Ergonomics Awareness Training
Ergonomics Awareness

Welcome to the Ergonomics Awareness module. The purpose of this module is to explain the importance of ergonomics and the risks that can result when ergonomics principles are not applied to work activities.

Upon completion of this module you will be able to:

- Define the term ergonomics
- Identify workplace physical risk factors
- Identify contributing risk factors
- Understand the difference between physical and contributing risk factors
- Define Work-related Musculoskeletal Disorders (WMSDs)
- Identify WMSD signs and symptoms
- Identify work activities with potential ergonomics risk

This module also includes a list of web-links to key ergonomic resources.
Ergonomics Defined

Ergonomics is the study of how to fit the workplace to the worker. While the use of the term ergonomics has become more common lately, ergonomics is not a new science. The term was actually coined in 1857 by a Polish scholar.

The key points to remember are that ergonomics should:

- Fit the workplace to the worker
- Not fit the worker to the workplace.

Where does the word Ergonomics come from?

Ergonomics is derived from two Greek words Ergon meaning work, and Nomos meaning principles or laws, therefore, ergonomics is the study of work.
Fitting the Worker to the Workplace

Incorrect:
A worker should not have to adjust themselves to accommodate their workplace set up. If a worker must adjust to fit the workplace they become at risk to sustain a work-related musculoskeletal disorder or WMSD.

Example: A worker that is trying to fit into their workplace by adjusting their posture. This worker wears bifocals and must view a monitor through the bottom portion of her glasses which forces her to extend her neck back to view the screen. Prolonged periods in this posture could cause neck and eye strain.

Fitting the Workplace to the Worker

Correct:
To reduce the risk of WMSDs, the workplace should be designed to fit the worker. The worker no longer has to extend their neck back to view the monitor because the monitor has been positioned at the proper sight level, directly in front of the user. This is an example of a workplace that is fit to the worker.
Importance of Ergonomics

The application of ergonomics can:

- Support mission readiness
- Improve health and safety through the reduction of ergonomics risk factors and resulting work-related injuries and disorders
- Improve comfort, morale, productivity, and job satisfaction
- Reduce workers' compensation costs and employee turnover
One Work-related Musculoskeletal Disorder Injury Affects Many People

Injuries affect not only the worker but the people they interact with as well.

For example, a serviceman lifting and carrying a piece of a bridge incurs back strain. Co-workers may have to work harder to compensate for their injured colleague, which may increase their risk of injury. Safety and health personnel must document and investigate the incident, which involves supervisors, administrative assistance, and management. Medical personnel are involved in the diagnosis and treatment of the injury.

The effects can carry over into the serviceman’s career and personal life. Family and friends may have the task of caring for him during his recovery and taking on some of his responsibilities around the home, such as maintaining the yard, fixing the cars, or even coaching little league. The impacts of an injury extend well beyond the worker who experiences the problem.
Injuries – Musculoskeletal Disorders (MSD)

WMSDs are a category of injuries and disorders that deal with the musculoskeletal system. These disorders are not usually caused by acute trauma but instead occur slowly over time due to wear and tear on soft tissues such as:

- Muscles
- Tendons
- Ligaments
- Cartilage
- Nerves

MSDs are preventable but everyone is at risk.
Work-related Musculoskeletal Disorders (WMSDs)

WMSDs are MSDs that are caused or aggravated by work practices and/or environments. WMSDs do not generally result from a single event or accident, but rather are disorders that have developed gradually from chronic workplace and occupational conditions causing repeated trauma.

Common WMSDs include:

- Tendonitis
- Epicondylitis
- Bursitis
- Trigger Finger
- Carpal Tunnel Syndrome
- Herniated Spinal Disc
WMSDsAliases

WMSDs go by other names, including:

- Repetitive Strain or Stress Injury (RSI)
- Repetitive Motion Injury (RMI)
- Cumulative Trauma Disorder (CTD)
- Overuse Syndrome
- Activity Related Pain Syndrome

Some people who have been diagnosed with a disorder such as carpal tunnel syndrome may not know that it is a part of the category of injuries known as WMSDs.
Risk Factors

There are two types of risk factors for developing WMSDs:

**Physical** - the characteristics of the job that place the worker at risk of developing a WMSD, but which usually can be modified.

**Contributing** - the characteristics of the person or job that contribute to, but do not cause, WMSDs and which usually can not be changed. Contributing risk factors are frequently difficult to control.
Physical Risk Factors

Physical workplace risk factors can cause WMSDs to develop. The risk factors must occur in combination to present a risk of WMSDs and they typically magnify each other as a result.

There are six common physical risk factors:

- Compression or Contact Stress
- Position or Posture
  - Non-neutral
  - Static
- Vibration
  - Whole body
  - Hand-Arm
- Force
- Repetition
- Duration
Compression or Contact Stress

Compression occurs when an object presses on soft tissue. This concentration of force on small areas reduces blood flow and nerve transmission and can damage the soft tissue.

