Learning Objectives

Upon completion of this unit, students should be able to:

1. Explain the general process for workplace design.
2. Discuss the design principles for standing and sitting operators.
3. Explain work envelopes.
4. Explain human body structures impacted by work-related musculoskeletal disorders (WMSDs).
5. Identify and discuss the types of WMSDs.
6. Discuss the personal risk factors that impact the occurrence of WMSD.
7. Compare and contrast the guidelines to develop programs to reduce WMSDs.

Unit Lesson

This unit focuses on the design of workplaces and hand tools as well as work-related musculoskeletal disorders (WMSDs). The first chapter of the unit introduces the basic ergonomic principles of workplace design and hand tool evaluation. The general process for workplace design and evaluation are also discussed.

A five-step approach for an effective workplace design is shown in Figure 6.1. The first step is to perform an initial evaluation. The tasks and environment should be described thoroughly and include the components of the analysis such as task and process design, workplace design, and equipment design. The second step is to evaluate the workplace and environment including equipment, tasks, and safety. The third step is to analyze human performance. The productivity, output quality, physiological responses (e.g., heart rate), and psychophysical responses (e.g., perceived exertion) can be measured. The fourth step is to compile all results from the analysis and prioritize factors of importance for inclusion in the design. The final step is to develop solutions, which may be multiple design solutions, based on sophistication, costs, and time to implementation.

The working height for a standing operation depends on the activity and the size of the object handled, as shown in Figure 6.2. The elbow height is the main reference point because the hands are used mostly within the range between the elbow and hip heights. Kroemer and Grandjean (1997) provided height guidelines for three types of standing work. For delicate work, such as drawing, the work surface should be 50–100 mm (2"-4") above the elbow height; the elbows should be supported to minimize loading on the back. For manual work, such as light assembly, the work surface should be 100–150 mm (4"-6") below the elbow height, and enough space for hand tools and materials should be provided. For heavy work, such as heavy assembly, the work surface should be 150–400 mm (6"-16") below the elbow height. Although an operator can control the hand movements better when sitting rather than standing, the force exerted by the hands is reduced. An overview of the dimensions for a seated operator is shown in Figure 6.3.
Chapter 7 deals with the nature and risk factors of work-related musculoskeletal disorders (WMSDs) and discusses the evaluation techniques and ergonomic programs to reduce the risks of WMSDs.

The main risk factors of WMSDs are force, repetition, and awkward posture. Back injuries develop over a long period of time by repetitive loading on the spinal discs, which are rubber-like pads filled with thick fluid and serve as shock absorbers. When discs rupture and bulge, the produced pressure on the spinal nerve results in back pain. Carpal tunnel syndrome (CTS) is a condition whereby the median nerve is compressed through the carpal tunnel, which is comprised of eight carpal bones at the wrist (Figure 7.1). Early symptoms include intermittent numbness, along with tingling and burning sensations in the fingers.

The recognition of WMSDs varies among workers. The symptoms of WMSDs can be categorized into three stages. In the first stage, workers experience momentary aches, and symptoms go away with days off from work. In the second stage, symptoms including tenderness, swelling, weakness, numbness, and pain do not go away overnight; workers may have a difficult time sleeping due to the pain. In the final stage, symptoms persist despite complete rest, and sleep is disturbed.

Chapter 7 discusses personal risk factors which are useful in providing training and administrative controls. Buckwalter et al. (1993) found out that MSDs, especially of the back, are among the most prevalent occupational problems of middle aged and older workers. According to the U.S. Department of Health and Human Services (2013), women are three times more likely to have CTS than men.

Screening methods have been developed to diagnose and treat WMSDs. A simple checklist provided by Kroemer et al. (2001) is shown in Table 7.4 in your textbook. Surveillance approaches, which are used to assess risk levels, can be either passive or active. A passive surveillance method is used to evaluate information that already exists in an organization (i.e., injury statistics, quality control data). Active surveillance techniques are used to collect data specifically for given purposes (i.e., ergonomic evaluation of a workplace). Actual physical screening tests can also be used to assess the presence of WMSDs. These methods include Phalen’s test, Durkan test, vibrometry test, and Tinel's test.

The guidelines for developing programs to reduce WMSDs in the former OSHA Ergonomics Legislation are introduced in the chapter 7. Management leadership is required to take an active role in reducing WMSDs. Employee participation is designed to allow employees to actively participate in the procedure for reporting symptoms of WMSDs. Job hazard analysis and reporting should be used to provide the employees information on the hazards and symptoms of WMSDs. Training is required when an employee is assigned to the problem job and additionally at least every three years afterwards. The employer must continually assess the condition of the workplace and the presence of injuries, as well as identify any significant deficiencies in the program.

References


**Supplemental Reading**


**Learning Activities (Non-Graded)**

Apply What You Have Learned

Complete exercises 6.2 and 6.5 on page 199 of your textbook.
1. (6.2) What is the OSHA perspective on ergonomic workplace design?
2. (6.5) Use the AET approach to design the analysis of a real or hypothetical manufacturing task.

Complete exercises 7.1, 7.4, and 7.10 on pages 236-237 of your textbook.
1. (7.1) Discuss the history of non-related musculoskeletal injuries in your country and on a global level.
2. (7.4) What professionals other than truck drivers are particularly exposed to vibrations or impacts?
3. (7.10) List two occupational and two non-occupational risk factors for CTS.

*Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.*