

October 27, 2023

12:45 PM - 1:30 PM

Preventing Musculoskeletal Injuries Through Effective Risk Controls

AARON DEROUIN

Safety Advisor Specialist - Ergonomics
Manufacturing Safety Alliance of BC

GEOFF WRIGHT

Ergonomist, Prevention Services Division
WorkSafeBC

MIS
MAKE IT SAFE



Copyright Disclaimer

© 2023, Workers' Compensation Board of British Columbia. All rights reserved.

This resource is owned by the Workers' Compensation Board ("WorkSafeBC") and protected by Canadian copyright laws. We encourage you to use this resource for your own personal and educational purposes. However, you are not permitted to use it (in whole or in part): for any commercial purposes, to make copies other than for your own personal use, to republish or redistribute it, or to otherwise share it outside of WorkSafeBC. You are also not permitted to modify the content.

If you wish to obtain permission to use this resource for non-commercial educational purposes (for example, if you are an occupational health and safety trainer), you can request copyright permission by emailing copyright@worksafebc.com. You can find our full copyright terms at www.worksafebc.com.

Use of WorkSafeBC's intellectual property does not constitute an endorsement, express or implied, of any person, service provider, service or product.

Use of WorkSafeBC publications and materials is at your own risk. WorkSafeBC does not warrant the quality, accuracy or completeness of any information contained in the publications and materials, which are provided "as is" without warranty or condition of any kind.

MUSCULOSKELETAL INJURY PREVENTION

1. Why a different approach is needed
2. Ergonomics Approach is needed
3. Build a Foundation for MSI Prevention
4. Manage the Risk of Musculoskeletal Injury
5. Control Risk Factors for Musculoskeletal Injury
6. Resources and Tools for MSI Prevention



Preventing Musculoskeletal Injuries

1. Why a different approach is needed



Musculoskeletal Injury (MSI)

Definition & Incidence

An injury or disorder of the musculoskeletal system, which includes muscles, tendons, blood vessels, ligaments, nerves, joints, spinal discs, and related soft tissue

CANADA LABOUR CODE, PART II



MSI Risk Control is JENGA in Reverse



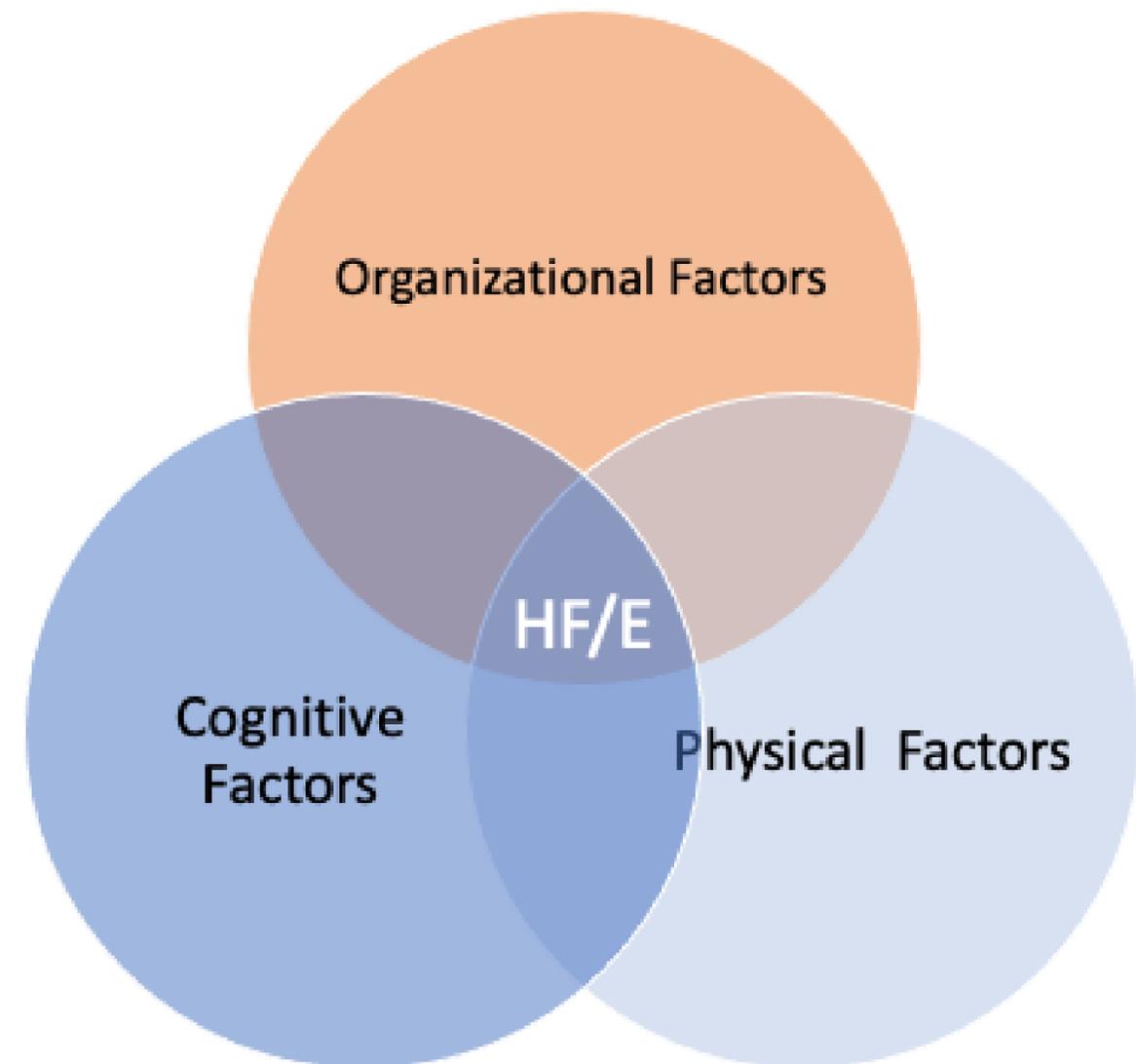


Preventing Musculoskeletal Injuries

2. Ergonomics approach is needed

Ergonomics *Defined*

- Ergon -> work (Greek)
- Nomos -> laws
- The science of work
- Fitting the workplace, facility, equipment, task, and processes to the physical and cognitive capabilities and limitations of humans



Ergonomics

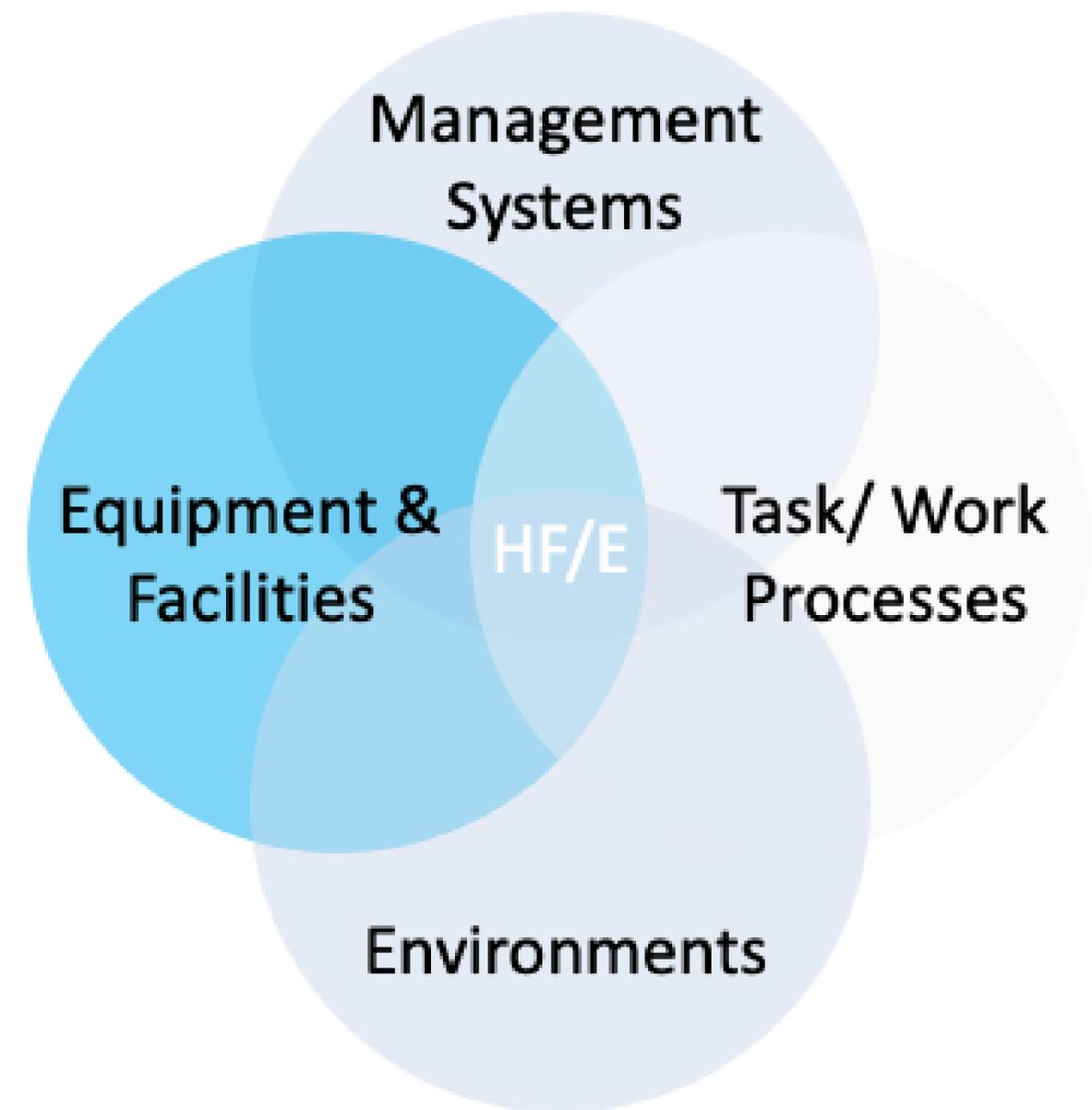
DEFINITION

The scientific discipline concerned with the understanding of interactions among humans and other elements of a system.