Compression occurs from:

- Leaning or pressing against hard edges, sharp surfaces, corners
- Supporting excessive weight
- Gripping tools

Ergo Tip - As a rule of thumb, jewelry should be loose fitting and not cause an impression on the skin. This will reduce exposure to contact stress.
Neutral Posture vs. Non-neutral Posture

Posture or position dictates how hard the body works.

Neutral posture - a posture that maximizes strength, speed, endurance, and comfort while decreasing the risk of WMSDs.

Non-neutral posture - an awkward or unsupported position that stretches the physical limits and which can cause muscle fatigue, micro-trauma to tendons or ligaments, and compress or elongate soft tissues such as nerves.
Working Neutral Standing Posture

Neutral posture is the position where the least tension or pressure on nerves, tendons, muscles and bones occurs. It is also the position where muscles are at their resting length, neither contracted nor stretched.

Neutral standing posture can be recognized by the following body landmarks:

- Ears over shoulders
- Shoulders over hips
- Hips over knees
- Knees over ankles, knees relaxed (not locked)
- Elbows close to the body, bent at a 90-110 degree angle

Even in bulky clothing and PPE you should still be able to see these body landmarks.
Working Neutral Sitting Posture

You can recognize neutral posture at a computer workstation by looking for key body landmarks.

- Hands, wrists, and forearms are straight, in-line, and roughly parallel to the floor.
- Head is level or bent slightly forward, forward facing, and balanced. Generally the head is in-line with the torso.
- Shoulders are relaxed and upper arms hang normally at the side of the body.
- Elbows are in close to the body and are bent between 90 and 120 degrees.
- Feet are fully supported by the floor or a footrest.
- Back is fully supported with appropriate lumbar support when sitting vertically or leaning back slightly.
- Thighs and hips are supported by a well-padded seat and are generally parallel to the floor.
- Knees are about the same height as the hips with the feet slightly forward.
**Static Posture**

Holding a posture for extended periods of time is known as a static posture.

Static postures prevent the flow of blood which brings nutrients to the muscles and carries away waste products. Holding a muscle in contraction causes waste products to build up and can lead to fatigue and discomfort.
Vibration

Vibration is another type of physical risk factor. A simple definition of vibration is rapid movement back and forth; however, vibration involves the exposure to movement against the body from all directions. Vibration occurs in two forms:

- Whole body
- Hand-Arm
**Whole Body Vibration**

Whole body vibration is caused by standing or sitting on vibrating surfaces, which in turn causes muscle contractions and fatigue. The vibration works its way through the body and results in muscle fatigue and contractions.

High or prolonged exposure to whole body vibration can affect the skeletal muscles and digestive system and cause lower back disorders.

An example of workers who experience this type of vibration are heavy vehicle operators who are exposed to whole body vibration when they drive.
Hand-Arm Vibration

Hand-arm vibration is usually caused when a worker holds a vibrating hand tool for a long period of time. This action causes reduced blood flow to the fingers and can lead to blanching of the fingers or Raynaud’s Syndrome. Cold weather is a contributing factor to vibration-related WMSDs.

Some of the WMSDs associated with hand-arm vibration are:
  • Reynaud’s Syndrome
  • Vibration-induced white finger
  • Carpal Tunnel Syndrome

What are some examples of tools that contribute to hand-arm vibration?

A chain saw, jack hammer, impact wrench, saws-all, needle gun, riveter, chipping hammers, soil compactor, pavement breaker, floor buffer are all considered percussion types of tools which typically produce high levels of vibration. A jig saw, grinder, and sander usually cause moderate vibration.
Force

Force is the use of power or exertion to move, direct, or operate equipment. The less force required to operate equipment the less traumatic it is to the body. Excessive force exertion may cause the muscles to meet or exceed their maximum capability, resulting in possible fatigue or injury. Repeated muscle trauma can result in damage or injury.
High Force Examples

High force risk factors can occur while lifting, carrying, pushing, pinching and gripping. Posture and position are important in considering high force risks.

The power zone for lifting with the greatest strength and lowest risk of injury is close to the body between thigh and shoulder height. And, it is important to note that lifting even a 20 lb weight one hundred times a day in a non-neutral posture may pose a high force risk.

The following guidelines are from the MIL Standard 1472F.

- Lifting and Carrying Limits
- Pushing and Pulling Limits
- High Hand Forces Pinching and Gripping Limits

<table>
<thead>
<tr>
<th>Adjustments need to be made for one-handed, multi-person, obstacles, object size, object balance and frequently</th>
<th>Male and Female Teams</th>
<th>Male Only Teams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lift an object from the floor and place it on a surface not greater than 5 ft above the floor</td>
<td>37 lb (74)</td>
<td>56 lb (112)</td>
</tr>
<tr>
<td>not greater than 3 ft above the floor</td>
<td>44 lb (84)</td>
<td>87 lb (174)</td>
</tr>
<tr>
<td>Carry an object 10 m (33 ft) or less</td>
<td>42 lb (84)</td>
<td>82 lb (164)</td>
</tr>
</tbody>
</table>

Note: Values doubled for two people in italics where object weight is evenly distributed
Repetition

The physical risk factor repetition is defined as performing the same motion or group of motions excessively, for example:

- Repeating the same motion every few seconds
- Repeating a cycle of motions involving the same body parts/muscle groups
- Using a tool or device in a steady manner

Repetition usually occurs in conjunction with other risk factors. It is important to note that if you change the job but still use the same muscle group you are not doing anything different. Repetition is often seen in tasks such as assembly, typing, operating machinery, or loading and unloading a vehicle.

