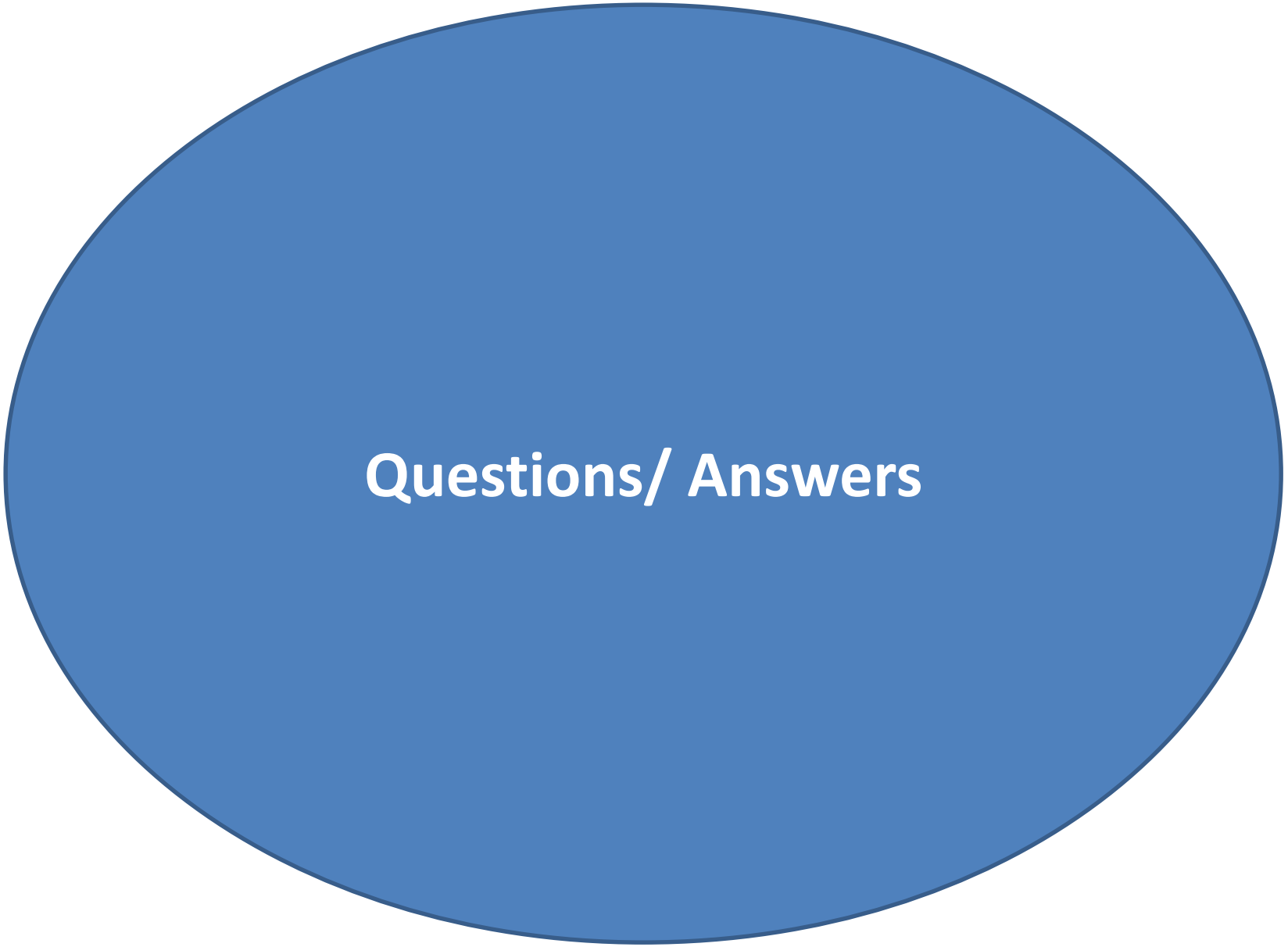
Epidemiology and Prevention of Musculoskeletal Disorder

Dr Salma

C Med

What's Wrong Here?


Questions/ Answers

Workplace Ergonomics.mp4

Learning outcomes

- Describe work related MSD
- Identify risk factors of MSD at workplace.
- Describe the preventive measure for different type risk factors for MSD
- Explain the burden\ epidemiology of Musculoskeletal Disorders
- Discuses prevention strategies and safety guidelines in order to reduce the incidence of MSDs related to work place
- Describe the application of ergonomic in the prevention of work related MSD

A lady stretching her neck and back after prolonged static posture

What is Niosh?

- The National Institute for Occupational Safety and Health

It is the United States federal agency responsible for :

- Conducting research and
- Making recommendations for the prevention of work-related injury and illness.

Workers Rights under the OSHA Act

- **What is OSHA?**

OSHA is a federal agency of the United States government, part of the Department of Labor.

• It was created in 1970 by the Occupational Safety and Health Act (also known as the ―OSH A Act‖) with the purpose of assuring safe and healthy working conditions for all workers.

• This agency is responsible for workplace health and safety in the United States.

• Before this law existed, there were no national laws on workplace health and safety.

OSHA's Mission?

- OSHA's mission is to prevent accidents and protect the health of workers.

Its functions include—

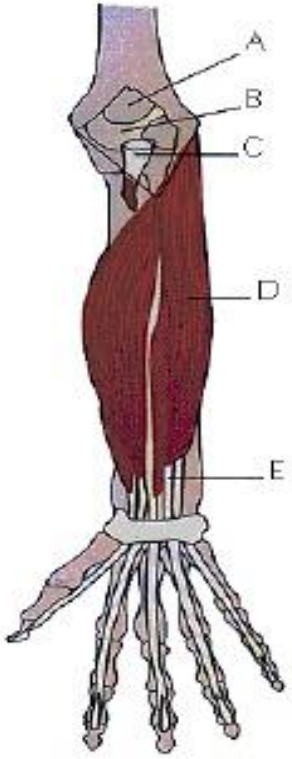
- Developing rules on workplace health and safety and enforcing these rules through workplace inspections.
- Tracking workplace accidents.
- Giving trainings on workplace health and safety

Work-Related Musculoskeletal Disorders

- MSDs are defined as injuries to muscles, tendons, ligaments, joints, nerves and discs that are caused or aggravated by our actions and/or environment that does not follow safe and healthy work practices.
- include only disorders that develop gradually and are caused by the overuse of the components of the musculoskeletal system.
- The traumatic injuries of the muscles, tendons and nerves due to accidents or injuries caused by slips, falls, or other similar accidents are not considered to be WMSDs or are considered separately.

Musculoskeletal Disorders

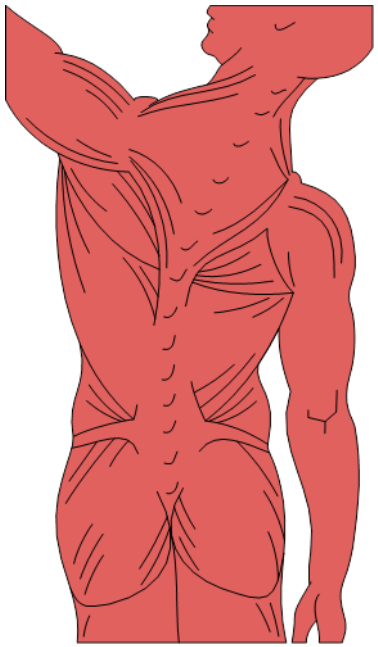
- An MSD is an injury or illness of
  - Muscles
  - Nerves
  - Tendons
  - Ligaments
  - Joints
  - Cartilage
  - Spinal Discs



A - articular capsule
B - ligament
C - tendon (section view)
D - muscle
E - tendons

Common Body Parts Prone To Workplace MSDs

- Back - Lower
- Neck and Upper Back
- Upper Extremities - Arms and Hands
- Lower Extremities - Legs and Feet



Risk factors of MSD

- WMSDs arise from arm and hand movements such as bending, straightening, gripping, holding, twisting, clenching and reaching. These common movements are not particularly harmful in the ordinary activities of daily life.
- What makes them hazardous in work situations is the continual repetition, often in a forceful manner, and most of all, the speed of the movements and the lack of time for recovery between them.