INTERNATIONAL ERGONOMICS ASSOCIATION (IEA), 2000

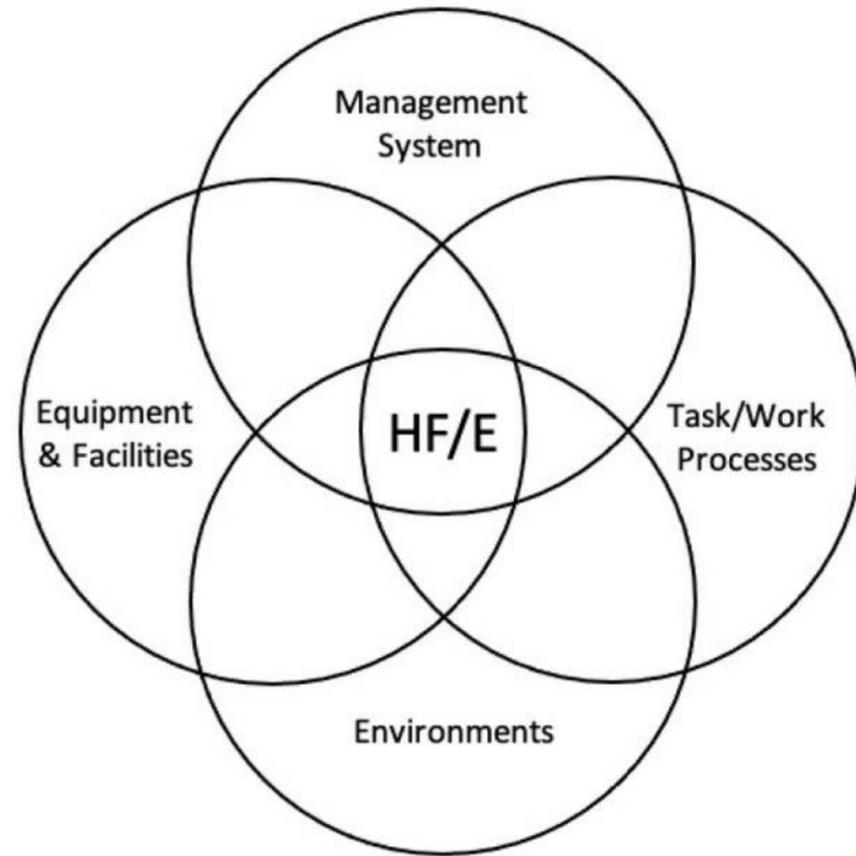
ERGONOMISTS

APPLY THEORY, PRINCIPLES, DATA, AND METHODS TO DESIGN IN ORDER TO OPTIMIZE HUMAN WELL-BEING AND OVERALL SYSTEM PERFORMANCE.



Human Factors/ Ergonomics (HF/E)

Worker(s) are at the centre of the total work system



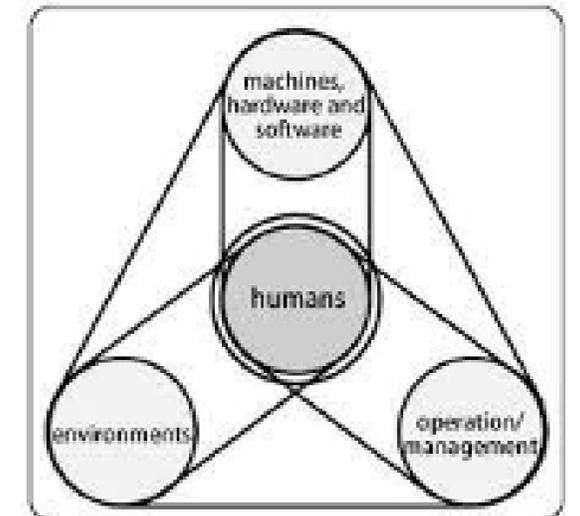
NEED TO CONSIDER:

The scientific discipline concerned with the understanding of interactions among humans and other elements of a system.

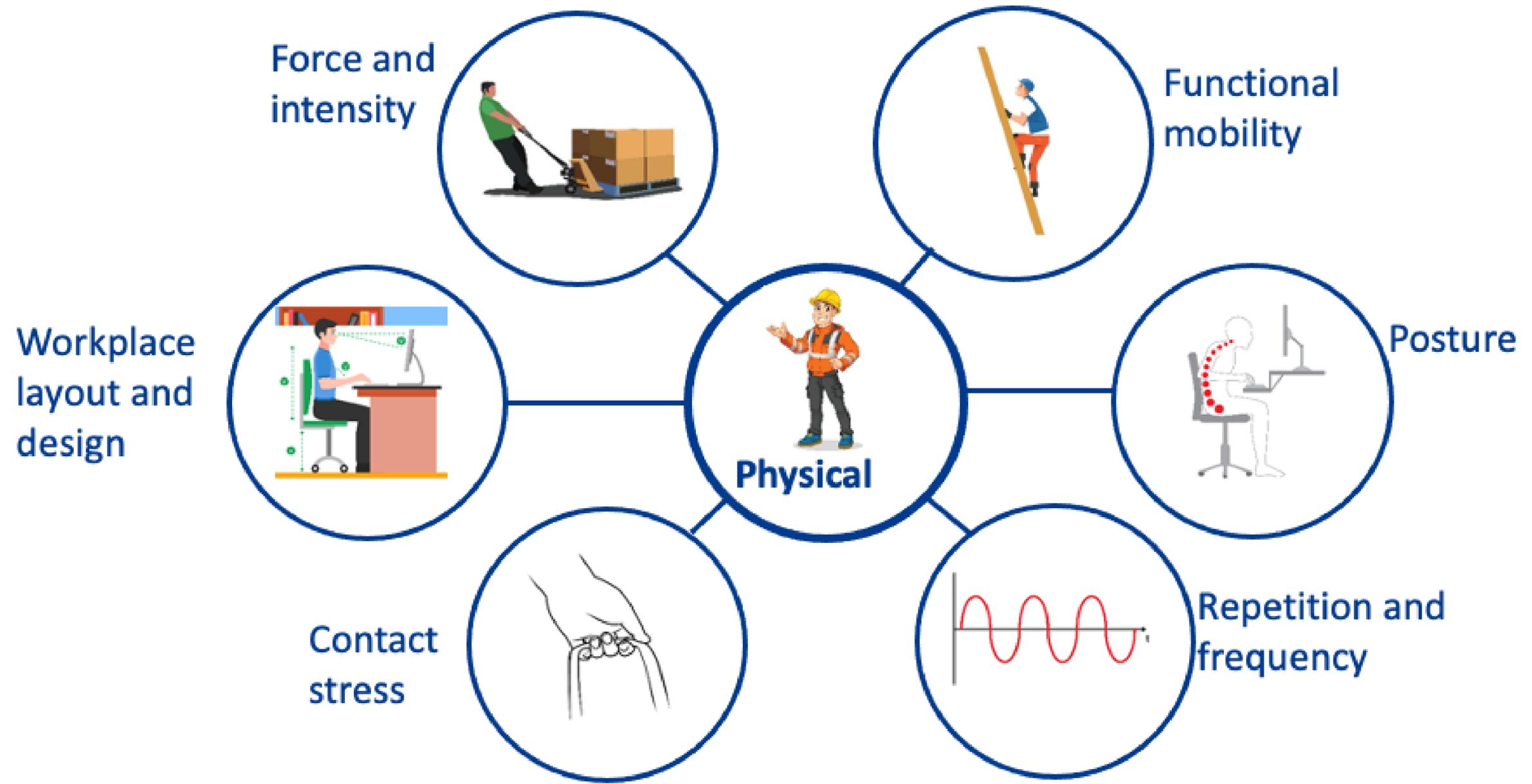
NEED TO ENSURE:

APPLY THEORY, PRINCIPLES, DATA, AND METHODS TO DESIGN IN ORDER TO OPTIMIZE HUMAN WELL-BEING AND OVERALL SYSTEM PERFORMANCE.

