All engineers and maintenance personnel

An effective training program includes a mix of both theoretical and practical ways in which employees can develop their skills to work safely. They must manage the amount of time that an employee spends performing a particularly challenging job.

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