WMSDs are associated with work patterns that include:

- Fixed or unnatural body positions.
- Continual repetition of movements.
- Force concentrated on small parts of the body, such as the hand or wrist.
- A pace of work that does not allow sufficient recovery between movements.

Generally, none of these factors acts separately to cause WMSD.

WMSDs commonly occur as a result of a combination and interaction among them.

- Heat, cold and vibration also contribute to the development of WMSD.

What are the risk factors for WRMSDs?

- Work-related (ergonomic) risk factors :primary and secondary mean environmental
- Individual-related risk factors.

WRMSDs commonly occur as a result of a combination of risk factors and interaction among them.

Risk factors dependent upon:

- Work positions and postures
- How often task is performed
- Level of required effort
- Duration of task

1. Ergonomic risk factors

A. Primary risk factors

1. High task repetition.

- Performing the same motion or series of motions repetitively or frequently for an extended period of time.
- Injury may result from repetition when the tissues do not have adequate time to recover.
- According to OSHA Ergonomic Guides:

A job is considered highly repetitive if the cycle time is 30 seconds or less.

Example: the bottle packing operation requires workers to pack boxes with **twenty-four** bottles.

One cycle:

- Reach for bottles.
- Grasp bottles.
- Move bottles to box.
- Place bottles in box.
- If a worker grasps 4 bottles each time
- The same cycle would have to be repeated 6 times to fill a box.
- If one cycle lasts two seconds
- It would take 12 seconds to pack a box with 24 bottles.

2. Exerting excessive force:

With excessive force the muscles are contracting much harder than normal

- This can lead to stress on the muscles, tendons and joints.

Examples:

- Lifting heavy objects
- Pushing or pulling heavy loads
- Maintaining control of equipment or tools.
- NIOSH lifting standard: 23kg maximum lift

3. Repetitive or sustained awkward postures.

- e.g. bent neck, back, wrists, arms above the head etc.
- Place excessive force on joints and overload the muscles and tendons around the effected joint.

Lifting objects - hazards

– Heavy, frequent, and awkward lifting

The load on the low back when lifting something heavy can strain the muscles and damage the disks in spine. The load can strain the muscles in the shoulders and upper back as well.

Source of graphics: OSHA

Examples:

- Prolonged or repetitive reaching above shoulder height
- Kneeling, squatting, leaning over a counter
- Using a knife with wrists bent
- Twisting the Upper body while lifting.

Guidelines: Duty Cycle = % repetition /day
30 cycles per minute or 2 hours/day

Awkward body postures - hazards

– Working with the neck or back bent forward more than 30° for more than 2 hours per day

Source of graphics: OSHA

Awkward body postures - hazards

– Squatting for more than 2 hours per day

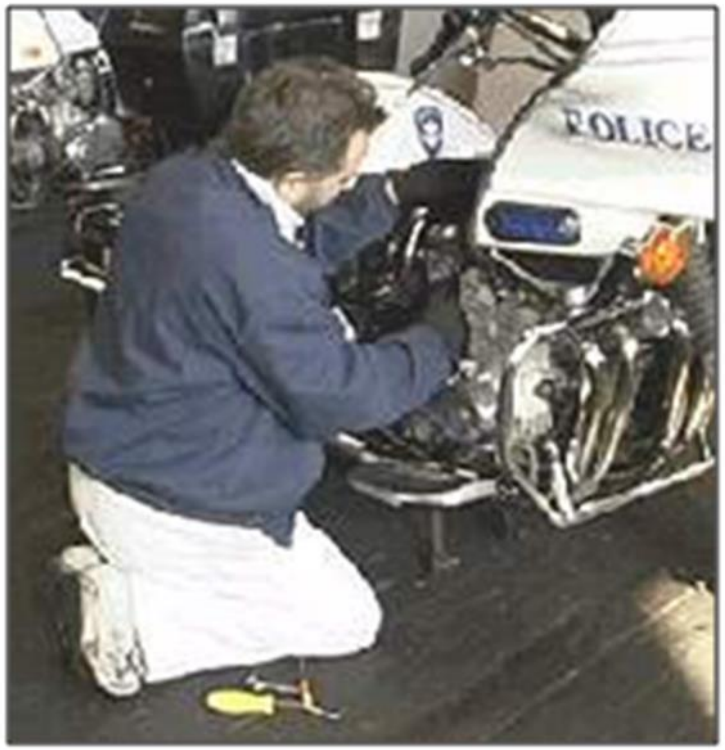
If the location of your work is too low, you're going to have to get into an awkward posture to get to it.

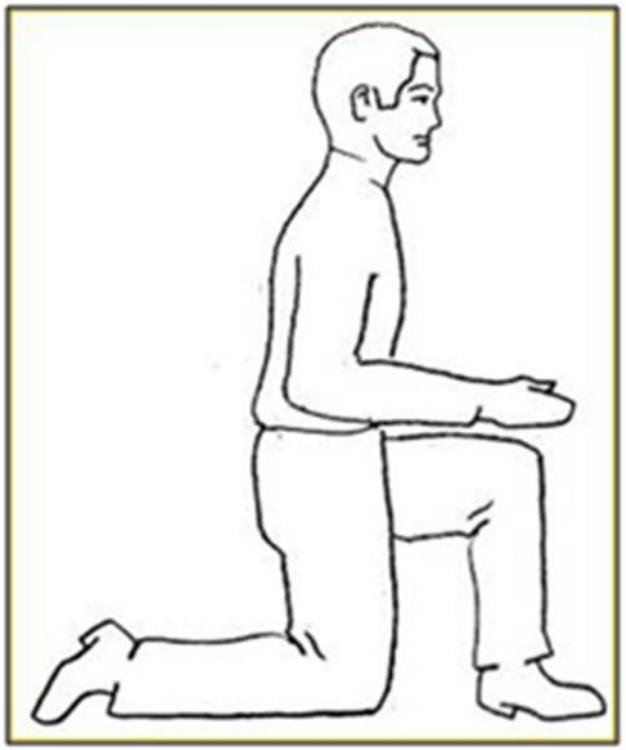
Source of graphics: OSHA

It creates a lot of pressure behind the knee cap

Awkward body postures - hazards

– Kneeling for more than 2 hours per day





Source: OSHA

It creates pressure both in front of and behind the knee cap. and can cause knee injuries over time.

4.Static Posture

- Muscles will become fatigued from a lack of blood flow during a static posture.

Examples:

- Welding,
- Microscope work
- Dental hygienists

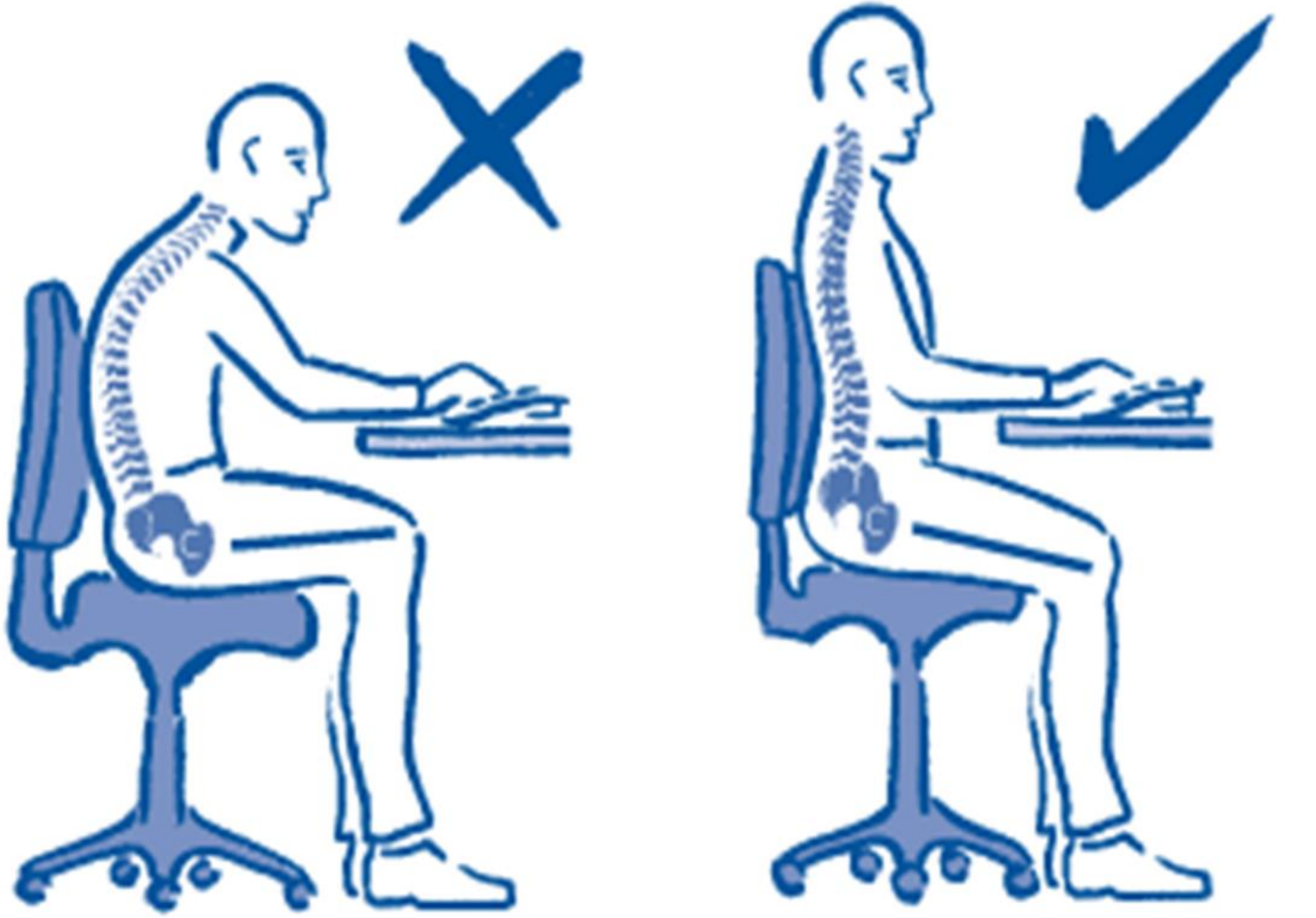
Static Posture

5. Contact Stress/Localized pressure into the body part

- Caused by any sharp or
- Hard object putting localized pressure on a
- Part of the body.
- It will irritate local tissues and
- Interfere with circulation and
- Nerve function.

Examples:

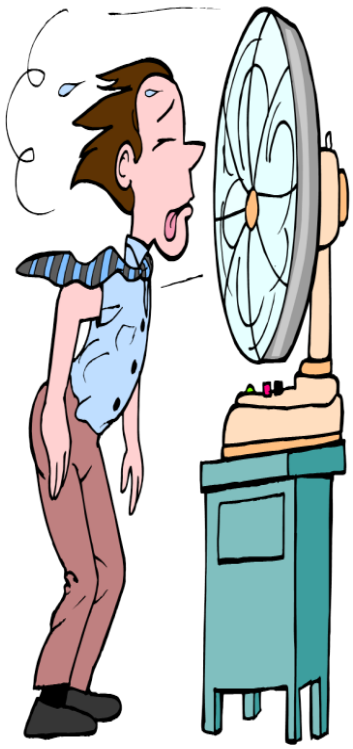
- When a wrist rests on the edge of a desk while typing
- When elbows lean against a hard armrest
- When sitting in a chair that places pressure on the back of a worker's thighs.



Poor Working Posture

Correct Working Posture

B. Environmental Ergonomic Risk Factors (Secondary risk factors)



Extreme cold: Constricts blood vessels and

- Reduces sensitivity and
- Coordination of body parts.

Excessive heat:

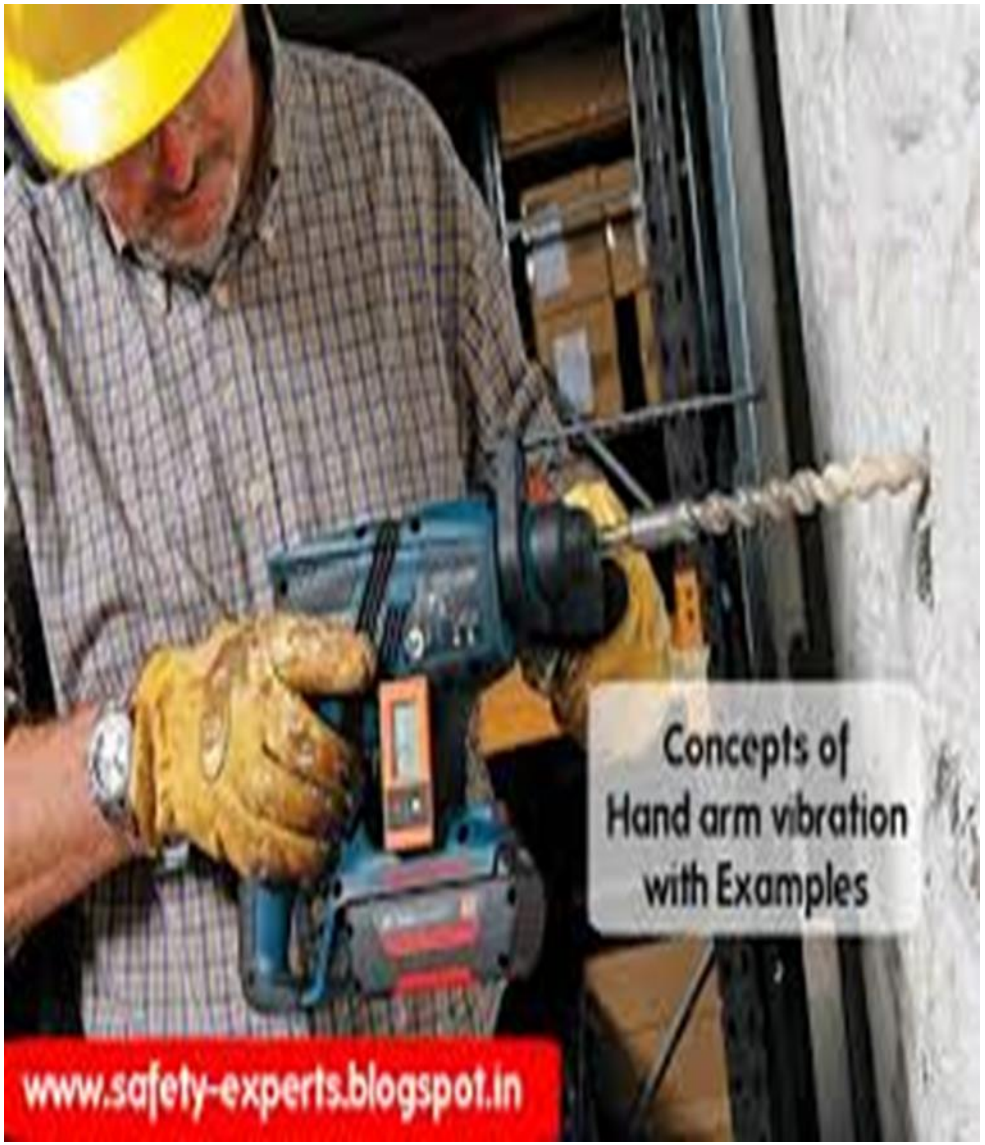
- Increased fatigue and
- Heat stress
- **Environmental conditions such as extreme heat or cold can place stress on tissues**

2. Vibration

- Whole body and hand-arm vibration
- **Hand-arm vibration:**
- Can damage small capillaries and
- Can make hand tools more difficult to control.
- It may also cause a worker to lose feeling in the hands and arms resulting in increased force exertion to control hand-powered tools

Vibration hazards Examples:

- Hammer drills,
- Portable grinders
- Chainsaws



3.Noise

- Increased muscle tension
- Quicker onset of fatigue
- Mental stress
- Reduced concentration
- Diverted attention

4. Light

- **Too little or too much light**

  may lead to:
- Awkward postures

- Muscle fatigue

- Eye strain

- Mental fatigue

5. Psycho-social Issues

- Stress, boredom, job dissatisfaction and anxiety
- Can create increased muscle tension and
- Reduce a person's awareness of work technique.

2. Individual-related Risk Factors

1.Poor overall health habits:

- Workers who smoke, drink excessively, and obese etc

2. **Poor nutrition**, fitness and hydration.

3. **Poor work practices**.

- Poor work practices create unnecessary stress on body
- Increases fatigue and
- Decreases their body's ability to properly recover.

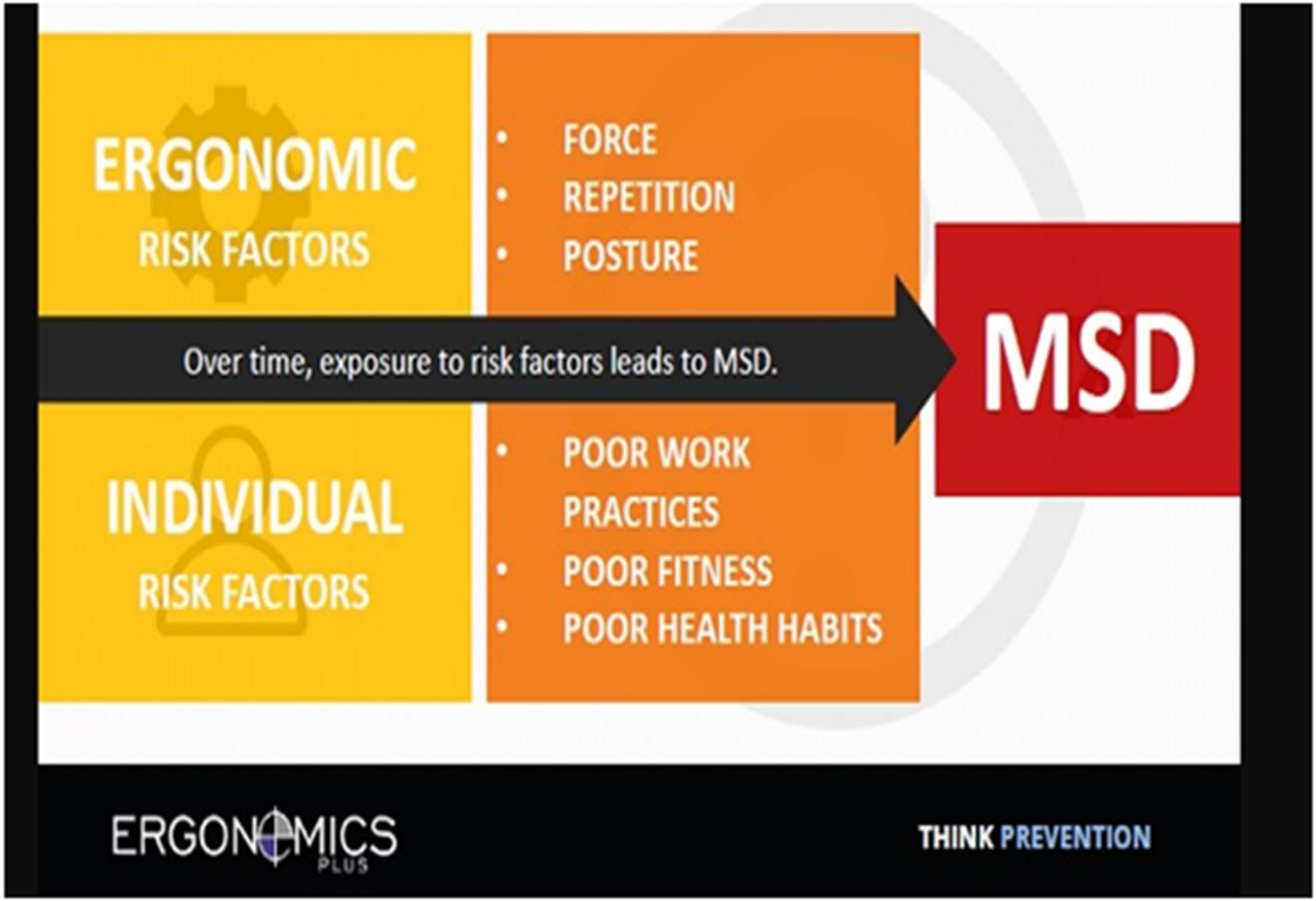
3. Poor work practices. Examples

- Heavy lifting from above the shoulders
- Heavy lifting from below the knees.
- Twisting while lifting/carrying.
- Bending over at the waist.
- → → → → → → → → →
- Carrying objects to one side
- Can cause back injuries

3. Poor work practices.

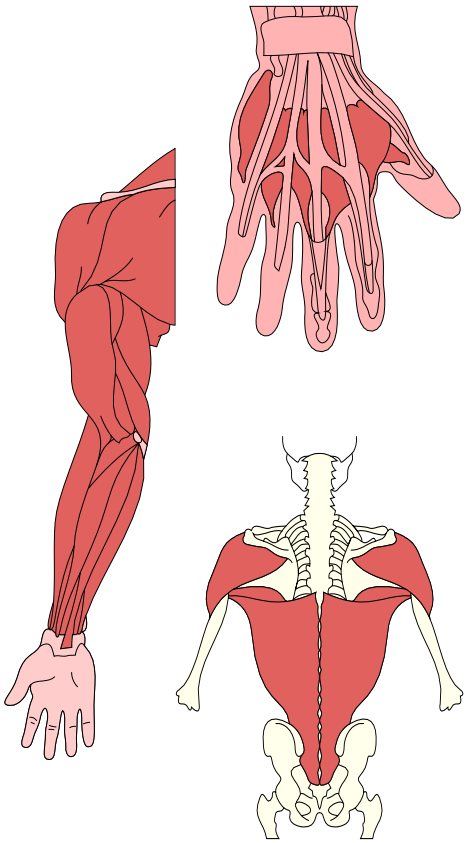
- Leaning the side of the elbow on a hard surface.
- Carrying heavy loads on the shoulder.
- Long periods of kneeling.
- Exposure to these individual risk factors puts workers at a higher level of MSD risk.

The Cause of Musculoskeletal Disorders – Exposure to Risk Factors



Examples of WRMSDs

- Back strain/disability
- Carpal Tunnel Syndrome
- Tendonitis
- Tension Neck Syndrome
- Thoracic Outlet Compression
- Rotator Cuff Tendonitis
- Epicondylitis
- Radial Tunnel Syndrome
- Digital Neuritis
- Mechanical Back Syndrome
- Degenerative Disc Disease
- Ruptured / Herniated Disc



Symptoms of MSDs

- Pain
- Weakness
- Stiffness
- Sensitivity
- Swelling
- Burning sensation
- Tingling
- Drowsiness
- Difficulty in moving

Occupational risk factors and symptoms of the most common disorders of the upper body associated with WMSDs.

Disorders	Occupational risk factors	Symptoms
Tendonitis/tenosynovitis	Repetitive wrist motions Repetitive shoulder motions Sustained hyper extension of arms Prolonged load on shoulders	Pain, weakness, swelling, burning sensation or dull ache over affected area
Epicondylitis (elbow tendonitis)	Repeated or forceful rotation of the forearm and bending of the wrist at the same time	Same symptoms as tendonitis
Carpal tunnel syndrome	Repetitive wrist motions	Pain, numbness, tingling, burning sensations, wasting of muscles at base of thumb, dry palm

Disorders	Occupational risk factors	Symptoms
Thoracic outlet syndrome	Prolonged shoulder flexion Extending arms above shoulder height Carrying loads on the shoulder	Pain, numbness, swelling of the hands
Tension neck syndrome	Prolonged restricted posture	Pain
DeQuervain's disease	Repetitive hand twisting and forceful gripping	Pain at the base of thumb

EPIDEMIOLOGY of WRMSDs by WHO

- Approximately 1.71 billion people have musculoskeletal conditions worldwide.
- Among musculoskeletal disorders, low back pain causes the highest burden with a prevalence of 568 million people.
- Musculoskeletal conditions are the leading contributor to disability worldwide, with low back pain being the single leading cause of disability in 160 countries.

- Musculoskeletal conditions are also the biggest contributor to years lived with disability (YLDs) worldwide with approximately 149 million YLDS, accounting for 17% of all YLDs worldwide.
- Other contributors to the overall burden of musculoskeletal conditions include fractures with 436 million people globally, osteoarthritis (343 million), other injuries (305 million), neck pain (222 million), amputations (175 million) and rheumatoid arthritis (14 million) .

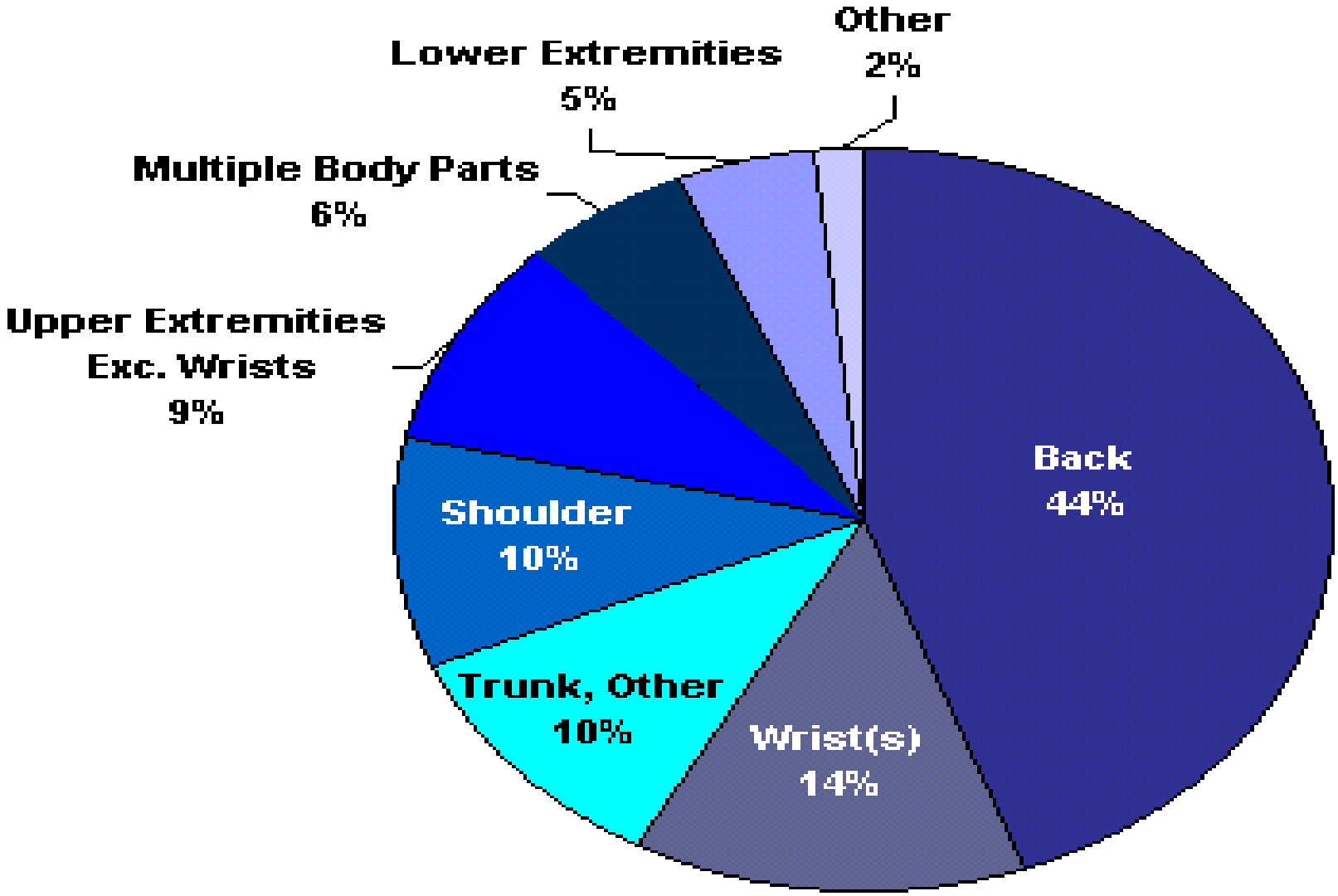
- Musculoskeletal conditions significantly limit mobility and skill, leading to early retirement from work, lower levels of well-being and reduced ability to participate in society.
- High-Income countries are the most affected - 441 million, followed by countries in the WHO Western Pacific Region with 427 million and South-East Asia Region with 369 million

8 February 2021 WHO

- Prevalence of musculoskeletal conditions increases with age, younger people are also affected, often during their peak income-earning years.
- Low back pain, for example, is the main reason for a premature exit out of the workforce. The societal impact of early retirement in terms of direct health-care costs and indirect (i.e., work absenteeism or productivity loss) costs is huge.

- Musculoskeletal conditions are also highly associated with significant mental health decline and deteriorated functioning.
- Projections show that the number of people with low back pain will increase in the future, and even more rapidly in low-income and middle-income countries .

Figure 1. MSD claims by body part, Oregon, 1996-2000



How are WMSDs Diagnosed

Diagnosis of WMSDs is confirmed by:

- Laboratory and electronic tests that determine nerve or muscle damage.
- Magnetic resonance imaging (MRI)

Treatment

- Avoid the activities causing the injury .
- Applying heat or cold to relieve pain and may accelerate the repair process.
- Exercise: Stretching to promotes circulation and reduces muscle tension.
- Medication: Anti-inflammatory drugs to reduce pain and inflammation
- Surgery if all other approaches fail.

Preventive Measure for Different Type Risk Factors for MSD at work place

1. **Identify the Causes**: implement policies that address the specific risk factors causing MSDs. eg frequent application of excessive force, such as when lifting heavy equipment. **use equipment that eases** the task of lifting bulky machines. Items like wheeled vehicles and trollies take the hard work out of lifting and moving the equipment.

2. Scheduling Breaks: the benefit of doing this is that it interrupts the extensive periods of repetitive or uninteresting workloads and periods, which increase risk of MSDs.

3. Education and Training: by providing your staff with the necessary knowledge, they'll be able to better exercise caution and avoid work-related risks on their own.

4.Provide an Active Environment:

the effectiveness of exercise in reducing work-related musculoskeletal disorders.

5. Advocate for Early Reporting

Employers should also encourage their workers to report cases of musculoskeletal disorders early.

6.Implement Organizational Changes to Eliminate Repetitive Tasks:

- Shortened Job rotation:This means that the workers rotate between workstations or duties at shorter intervals, hence reducing exposure to the repetitive nature of the job.

- Job diversification – this demands training your employees to perform an range of tasks that may be related or unrelated to their specific skill sets. Job diversification gives your workers opportunities to take part in non-repetitive tasks, which don’t carry any risk of MSDs.

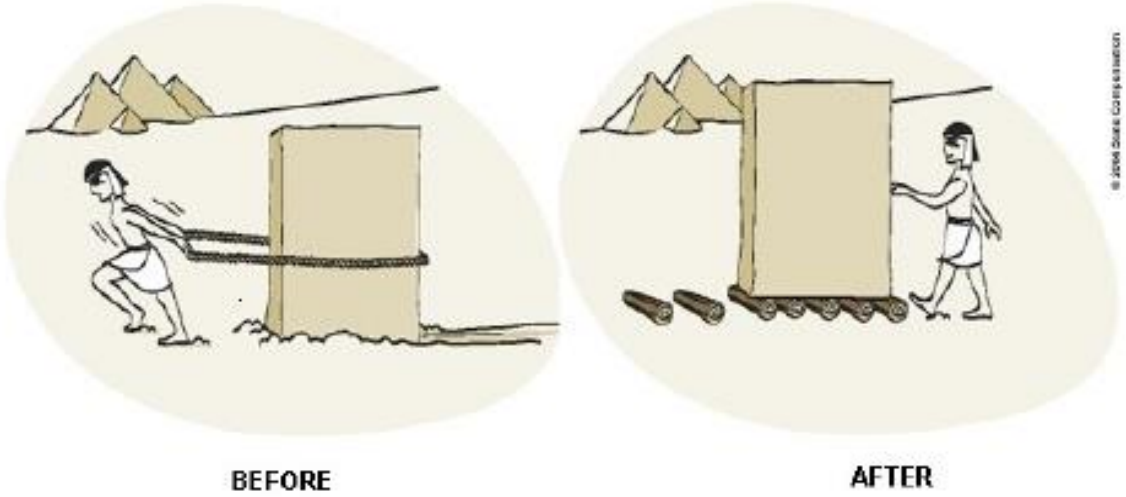
History

- As early as 18th century doctors noted that workers who required to maintain body positions for long periods of time developed musculoskeletal problems.

- Within last 20 years research has clearly established connections between certain job tasks and MSD.

Ergonomics Defined

- Early 1700's, Ramazzini's study of ill-effects of poor posture & poorly designed tools on the health of workers



BEFORE AFTER

Greek Words	"Ergon = work, Nomikos = law"
Ergonomics	Study of Work Laws

- The word ergonomics comes from the Greek word “ergon” which means work and “nomos” which means laws. It’s essentially the “laws of work” or “science of work”.
- Good ergonomic design removes incompatibilities between the work and the worker and creates the optimal work environment.

- The goal is to eliminate discomfort and risk of injury due to work.

- Ergonomics is the science of fitting jobs to workers instead of trying to get the worker to fit the job. It focuses on designing workstations, tools & work tasks for safety, efficiency and comfort.
- Ergonomics seeks to decrease fatigue and injuries, along with increasing comfort, productivity, job satisfaction and safety, because work injuries are not inevitable and a well-designed job should not hurt you.

- Ergonomics is important because when you’re doing a job and your body is stressed by an awkward posture, extreme temperature, or repeated movement your musculoskeletal system is affected. Your body may begin to have symptoms such as fatigue, discomfort, and pain, which can be the first signs of a musculoskeletal disorder.

Application of Ergonomic in the Prevention of work related MSD

Principles of Ergonomic

1. Work in neutral postures

- Proper posture maintenance is necessary
- Working too long with “C” curve can cause strain
- Keeping the proper alignment of neck hands wrist are also necessary

Principles Of Ergonomics

- **Maintain the ‘S’ curve**

2. Reduce excessive force

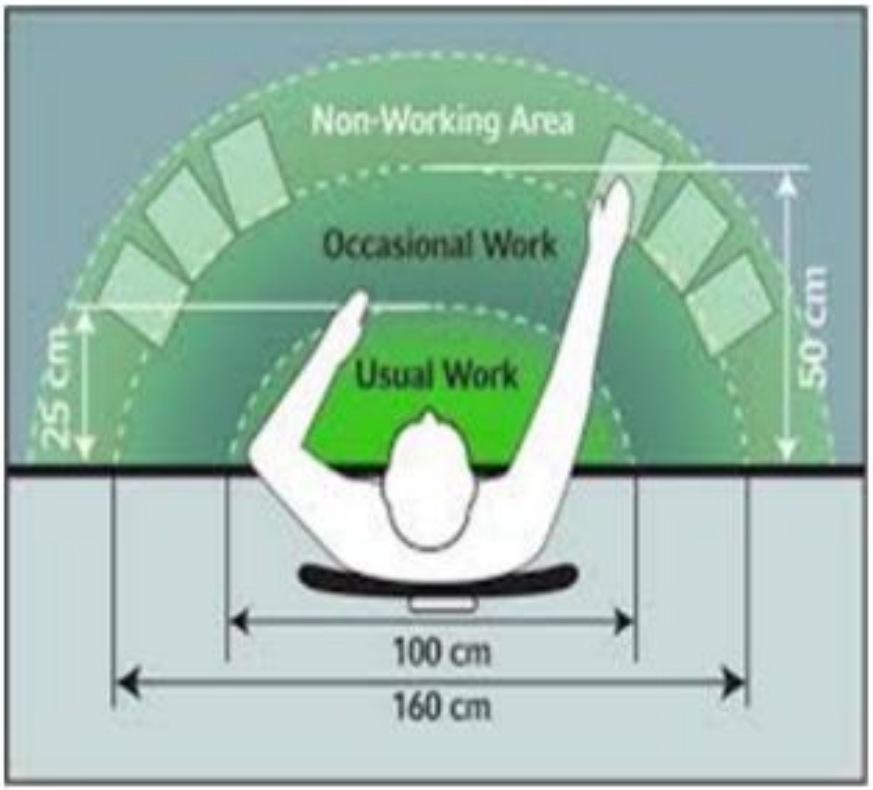
- Excessive pressure or force at the joints can cause injury
- Better to minimize the work that requires more physical labor

3. Keep everything in reach

- Keeping everything in reach would help in avoiding unneeded stretching and strain

Principles Of Ergonomics

- Keep everything in easy reach



4. Work at proper height

- Working at right makes things way easier
- Sometimes height can be maintained by adding extensions or avoiding extensions on the chair or tables

5. Reduce excessive motions

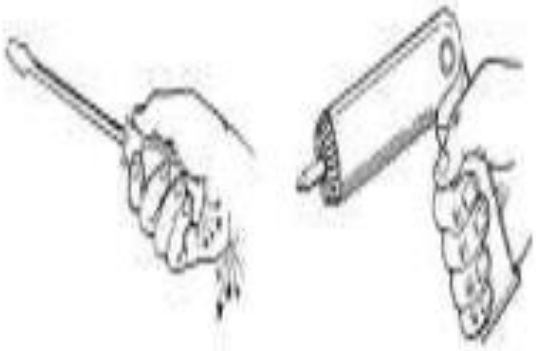
- Repetitive motion needs to be avoided
- This can cause disorder and numbness in long run
- Motion scan be reduced by the use of power tools

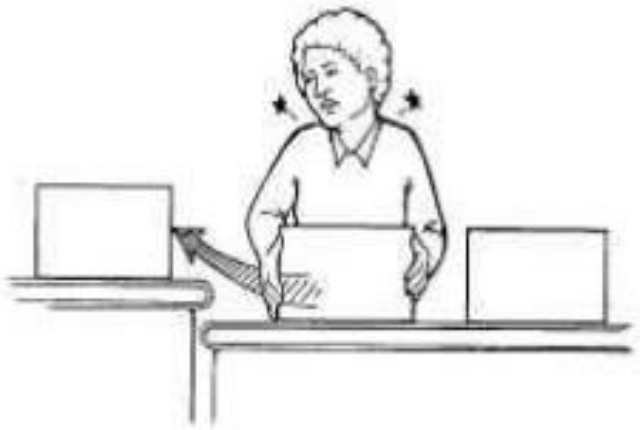
Principles Of Ergonomics

- **Reduce excessive force**

Principles Of Ergonomics

- **Reduce excessive motion**

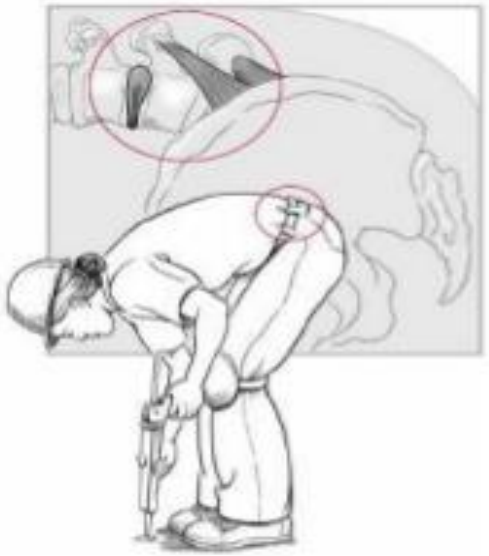


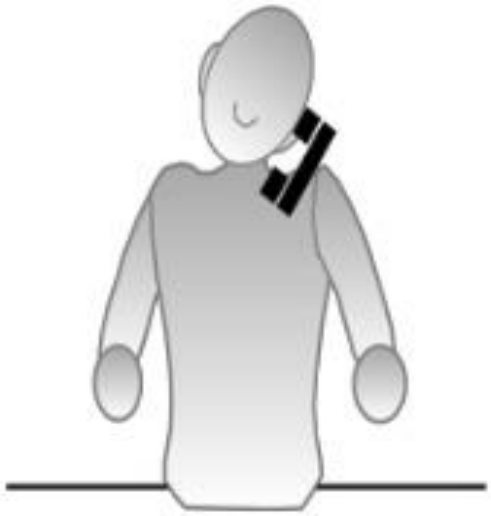


- **6. Minimize fatigue and static load**
- Fatigue is common in energetic work
- Having to hold things for longer period is example of static load
- Fatigue can be reduced by the intervals and the breaks between the works.
- **7. Minimize pressure points**
- One needs to be aware of pressure points
- Almost everyone has to sit on chairs that had cushioning. Pressure point is also created in between your thigh and the bottom of a table when you sit.
- Anti-fatigue mats or insole can be used

Principles Of Ergonomics

- **Minimize static and fatigue load**





8. Provide clearance

- Work area should have enough clearance

9. Move, exercise and stretch

- Move and stretch when you can
- It better to take intervals between the works and stretch and move along
- Stretching technique may differ and depend on the work one does

10. Maintain a comfortable environment

- This principle is focused on the other component of the working environment.
- It is concerned about the lightening, space, cool air and many more.

Principles Of Ergonomics

- **Move, stretch and exercise**

Importance of Ergonomics at work place

- **Increases productivity**

- Best ergonomic solution enhances the productivity
- Ergonomic reduces the unwanted tension, awkward position of the body.
- Ergonomic is focused in making the work your easier and comfortable, this thereby reduces any kind of stress, risk and enhances the satisfaction and productivity.

Reduces the cost

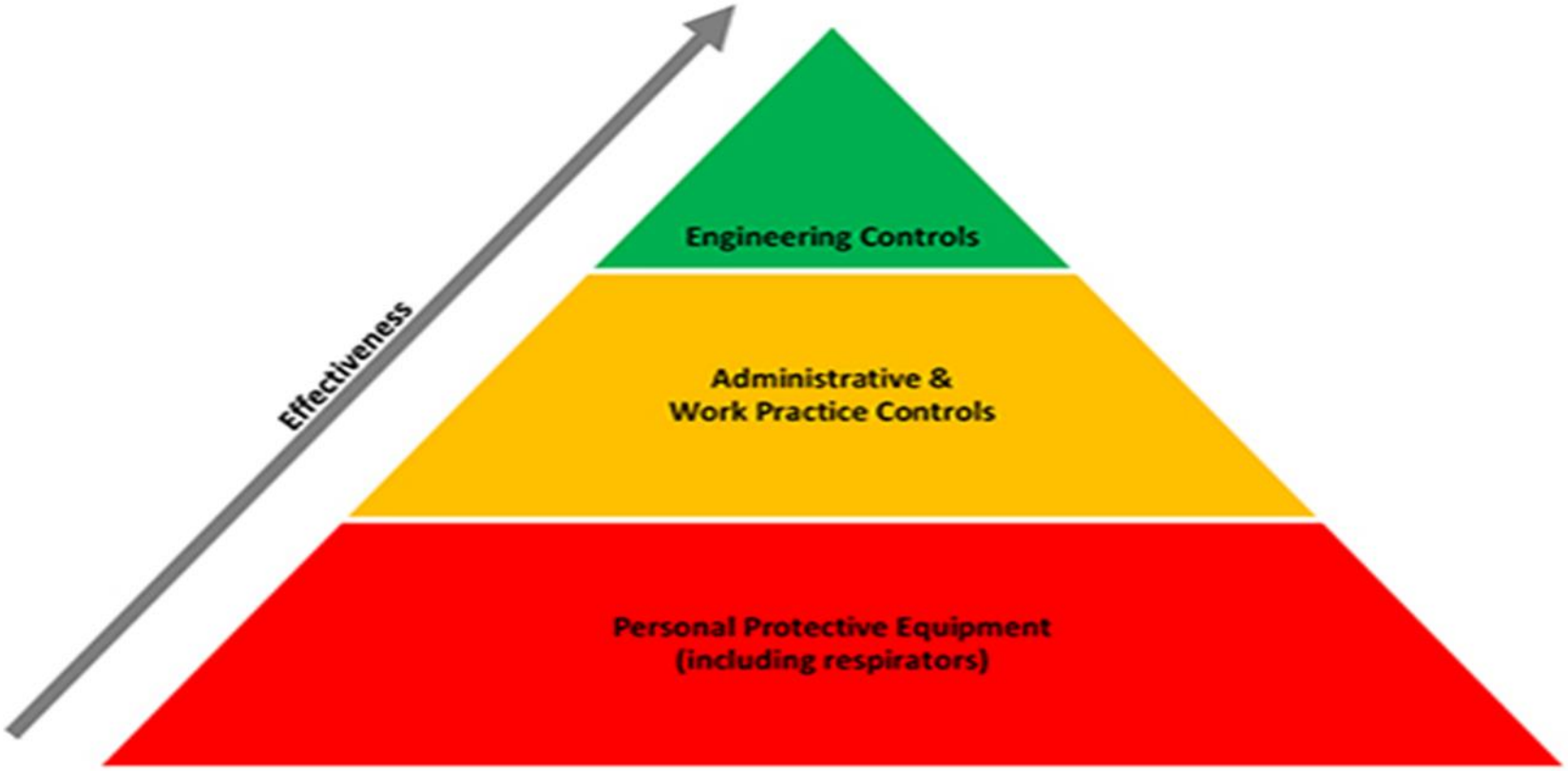
- Ergonomics can be considered as the one-time investment
- As ergonomics is focused about marinating the better health of the worker it can further reduce the cost of compensation that would be made by the injured or unhealthy staffs.

Improves the quality of the work

- Improved ergonomics favors the favorable environment where the workers can work efficiently.
- As the ergonomics improves, level of satisfaction in the quality of the work increases.
- It also helps to **reduce the absenteeism** due to more comfort, safety and healthy working environment
- Assurance to the worker as their workplace is safer (acts as the motivation)

Prevention Strategies and Safety guidelines to reduce theMSDs related to work place

- First step is to identify the risk factors and their causes
- A three-tier hierarchy of controls is widely accepted as an intervention strategy for:
- Reducing, eliminating, or controlling workplace hazards,.



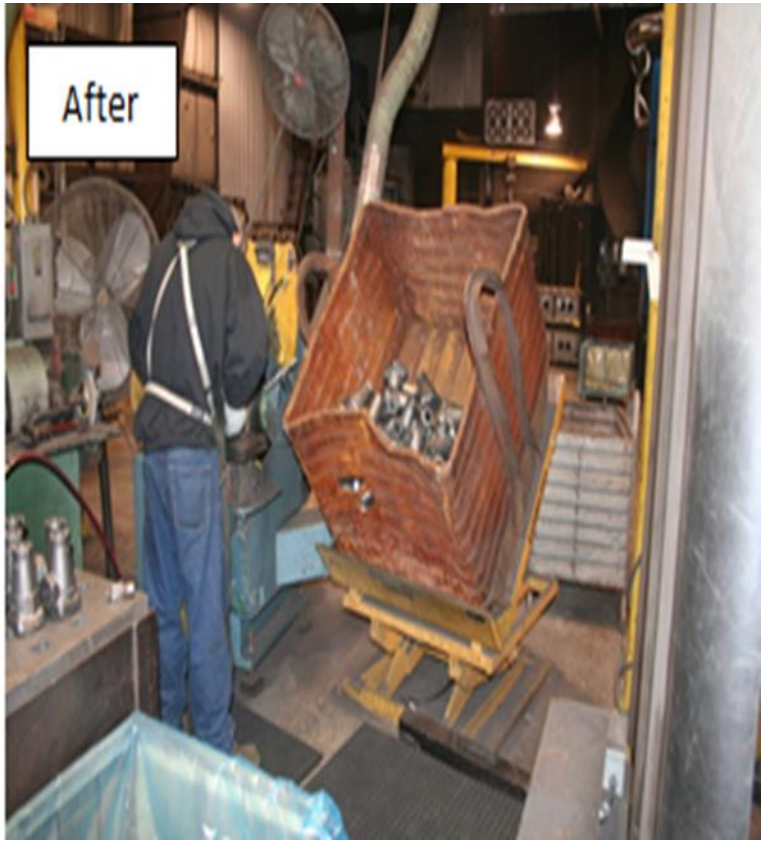
Engineering Improvements. (implement physical change to the workplace, which eliminates/reduces the hazard on the job/task)

include rearranging, modifying, redesigning, or replacing tools, equipment, workstations, packaging, parts, or products.

These improvements can be very effective because they may reduce or eliminate contributing factors

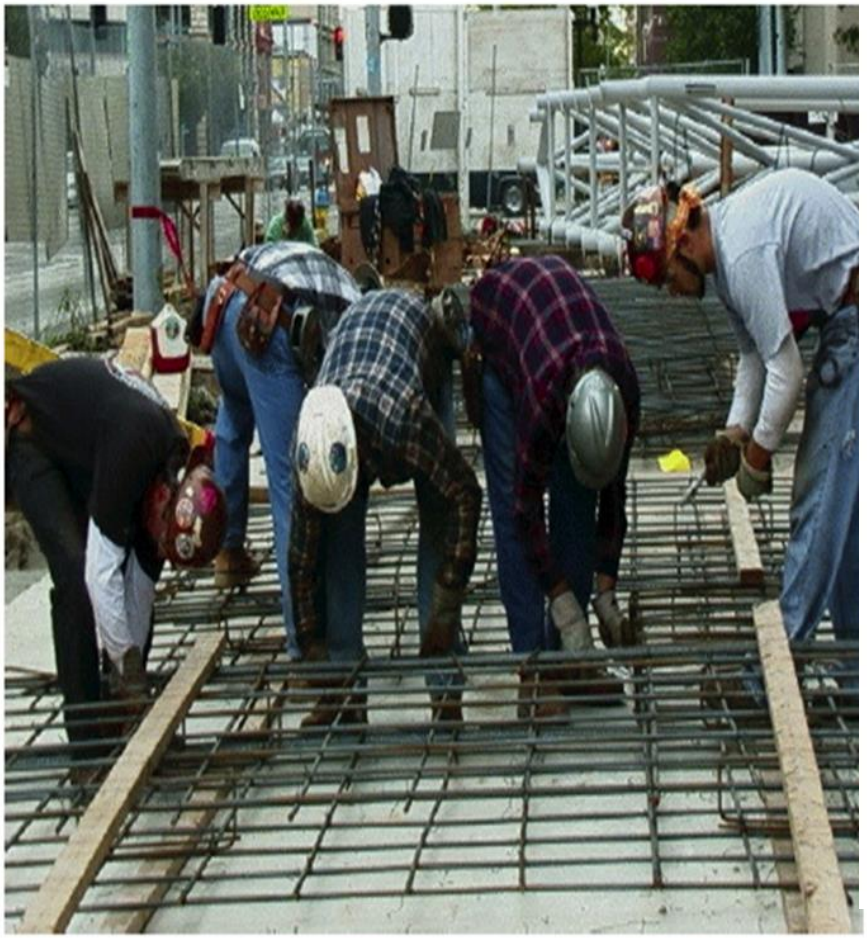
- Use a device to lift and reposition heavy objects to limit force exertion
- Reduce the weight of a load to limit force exertion
- Reposition a work table to eliminate a long/excessive reach and enable working in neutral postures
- Install diverters on conveyors to direct materials toward the worker to eliminate excessive leaning or reaching
- Redesign tools to enable neutral postures

Example of an engineering control: mechanical devices that lift and tilt to adjust materials for easier handling
Source: Solutions for the Prevention of Musculoskeletal Injuries in Foundries, OSHA Publication 3465-08 (2012)



Use a drum mover to reduce lifting, pushing, and pulling heavy drums

Source: Guidelines for Shipyards: Ergonomics for the Prevention of Musculoskeletal Disorders (PDF). OSHA Publication 3341-03N (2008



- **Administrative Improvements**. include changing work practices or the way work is organized.
    - Providing variety in jobs
    - Adjusting work schedules and work pace
    - Providing recovery time (i.e., muscle relaxation time)
    - Modifying work practices
    - Ensuring regular housekeeping and maintenance of work spaces, tools, and equipment
    - Encouraging exercise

- Require that heavy loads are only lifted by two people to limit force exertion
- Establish systems so workers are rotated away from tasks to minimize the duration of continual exertion, repetitive motions, and awkward postures. Design a job rotation system in which employees rotate between jobs that use different muscle groups

- **Personal Protective Equipment**.
- (to reduce exposure to ergonomics-related risk factors)
- Safety gear, or personal protective equipment (PPE), includes gloves, knee and elbow pads, footwear, and other items that employees wear.
- Use padding to reduce direct contact with hard, sharp, or vibrating surfaces
- Wear good fitting thermal gloves to help with cold conditions while maintaining the ability to grasp items easily

SUMMARY

- Workers who do not take care of their bodies with a good nutrition and fitness regimen and do not get adequate rest and recovery put themselves at higher risk of developing WMSDs.
- Ergonomics looks at potential results of faulty systems and activities which may result in WRMSD
- By applying ergonomics, risk factors can be reduced and WRMSDs prevented.

Refrenceses

- Prevention of Musculoskeletal Disorders in the Workplace (n.d.), OSHA Safety and Health Topics, https://www.osha.gov/SLTC/ergonomics/
- MusculoskeletalDiseases :https://health.uconn.edu/occupational-environmental/clinical-services/musculoskeletal-diseases/
- https://www.ccohs.ca/oshanswers/diseases/rmirsi.html
- The Definition and Causes of Musculoskeletal Disorders (MSDs) https://ergo-plus.com/musculoskeletal-disorders-msd
- /
- Work-Related Musculoskeletal Disorders & Ergonomics
- https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/index.html
- **Ergonomics and Injury Prevention Guidelines by Industry.** https://ergo-plus.com/ergonomics-injury-prevention-guidelines-by-industry/
- http://ew2007.osha.europa.eu