A change in one component affects other components in the total work system



MSI Risk Factors – Physical Demands





Preventing Musculoskeletal Injuries

3. Build a Foundation for MSI Prevention





Preventing Musculoskeletal Injuries

A firm foundation for MSI Prevention has:



MANAGEMENT COMMITMENT



EMPLOYEE PARTICIPATION

MANAGEMENT COMMITMENT TO MSI PREVENTION

- Understanding the concerns and opportunities as work changes
- Engaging employees and staff from all levels of the company
- Taking a visible and active role in decisions and development of plans
- Opening lines of communication - include updates
- Learning and improving and remaining open to ideas.
- Providing time and resources to support and maintain efforts to manage MSIs in a timely manner



MANAGEMENT ENGAGEMENT IN MSI PREVENTION

- Inviting workers to participate
- Involving workers in all aspects of the work and safety process
- Acting on ideas based on feedback to minimize MSI
- Evaluating solutions involving workers to assess effectiveness
- Communicating throughout the entire process in a transparent, open, two-way style

Employee Engagement in MSI Prevention

- Operators, maintenance workers, and procurement staff are also involved in safety
- Employees are asked for their input on safety
- Operators report unsafe conditions or near misses
- Active and structured involvement of staff in workshops, risk assessments, design projects
- Cooperation over safety – a joint effort between all in the company



PREVENTING MUSCULOSKELETAL INJURIES

- Are workers actively involved in the process?
- Is there an appropriate and effective system for **employees and their supervisors to raise health and safety concerns?**
- Workers are a key source of information about the demands of the job, the potential MSI hazards, and have suggestions on fixing it



Preventing Musculoskeletal Injuries

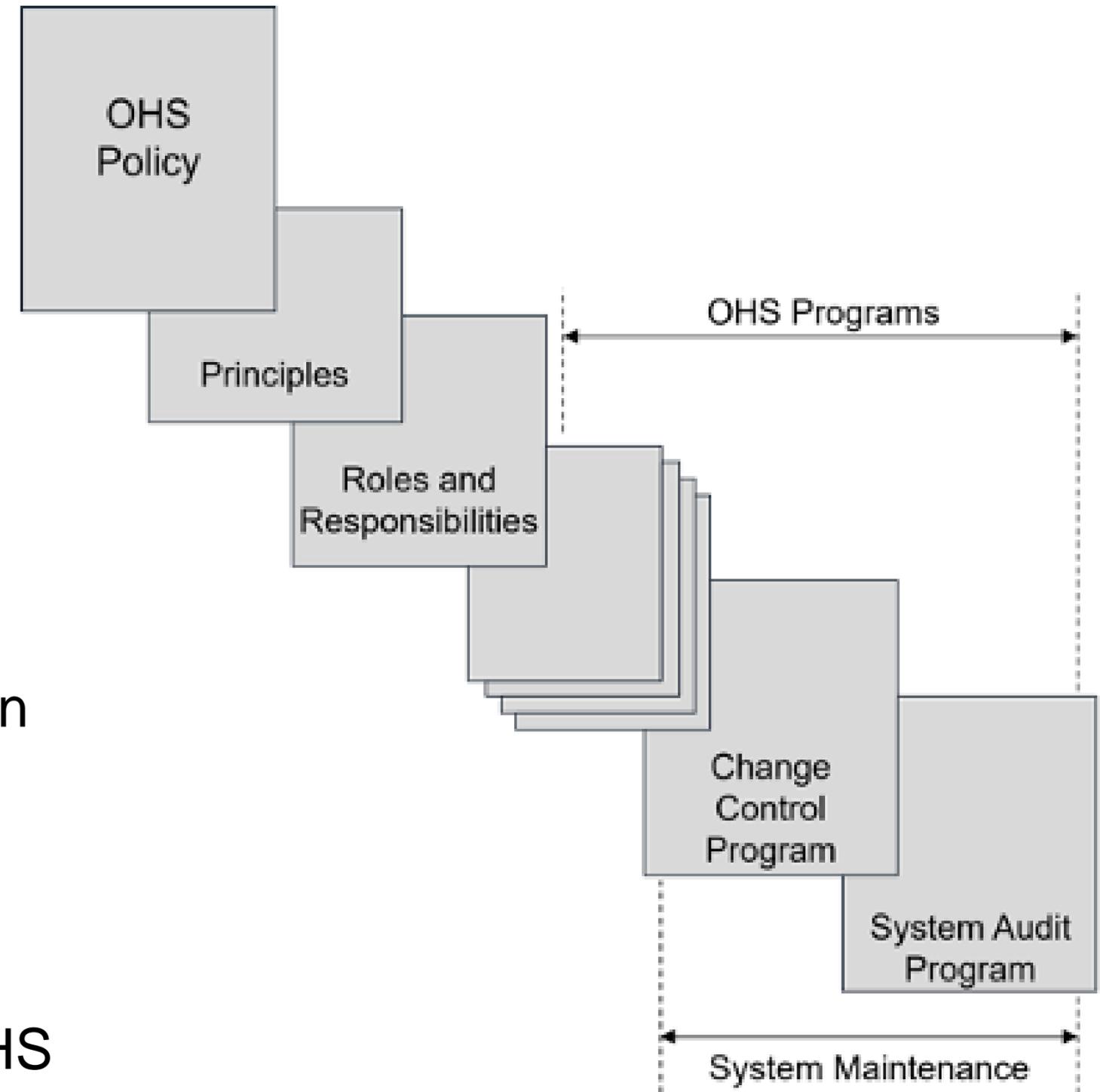
4. Manage the Risk of Musculoskeletal Injury

Compliance with Ergonomics (MSI) REGULATION



Occupational Health and Safety Systems

- A guide to action, expressing important principles, values or beliefs, that should be followed by individuals in the organization in order to attain stated goals and to provide consistency of decisions.
- Concepts which frame the organization's philosophy and approach to addressing OHS



Preventing Musculoskeletal Injuries

EMPLOYEE PARTICIPATION IN MSI PREVENTION:

- Provides insights about the demands of the job and potential MSI hazards
- Suggest ideas and methods to implement interventions that will reduce MSI risk

There is continuous improvement and a total quality approach



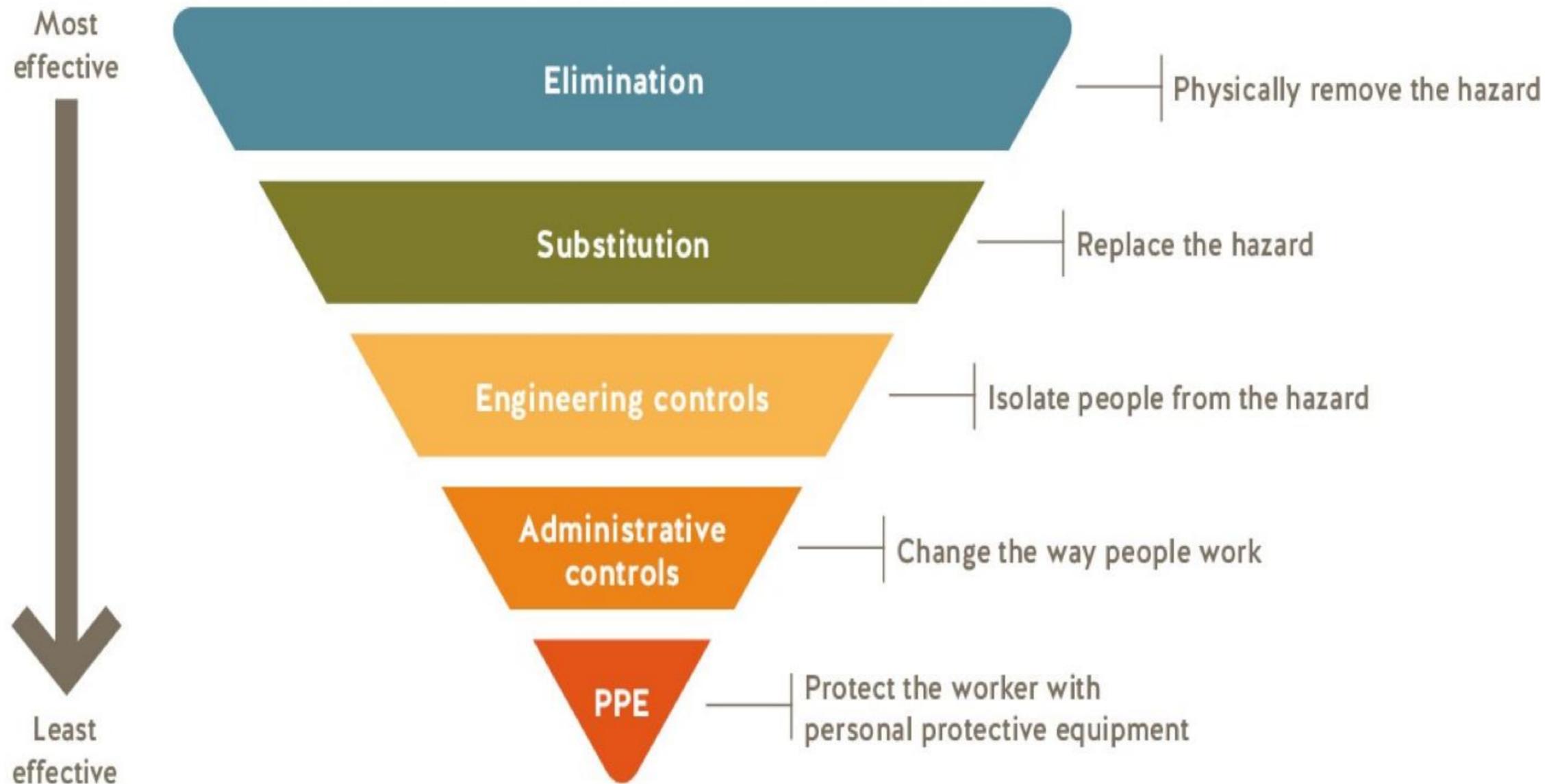


Preventing Musculoskeletal Injuries

5. Control Risk Factors for Musculoskeletal Injury



Hierarchy for Controlling MSI Risks



Ergonomics Principles for Controlling MSIs

- Fit the work task to human capabilities and goals
- Minimize concurrent, long duration and/ or high magnitude physical exposures (force, repetition, awkward/ static posture, mechanical compression, vibration)
 - a) Reduce static loads and physically stressful postures
 - b) Minimize peak force requirements and the percentage of time spent in forceful exertion
 - c) Minimize the duration of exposure to whole-body vibration and hand-arm vibration (WBV & HAV)
 - d) Ensure that work/rest recovery cycles within a work shift minimize fatigue



Effectiveness for *Controlling MSIs*

EVIDENCE THAT CONTROL IS EFFECTIVE

- Increased capacity or reduced demand
- Increased time in neutral postures
- Reduced injury rates
- Increased productivity, performance, quality



Effectiveness for *Controlling MSIs*

ADMINISTRATIVE CONTROLS

Job Rotation

- Distributes MSI risk factors more evenly across a group of people
- Requires accurate risk assessments and planning to implement the optimal rotation sequence to avoid loading the same musculotendinous groups in adjacent jobs



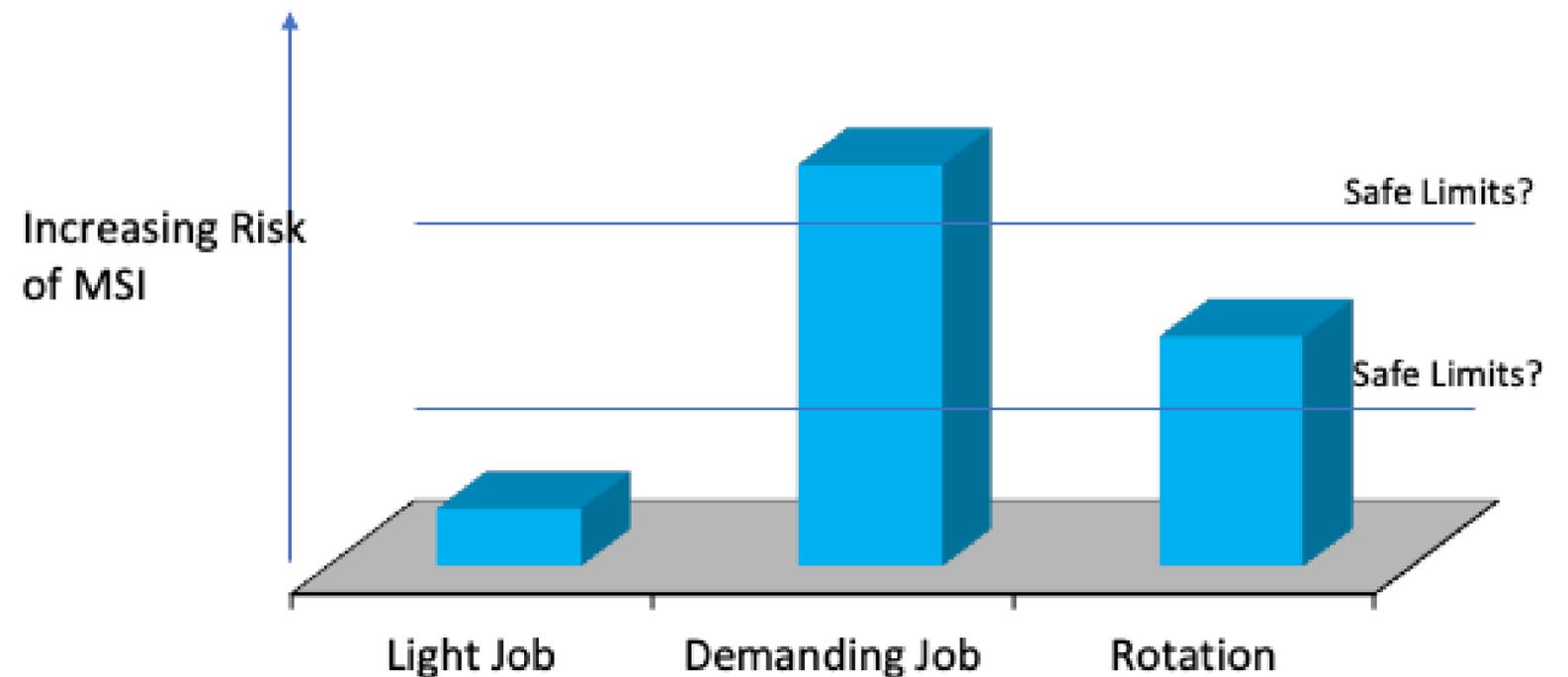
Effectiveness for Controlling MSIs

ADMINISTRATIVE CONTROLS

Job Rotation (Low)

- Job rotation alone does not change MSI risk factors in the facility
- The risk for some individuals can be reduced, while the risk for others can be increased
- No net change in risk factors present.

Job Rotation and Safe Limits



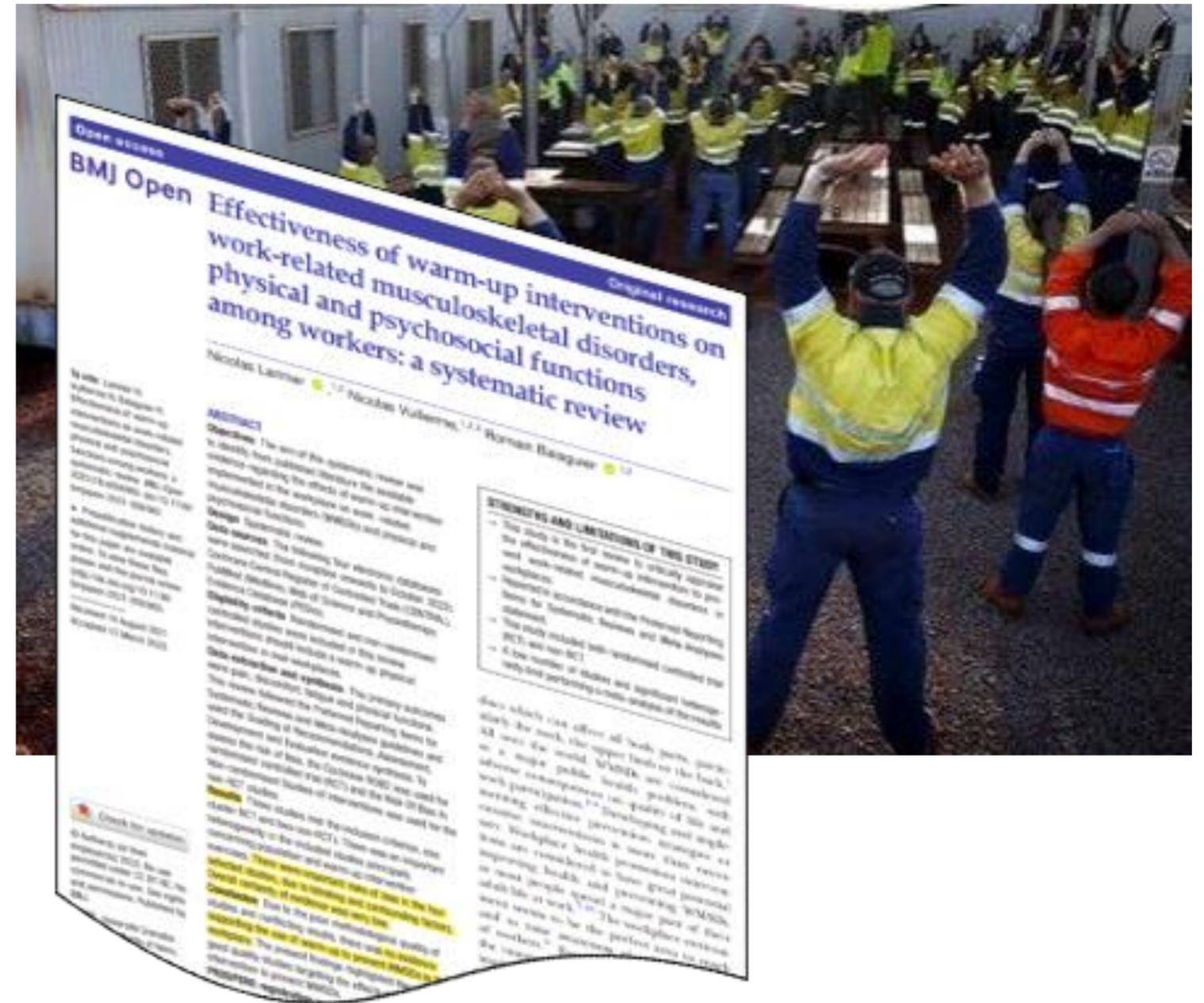
Adapted from: [MacLeod, 1993](#)

Effectiveness for Controlling MSIs

ADMINISTRATIVE CONTROLS

Pre-Shift Stretching (Low)

- Pre-shift stretching is commonly requested by manufacturing employers
- Weak evidence in the literature to support pre-shift stretching in industrial environments



Effectiveness for Controlling MSIs

ADMINISTRATIVE CONTROLS

Training and Advice (Low)

- Training workers to lift correctly does not change how people lift at work
- Does not prevent injury



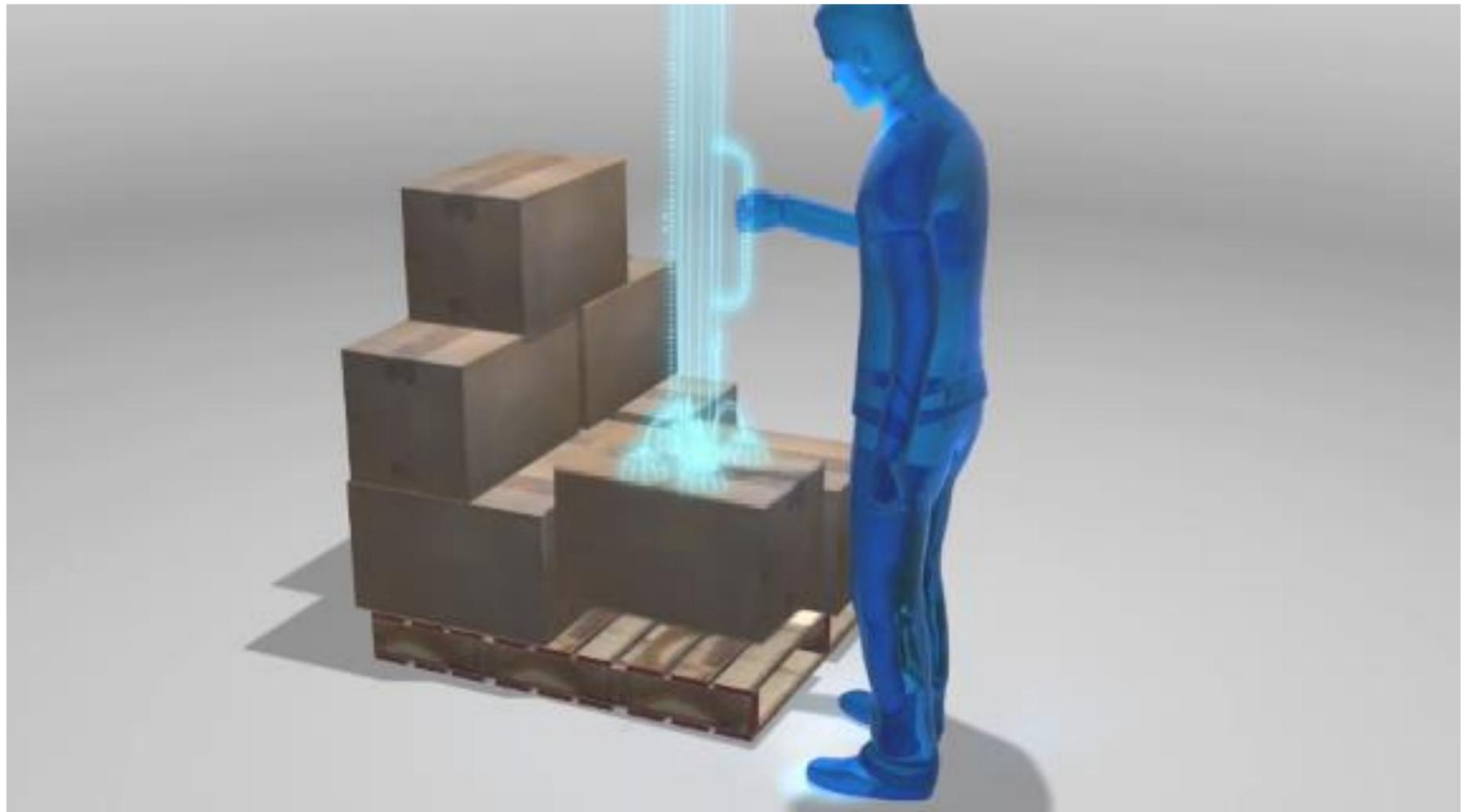
Effectiveness for *Controlling MSIs*

ENGINEERING CONTROLS – LIFT AIDS



Effectiveness for *Controlling MSIs*

ENGINEERING CONTROLS – LIFT TABLES



Effectiveness for Controlling MSIs

ENGINEERING CONTROLS Tool Design

- “Bend the tool, not the wrist”
- Tool selection in terms of handle shape is dependent on orientation of work

Tools with bent handles are better than those with straight handles when the force is applied horizontally (in the same direction as your straight forearm and wrist).



Straight handle



Bent handle

Body
y

Tools with straight handles are better than those with bent handles when the force is applied vertically.



Straight handle



Bent handle

Effectiveness for *Controlling MSIs*

ENGINEERING CONTROLSTool Design

- “Bend the tool, not the wrist”



HAGUE AND KHAN, 2010

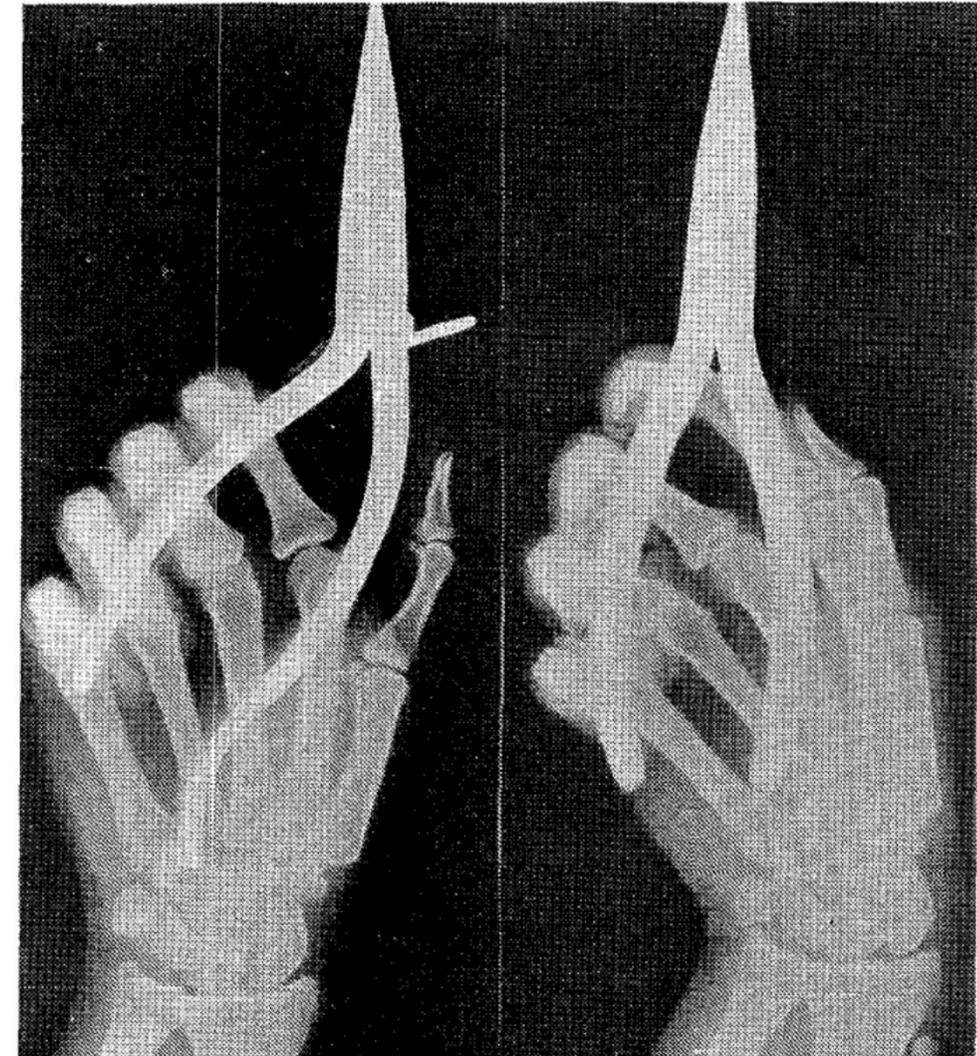


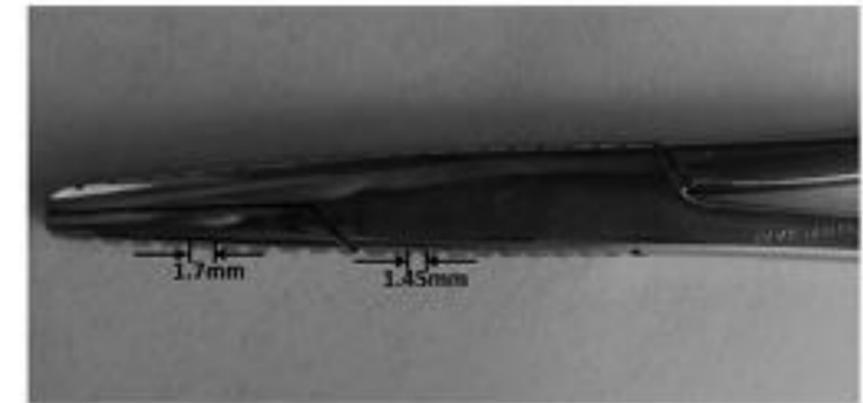
Figure 14 — A poorly designed handtool may cause ulnar deviation of the wrist as indicated in the top view. The offset handle (bottom view) allows more normal alignment of the wrist reducing the lateral deviation forces acting at the carpal tunnel.

TICHAUER AND GAGE, 1977

Effectiveness for Controlling MSIs

ENGINEERING CONTROLS Suturing Tool Design

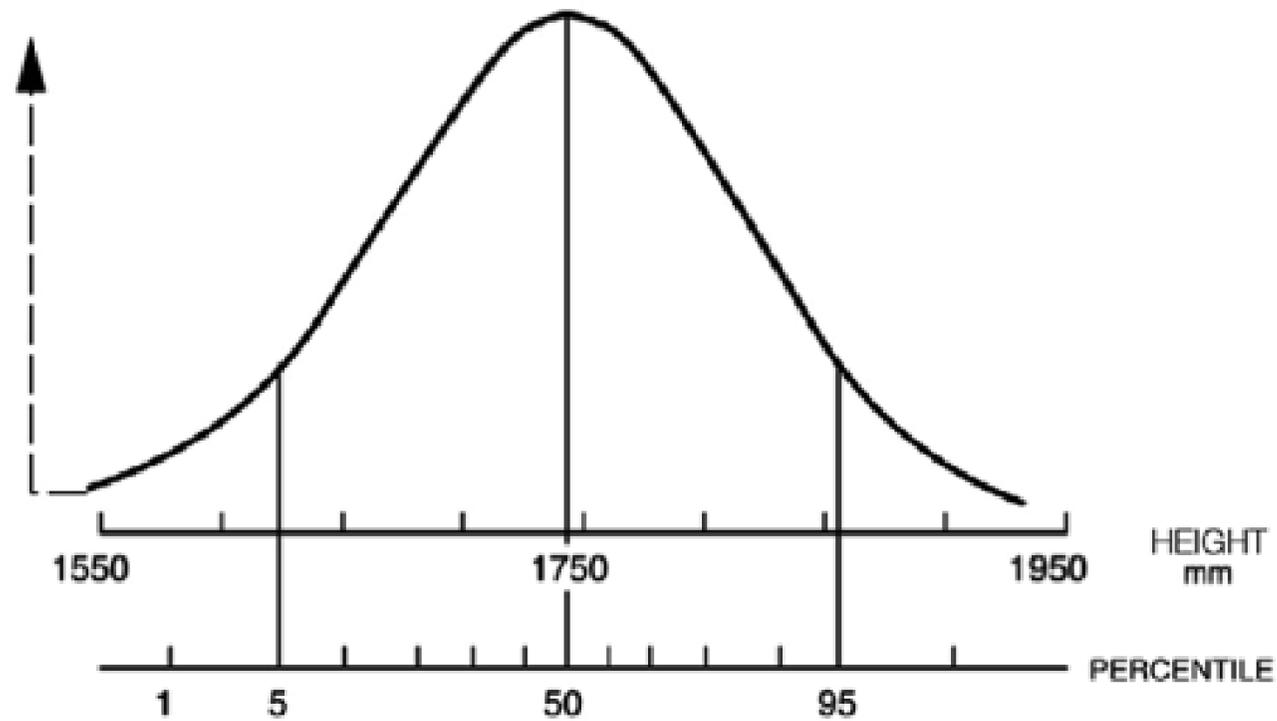
- “Bend the tool, not the wrist”
- “New grip design of needle holder reduced time to suture, led to better wrist posture, less difficulty, and less discomfort compared with traditional grip”



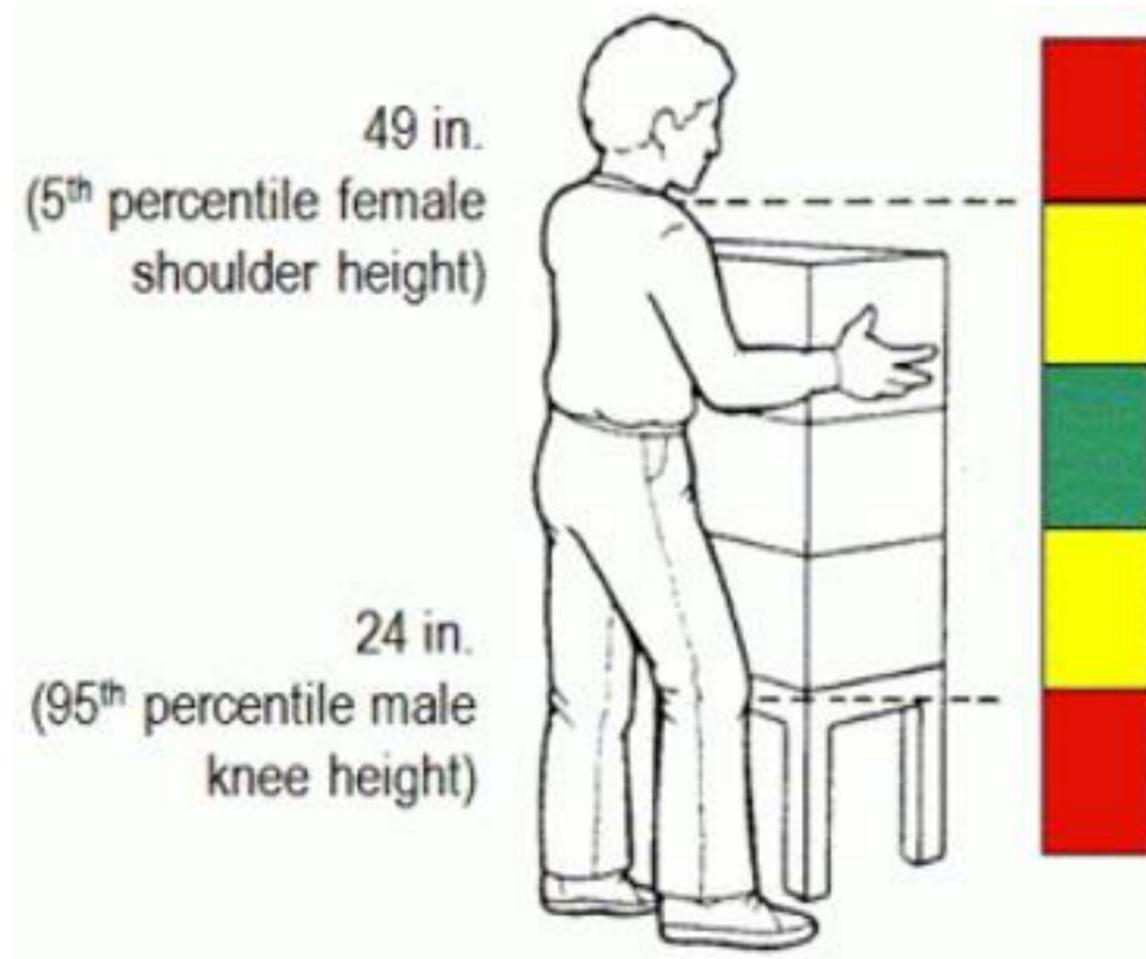
[Abdelall et al., 2021](#)

Effectiveness for *Controlling MSIs*

ANTHROPOMETRY AND DESIGN OPTIMAL LIFTING HEIGHT

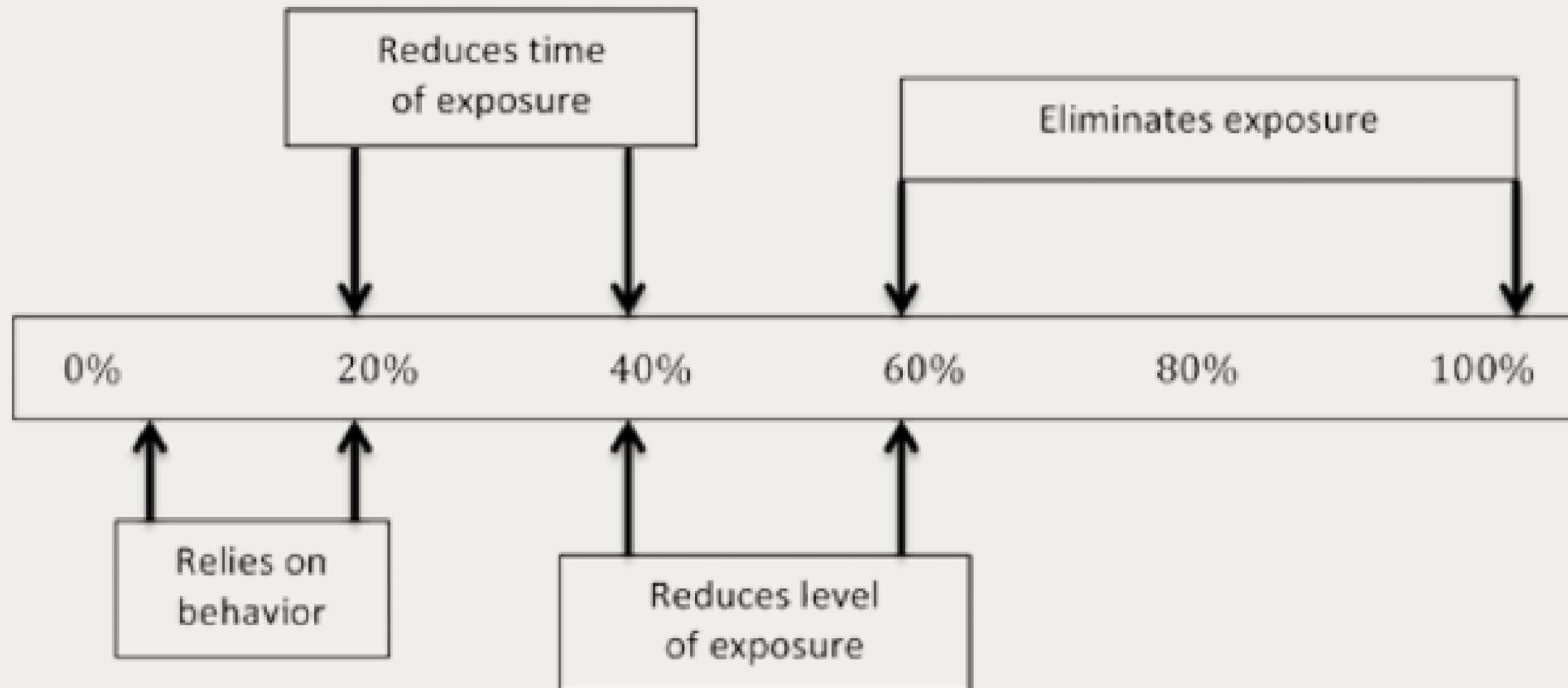


The curve obtained through approximation has a normal Gaussian distribution (the curve is symmetrical in comparison to the central value) and has a similar trend for all of the measurements of the human body found within sufficiently broad population groups. The data reported here refers to the adult population in the UK.

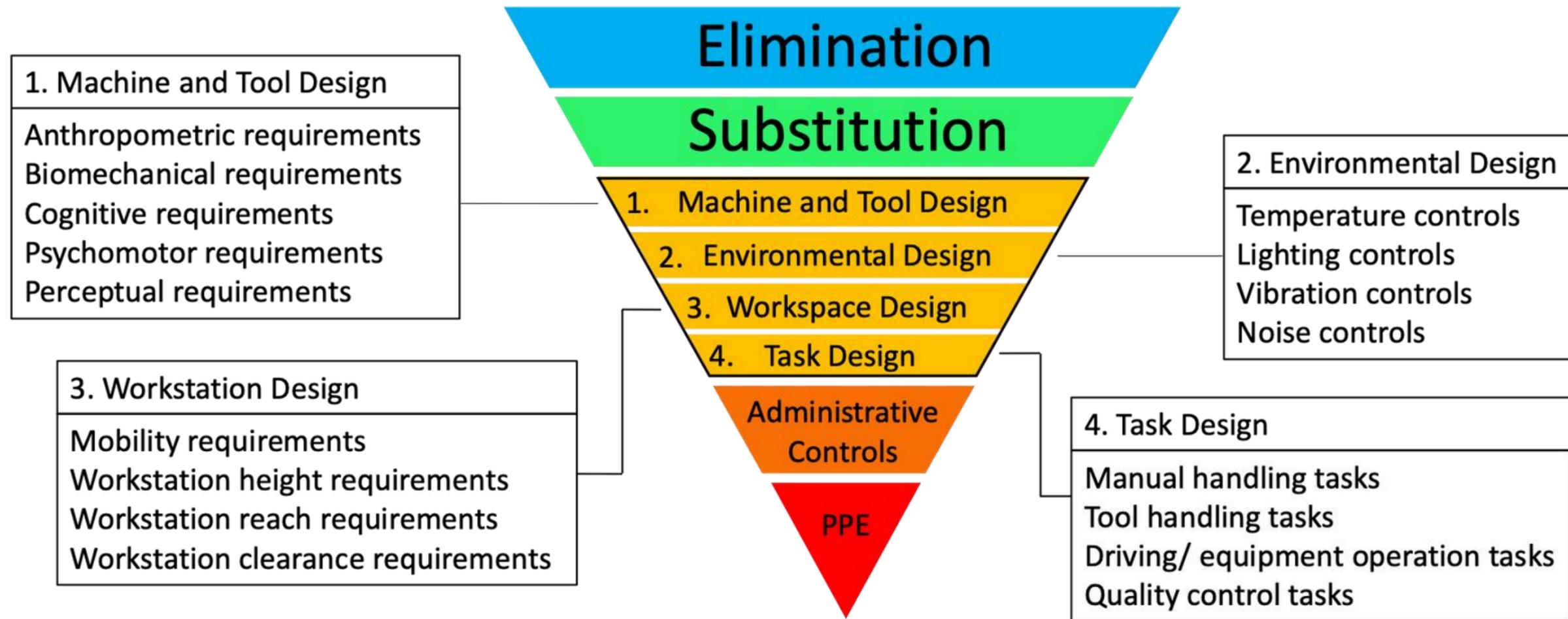


ERGOWEB, MACLEOD, 2013

Relationship of Safety Intervention Effectiveness



Hierarchy of Controls *with Engineering Controls*



DEROUIN, 2013

Preventing Musculoskeletal Injuries

FILL THE GAPS FOR MSI RISK CONTROL



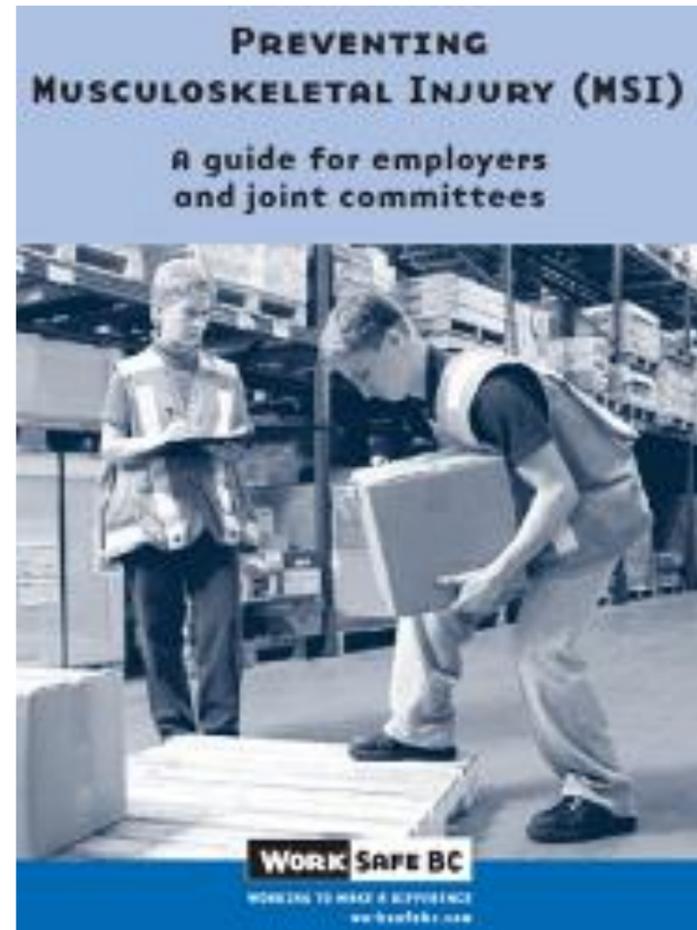
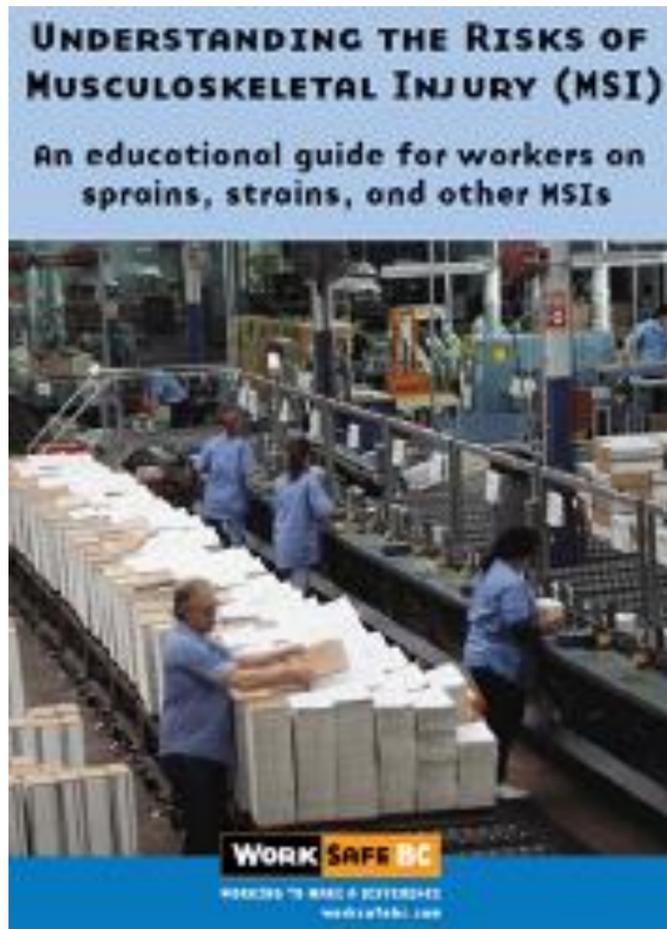


Preventing Musculoskeletal Injuries

6. Resources and Tools available for MSIP



WSBC Resources for Preventing MSIs



**ERGONOMICS
ENEWS**

WWW.WORKSAFEBC.COM/ERGONOMICS

WSBC Resources for Preventing MSIs

MSI PREVENTION GUIDANCE INFORMATION SHEETS



WSBC Worksheet for MSI Risk Assessment

1. Force required

Physical demands risk factor

Determine if any of the following

Low risk	Moderate risk
<input type="checkbox"/> Pinch gripping unsupported objects less than 2 hours total per day.	<input type="checkbox"/> Pinch gripping unsupported objects (2 lb.) for more than 2 hours total per day.
<input type="checkbox"/> Pinch gripping supported objects less than 2 hours total per day.	<input type="checkbox"/> Pinch gripping supported objects (2 lb.) for more than 2 hours total per day.

Contributing risk factors

- Aspects of workplace layout (working reaches, working heights, seating, floor conditions)
- Describe: _____
- Characteristics of objects handled (size and shape, load condition and weight)
- Describe: _____
- Environmental conditions (cold temperatures)
- Describe: _____
- Organization of work (work-recovery cycles, task variability, work rate)
- Describe: _____

Notes and observations:

4. Contact stress

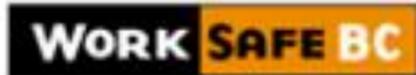
Physical demands risk factor

Determine if any of the following MSI risk factors are present. Check the boxes for the highest level of risk.

Hands	Knees	Local pressure																		
<table border="1"> <thead> <tr> <th>Low risk</th> <th>Moderate risk</th> <th>High risk</th> </tr> </thead> <tbody> <tr> <td> <input type="checkbox"/> Using a hand as a hammer less than 10 times per hour for less than 2 hours total per day. </td> <td> <input type="checkbox"/> Using a hand as a hammer more than 10 times per hour for more than 2 hours total per day. </td> <td> <input type="checkbox"/> Using a hand as a hammer more than once per minute for more than 2 hours total per day. </td> </tr> </tbody> </table>	Low risk	Moderate risk	High risk	<input type="checkbox"/> Using a hand as a hammer less than 10 times per hour for less than 2 hours total per day.	<input type="checkbox"/> Using a hand as a hammer more than 10 times per hour for more than 2 hours total per day.	<input type="checkbox"/> Using a hand as a hammer more than once per minute for more than 2 hours total per day.	<table border="1"> <thead> <tr> <th>Low risk</th> <th>Moderate risk</th> <th>High risk</th> </tr> </thead> <tbody> <tr> <td> <input type="checkbox"/> Using a knee as a hammer less than 10 times per hour for less than 2 hours total per day. </td> <td> <input type="checkbox"/> Using a knee as a hammer more than 10 times per hour for more than 2 hours total per day. </td> <td> <input type="checkbox"/> Using a knee as a hammer more than once per minute for more than 2 hours total per day. </td> </tr> </tbody> </table>	Low risk	Moderate risk	High risk	<input type="checkbox"/> Using a knee as a hammer less than 10 times per hour for less than 2 hours total per day.	<input type="checkbox"/> Using a knee as a hammer more than 10 times per hour for more than 2 hours total per day.	<input type="checkbox"/> Using a knee as a hammer more than once per minute for more than 2 hours total per day.	<p>Local contact stress occurs when a hard or sharp object comes in contact with the skin (e.g., holding hand tools, handling objects with grooved or uneven edges, using power tool triggers with sharp edges). See MSI prevention guidance: Contact stress for more information on assessing this risk.</p> <table border="1"> <thead> <tr> <th>Low risk</th> <th>Moderate risk</th> <th>High risk</th> </tr> </thead> <tbody> <tr> <td> <input type="checkbox"/> Local contact stress less than 10 times per hour for less than 2 hours total per day. </td> <td> <input type="checkbox"/> Local contact stress more than 10 times per hour for more than 2 hours total per day. </td> <td> <input type="checkbox"/> Local contact stress more than once per minute for more than 2 hours total per day. </td> </tr> </tbody> </table>	Low risk	Moderate risk	High risk	<input type="checkbox"/> Local contact stress less than 10 times per hour for less than 2 hours total per day.	<input type="checkbox"/> Local contact stress more than 10 times per hour for more than 2 hours total per day.	<input type="checkbox"/> Local contact stress more than once per minute for more than 2 hours total per day.
Low risk	Moderate risk	High risk																		
<input type="checkbox"/> Using a hand as a hammer less than 10 times per hour for less than 2 hours total per day.	<input type="checkbox"/> Using a hand as a hammer more than 10 times per hour for more than 2 hours total per day.	<input type="checkbox"/> Using a hand as a hammer more than once per minute for more than 2 hours total per day.																		
Low risk	Moderate risk	High risk																		
<input type="checkbox"/> Using a knee as a hammer less than 10 times per hour for less than 2 hours total per day.	<input type="checkbox"/> Using a knee as a hammer more than 10 times per hour for more than 2 hours total per day.	<input type="checkbox"/> Using a knee as a hammer more than once per minute for more than 2 hours total per day.																		
Low risk	Moderate risk	High risk																		
<input type="checkbox"/> Local contact stress less than 10 times per hour for less than 2 hours total per day.	<input type="checkbox"/> Local contact stress more than 10 times per hour for more than 2 hours total per day.	<input type="checkbox"/> Local contact stress more than once per minute for more than 2 hours total per day.																		

Contributing risk factors

WSBC Tools for MSI Risk Assessment

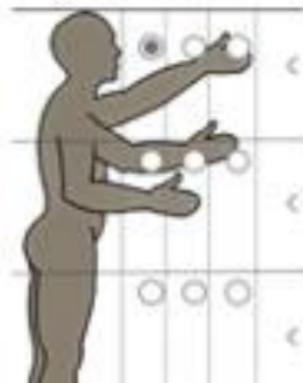


Lift/Lower Calculator

Step 1 › How much is the actual weight you are lifting or lowering?

Actual Weight lb. kg

Step 2 › Where are your hands when they are in the most extreme position (e.g., highest, lowest, and/or furthest away from you) during the lift or lower?



Step 3 › Do you twist your body more than 45 degrees during the lift or lower?

Yes No

Step 4 › How many lifts or lowers per minute?

1 lift every 5+ min

Step 5 › For how many hours per day?

1 hr or less

Step 6 › Click "Calculate" to view the results:

Effective for Controlling MSIs

UNDERSTANDING DEMAND VS. CAPACITY MMH TOOLS

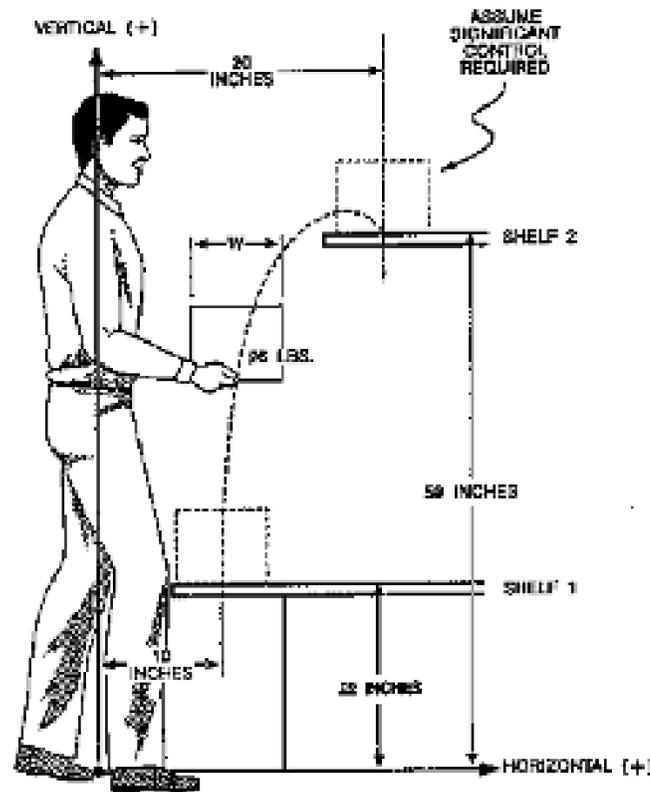
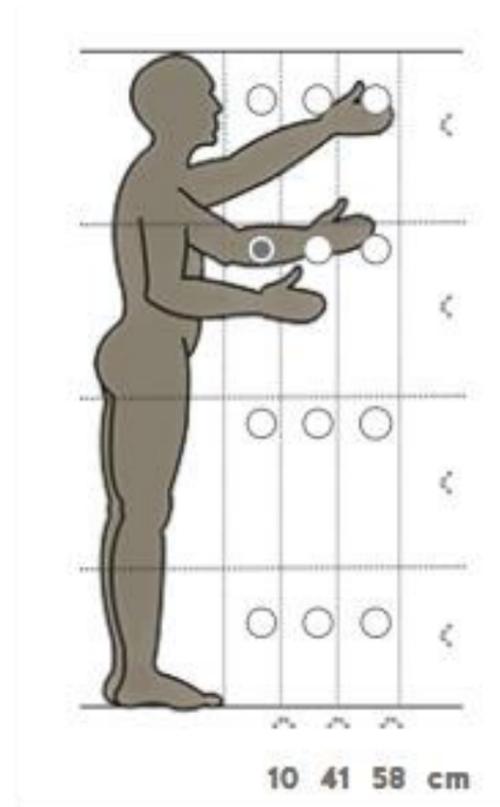
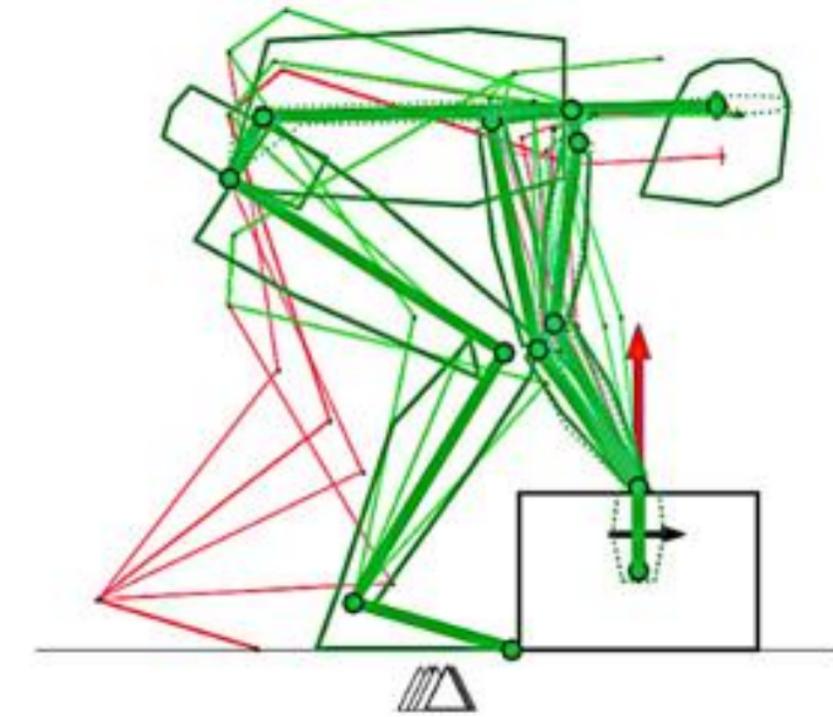


Figure 13 Package Inspection, Example 4

NIOSH Lifting Equation, 1994



WSBC Lift/Lower Calculator



Work(s) Ergo

Musculoskeletal Injury Prevention

SUMMARY

- Build a foundation for your MSI Prevention Program
- Assess and Manage MSI Risks
- Control the MSI risk factors
- Consult with workers throughout the process





AARON DEROUIN

Safety Advisor Specialist - Ergonomics
Manufacturing Safety Alliance of BC
a.derouin@safetyalliance.ca

GEOFF WRIGHT

Ergonomist, Prevention Services Division
WorkSafeBC
geoff.wright@worksafebc.com