What is an example of using the same muscle groups for different tasks?

Typing and using a calculator are different tasks yet they use the same muscle groups and create the same stress.
**Duration**

How long a task is performed or how frequently the same muscle groups are used in a day contributes to the risk factor known as duration. Duration is defined as the time period that an action continues or lasts. Continuous use does not allow muscles time to recover and in turn magnifies other risk factors.

The key point to remember is that the longer the duration the greater the exposure and the greater the risk.

Taking breaks, reducing the amount of time spent on similar tasks, and alternating between jobs that use different actions can help reduce duration exposure.
Physical Risk Factors Review

Physical risk factors have to occur in combination to pose a risk.

Physical risk factors include:
- Compression
- Non-neutral, awkward or static posture
- Vibration
- High forces
- Repetition
- Duration

By applying ergonomics principles to tasks, jobs and work environment, physical risk factors can usually be modified or reduced.

Next you will learn about factors that generally cannot be modified or reduced: contributing risk factors.
Contributing Risk Factors

In addition to the six physical risk factors, there are three important contributing risk factors.

Contributing factors can contribute to, but do not cause, WMMSDs. For example, temperature and humidity affect the worker performing repetitive work. When it is too hot and too humid, workers fatigue more quickly and become more susceptible to injury. Contributing risk factors are generally harder to control than physical risk factors.

Contributing risk factors include:

- Temperature
- Inadequate Recovery
- Personal Risk Factors
Temperature

Temperature is a known contributing risk factor. Working in cold environments places a greater aerobic demand on the worker which means they fatigue faster.

Cold
Cold temperatures impair blood flow in the extremities reducing tactile sensation, muscle strength and dexterity. Cold makes gripping harder, therefore more muscle force must be applied increasing the likelihood of injury. Cold temperatures can increase the risk of injury from vibration exposure.

Heat
Prolonged work in hot environments can result in fatigue and a variety of heat related illnesses. Wearing PPE may increase the risk of suffering heat related illnesses.
Inadequate Recovery

Inadequate muscle recovery is a contributing risk factor as working without rest can cause fatigue and contribute to injury. Working the same muscles without rest may result in injury.

Muscles need blood flow to supply nutrients and oxygen, and to carry away the waste products of muscle metabolism. Without sufficient muscle recovery, lactic acid can build up in the muscle. Inadequate muscle recovery can lead to fatigue and discomfort as well as possible injury.

Stretching, using alternative muscle groups, and taking short breaks can aid in recovery and help prevent fatigue.
Risk Factors

Personal Risk Factors

Personal factors also contribute to WMSDs, which is one of the reasons why it cannot be predicted who will suffer a WMSD, because factors other than those in the workplace contribute to risk.

Personal risk factors do not cause WMSDs but are contributing risk factors. Some examples include:

- Age
- Gender
- Hobbies
- Previous injuries
- Physical condition
- Medical conditions
- Pregnancy
- Medications
- Smoking
- Fatigue
- Weight management
- Stress management
- Blood Pressure
- Nutrition
Signs and Symptoms of WMSD

Early detection is key to preventing WMSDs, therefore, seek medical attention if you are experiencing any of the signs or symptoms listed here.

Signs and symptoms of WMSDs include:

- Painful aching joints or muscles
- Pain, tingling, or numbness
- Fingers or toes turning white
- Shooting or stabbing pains
- Swelling or inflammation
- Stiffness or difficulty moving
- Burning sensation
- Pain during the night
- Loss of strength and mobility
Summary

The key points to remember about ergonomics are that:

- Ergonomics is defined as fitting the work to the worker
- Physical risk factors that can cause WMSDs are: force, posture, duration, repetition, vibration, and compression
- Contributing risk factors, such as temperature and personal factors can contribute to, but do not cause, WMSDs
- Physical risk factors can be eliminated or reduced in the work place whereas contributing risk factors typically can not be changed
- Work-related Musculoskeletal Disorders (WMSDs) are MSDs that are caused by or aggravated by work practices and/or environments
- WMSD signs and symptoms include pain, tingling, or numbness
Resources

Three important resources that provide ergonomics assistance are:

- **DoD Ergonomics Working Group** - ergonomic tools, resources, guides, reports, best practices, ErgoNews.
- **National Institute for Occupational Safety and Health (NIOSH)** - free documents including Elements of Ergonomics Programs.
- **Occupational Safety and Health Administration (OSHA)** – is the main federal agency charged with the enforcement of safety and health legislation. OSHA provides standards, publications, posters and other resources.

An additional source of information is:

- **Computer/Electronic Accommodations Program (CAP)** – provides assistive technology and accommodation services to persons with disabilities in the Department of Defense (DoD), at no cost to individual activities.
For more information or to contact the NPS Safety Office
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http://my.nps.edu/web/safety/
or ESAMS via: