Fundamentals of Ergonomics

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January 26, 2022
Introductions

• A little about me…

• Tell me about you!!
Discussion Outline

• What is Ergonomics?
• Why Implement Ergonomics?
• Musculoskeletal Disorders
• MSD Risk Factors
• Building an Ergonomics / MSD Solution Program
What is Ergonomics?

Ergonomics is the study of work

Ergon → Work
Nomos → Laws of
What is Ergonomics?

**Ergonomics** is an applied science that considers people's abilities, limitations, and characteristics in the design and evaluation of work systems, including tasks, jobs, workstations, tools, equipment, and the work environment.
What is Ergonomics?

Work Requirements

Human Capabilities
What is Ergonomics?

• Every Human Ability has A Limit
  ✓ Ergonomics endeavors to define these limits and then design work to be within these limits

• People Are Different
  ✓ Ergonomics endeavors to understand these differences and use the data to design workplaces that accommodate the greatest possible percentage of the population

• People Act Predictably
  ✓ Ergonomics determines which population stereotypes (predictable population patterns of behavior) exist and then ensures that the workplace is designed to be consistent with them
Why Ergonomics?

Ergonomics is an applied science that considers people's abilities, limitations, and characteristics in the design and evaluation of work systems, including tasks, jobs, workstations, tools, equipment, and the work environment.

The goal of ergonomics is to design systems that preserve the wellbeing of all employees, minimize the risk of injury and illness, especially musculoskeletal disorders, and maximize system as well as human performance.
Why Ergonomics?

Musculoskeletal disorders are the largest category of workplace injuries in the US.

The U.S. private sector experienced 266,530 MSD injuries or illnesses involving days away from work in 2019.

According to the World Health Organization, approximately 1.7 billion people have musculoskeletal conditions across the globe.

Musculoskeletal conditions are the leading contributor to disability worldwide, with low back pain being the single leading cause of disability in 160 countries.

Because of population increases and aging, the number of people with musculoskeletal conditions is rapidly increasing.
Why Ergonomics?

Decreased Number and Severity of MSDs & other injuries & illnesses

Reduced Direct & Indirect Costs Associated with MSDs

• Worker's Compensation Costs
• Cost of Managing the Claim
• Employee Retraining
• Increased Overtime
• Reductions in Productivity
Why Ergonomics?

Improved Operational Performance
- Improved Quality
- Improved Reliability
- Increased Productivity
- Reduced Cycle Times
- Reduced Errors and Defects
- Reduced Waste
- Reduced Maintenance Costs

Worker Benefits
- Reduced Employee Discomfort
- Reduced Absenteeism
- Improved Employee Job Satisfaction
- Reduced Employee Turnover
Musculoskeletal Disorders

Musculoskeletal disorders (MSD) are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs.

Note: MSDs caused by slip, trips, falls, or other similar accidents are not included in this definition.
Musculoskeletal Disorders

**Bones** - Make up the Body’s Skeleton

**Joint** - Connection Between Bones

**Ligaments** - Connect Bone to Bone

**Cartilage** - Protects the joint surfaces

**Tendons** - Connect Muscle to Bone

**Muscles** - Contract to Create Movement

**Nerves** - Transmit Signals to Muscles Initiating Contraction
Common Musculoskeletal Disorders

- **Sprains** (Affect Connective Tissue)
- **Strains** (Injury to Muscle)
- **Muscle Tears**
- **Tendonitis**
- **Tennis Elbow** (Epicondylitis)
- **De Quervain’s Disease**
- **Trigger Finger**

- **Rotator Cuff Injuries**
- **Nerve Entrapment Syndromes**
  - Carpal Tunnel Syndrome
  - Thoracic outlet syndrome
- **Back Pain**
- **Herniated or Ruptured Disc**
- **Raynaud’s Syndrome**
MSD Signs & Symptoms

- Pain
- Tenderness
- Swelling
- Redness
- Burning
- Cramping

- Stiffness
- Loss of Strength
- Reduced Range of Motion
- Tingling
- Numbness
Musculoskeletal Disorders

Musculoskeletal disorders (MSD) are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs.

Work-related musculoskeletal disorders (WMSD) are conditions in which:

✓ The work environment and performance of work contribute significantly to the condition; and/or
✓ the condition is made worse or persists longer due to work conditions

Note: MSDs caused by slip, trips, falls, or other similar accidents are not included in this definition.
MSD Risk Factors

To prevent MSDs, we identify and eliminate (or reduce) the risk factors known to contribute to these injuries & illnesses.

What are risk factors?
MSD Risk Factors

Risk Factors are job attributes or workplace conditions or exposures that increase the likelihood of experiencing an MSD.

The more risk factors that are present in a job or task, the greater the risk for developing an MSD.
MSD Risk Factors

- Force
- Posture
- Repetition
- Contact Stress
- Vibration
- Temperature
Personal Risk Factors for MSDs

- Age
- Fitness Level
- Weight (Obesity)
- History of Injury
- Medical Conditions
- Non-Occupational Activities
- Psychosocial Factors
MSD Risk Factors

Primary Risk Factors

• Force
• Posture
• Repetition
• Contact Stress
• Vibration
• Temperature
MSD Risk Factors

- High **Forces**
- Awkward or Static **Postures**
- Excessive **Repetition**
- **Contact Stress** Against Soft Tissue
- Prolonged Exposure to Whole Body or Hand-Arm **Vibration**
- Cold **Temperatures**
MSD Risk Factors

• High **Forces**
  - Lift/Lower
  - Push/Pull
  - Carry
  - Power & Pinch Grips
  - Press
  - Torque

**Higher Force = Higher Risk**
MSD Risk Factors

• Awkward or Static Postures
  ✓ Posture is “body position”
  ✓ Neutral posture is the posture where we have the greatest strength and greatest endurance
  ✓ Awkward postures decrease muscle strength, increase strain on the connective tissues, decrease circulation and increase fatigue
  ✓ Static posture is holding the same position for a period of time

Greater Deviation from Neutral = Higher Risk
MSD Risk Factors

• Neutral Posture

- Knees at ~ 90°
- Shoulders Relaxed, Arms Resting at Sides
- Curves in Back Maintained
- Elbows at ~90°
- Wrists Straight and Hands Facing Inward
- Head Facing Forward
## MSD Risk Factors

<table>
<thead>
<tr>
<th>Extreme Posture</th>
<th>% Strength Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulnar Wrist Deviation</td>
<td>25%</td>
</tr>
<tr>
<td>Radial Wrist Deviation</td>
<td>20%</td>
</tr>
<tr>
<td>Wrist Extension</td>
<td>25%</td>
</tr>
<tr>
<td>Wrist Flexion</td>
<td>55%</td>
</tr>
<tr>
<td>Arms Fully Extended</td>
<td>81%</td>
</tr>
<tr>
<td>Floor Level Lift</td>
<td>40%</td>
</tr>
<tr>
<td>High Vertical Lift</td>
<td>60%</td>
</tr>
<tr>
<td>45º Twist During Lift</td>
<td>15%</td>
</tr>
<tr>
<td>90º Twist During Lift</td>
<td>30%</td>
</tr>
</tbody>
</table>
MSD Risk Factors

• Excessive **Repetition**
  
  ✓ Doing the same motion or movement over and over

- Idle, no regular exertions
- Slow steady motion Frequent pauses
- Rapid, steady motion Few if any pauses

**Lower Risk**

- Very slow motions, consistent, conspicuous pauses

**Higher Risk**

- Steady motion / exertions Infrequent pauses
MSD Risk Factors

• **Contact Stress** Against Soft Tissue

Contact stress occurs whenever focused pressure is exerted against part of the body. Compression of nerves and blood vessels can result in reduced circulation or discomfort and fatigue. Common examples include:

- Pressure against the hand from sharp edges on tool handles
- Resting the wrists or forearms on the edge of a work surface
- Leaning against a work surface
- Kneeling
- Sitting in a chair that is too low, too high or too deep
- Using the hand as a tool

**Longer Duration = Higher Risk**
MSD Risk Factors

- Prolonged Exposure to **Vibration**
  - Whole Body Vibration
  - Hand-Arm Vibration

**Longer Duration = Higher Risk**
MSD Risk Factors

• Cold **Temperatures**

Low temperatures affect circulation, manual dexterity and grip strength, aggravating other risk factors. Exposure can result from:

- Low ambient temperatures
- Handling cold materials
- Cold air exhaust or cold (metal) handles on tools

**Temperatures < 60°F (16°C) = Higher Risk**
**Longer Duration = Higher Risk**
MSD Risk Factors

Risk Factors are job attributes or workplace conditions or exposures that increase the likelihood of experiencing an MSD.

- High **Forces**
- Awkward or Static **Postures**
- Excessive **Repetition**
- Contact Stress Against Soft Tissue
- Prolonged Exposure to Whole Body or Hand-Arm **Vibration**
- Cold **Temperatures**

*The more risk factors that are present in a job or task, the greater the risk for developing an MSD!*
MSD Risk Reduction

To prevent MSDs, we identify and eliminate (or reduce) the risk factors in:

- Workstation
- Tools
- Equipment & Machinery
- Task & Work Practices
- Work Environment
MSD Risk Reduction

• Optimize the posture of the workers
  ✓ Seated versus standing
  ✓ Determine ideal work height
  ✓ Incorporate adjustability in work or worker
  ✓ Keep work as close as possible to worker
  ✓ Provide footrests & anti-fatigue mats
  ✓ Use work positioners or worker supports
  ✓ Organize materials & supplies according to frequency of use and weight
MSD Risk Reduction

• Minimize Forces
  - Use mechanical assists devices in MMH
  - Push rather than pull
  - Use conveyors and roller tables
  - Maintain and select proper castors
  - Use power grip over pinch grip
  - Keep cutting tools sharp
  - Use powered hand tools
  - Improve mechanical advantage of tools
MSD Risk Reduction

• Reduce frequency of exertions
  ✓ Eliminate re-handling
  ✓ Purchase materials in quantities and/or weights used
  ✓ Provide materials in the orientation used
  ✓ Use powered tools
  ✓ Organize materials and tools according to sequence and frequency of use
  ✓ Alternate hands / sides
  ✓ Rotate to jobs using different muscle groups *

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Building an MSD Solutions Program

Worker Resiliency & Well-being Initiatives

Ergonomics
- Identify and address existing MSD hazards and risks
- Prevent introduction of new MSD hazards and risks
- Interventions

MSD Medical Management
- Early Detection and Intervention
- Diagnosis & Treatment
- Return to Work

Leadership Commitment

Worker Engagement

Culture that Values Worker Safety & Health
**MSD Solutions Lab**

June 2021, NSC and Amazon announced a 5-year partnership to address MSDs, the largest category of workplace injuries in the US and globally.

Led by NSC and powered by Amazon, this initiative aims to prevent MSDs across all industries. It will do this by engaging key stakeholders, conducting research, inventing new technology and processes, and scaling the results. Five key components of this initiative are:

- Advisory Council
- Pioneering Research
- Small Business and University Grants
- Innovation Challenges
- Industry Call to Action – The MSD Solutions Business Pledge
Questions

Discussion
Thank you for joining us today!

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