Section VI

ERGONOMICS

CHAPTER 1: BACK DISORDERS AND INJURIES

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BACK DISORDERS AND INJURIES

A. INTRODUCTION

GENERAL

Chronic back disorders can develop gradually as a result of repetitive activity over time. Because of the slow onset and insidious character of this internal injury, the condition is often ignored until the symptoms become chronic.

Acute back injuries are usually the immediate result of improper lifting techniques or too heavy loading rather than from external agents. Injuries can arise in muscle, tendon, bursa, and ligaments, either singly or in combination.

INCIDENCE

Although musculoskeletal disorders including back injuries account for few work-related deaths, they do account for a significant amount of human suffering, loss of productivity, and economic burden on compensation systems.

Musculoskeletal disorders are the leading cause of disability of people in their working years and afflict over 19 million. Half of the nation's work force is affected at some time during their working lives.

An increase in musculoskeletal disorders is already evident. The frequency and economic impact of musculoskeletal conditions including back injuries and disorders on the work force are expected to increase over the next several decades as the average age of the work force increases and medical costs go up.

B. BACK INJURIES

CONTRIBUTING FACTORS

- Fatigue.
- Congenital defects of the spine.
- Increase in service and high-tech hand-intensive jobs.
- An aging work force.
- A reduction in worker turnover for economic reasons.
- Widespread use of vibrating and air-powered tools.
- Proliferation of assembly line techniques, increasing line speed, and piece rates.
- Increased awareness of workplace hazards.

MANUAL MATERIALS HANDLING

Manual materials handling is the principal source of compensable injuries in the American work force, and four out of five of these injuries will affect the lower back.

C. BACK DISORDERS

FACTORS ASSOCIATED WITH BACK DISORDERS

Back disorders result from the cumulative effect of several contributors:

- Poor posture-how one sits or stands.
- Stressful living and working activities-staying in one position for too long or not learning to relax.
- Loss of body flexibility with age, etc.-becoming stiff.
- Faulty body mechanics-how one lifts, pushes, pulls, or moves objects.
- Poor physical condition-losing the strength and endurance to perform physical tasks without strain, as in aging.
- Poor design of job or work station.
- Repetitive lifting of awkward items, equipment, or (in health-care facilities) patients.
- Excessive reaching or twisting.
- Bending while lifting.
- Static bent postures.
- Heavy lifting.
- Lifting with forceful movement.
- Sitting and vibration, as experienced by truck drivers, etc.

SIGNS AND SYMPTOMS

Signs and symptoms include pain when attempting to assume normal posture, shoulder droop, decreased mobility, and need for assistance to stand or rise from a seated position.

D. INVESTIGATION GUIDELINES

RECORDS REVIEW

OSHA 200 LOG

Note when back or other musculoskeletal disorders appear excessive from incidence rate calculations.

To determine if trends exist, at least several years of the OSHA 200 log will be needed for review.

Record or copy information, including occupational titles, departments, dates of injury or illness, from the OSHA 200 log and pertinent OSHA 101 (or equivalent). This information can be used to calculate the incidence rate (see Appendix VI:1-1).

If you determine that there is a need for a more in-depth analysis of the extent and magnitude of the back disorders, see Appendix VI:1-1.

EMPLOYER, EMPLOYEE INTERVIEWS

WALKAROUND

Videotaping can be considered for later viewing at the office.

Observe worker postures and lifting.

Determine weight of objects lifted.

EVALUATION

Videotapes can be later reviewed for evidence of potential musculoskeletal hazards (see Appendix VI:1-3).

Manual lifting:

- Repetitive material handling increases employee's vulnerability to disorders.
- Three variables in evaluating manual lifting tasks to determine how heavy a load can be lifted are: the horizontal distance from the load to the employee, the vertical distance through which the load is handled, and the frequency with which the load is handled.
- Additional variables include floor and shoe traction, space constraints, twisting, two-handed lifts, size of load, stability, gripability, etc.
- NIOSH Lifting Formula, computerized version (see Appendix VI:1-2), is available in area offices.

E. PREVENTION AND CONTROL

ENGINEERING CONTROLS

GENERAL

Alter the task in some way that will eliminate the hazardous motion and/or change the position of the arms, wrists, or body such as adjusting the height of a pallet or shelf.

MANUAL HANDLING TASKS

Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity.

Work methods and stations should be designed to minimize the distance between the person and the object being handled.

Platforms and conveyors should be built above the knee and below shoulder height to minimize awkward postures. Conveyors and rollers should be used for horizontal motion whenever possible. Reduce the size or weight of the object(s) lifted.

High-strength push-pull requirements are undesirable, but pushing is better than pulling. Material handling equipment should be easy to move, with handles that can be easily grasped in an upright posture. Load should be of size that can be handled by most employees.

Bending the upper body and spine to reach into a bin or container is highly undesirable. The bins should be tilted or equipped with collapsible sides.

Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving parts and conveyors closer to the employee.

Workbench or workstation configurations can force people to bend over and tilt the head. Corrections should emphasize adjustments necessary for employee to remain in a relaxed upright stance or fully supported, seated posture.

Store heavy objects at waist level.

Provide lift-assist devices, tables, and hoists.

ADMINISTRATIVE CONTROLS AND WORK PRACTICES

Administrative controls should not be viewed as primary methods of control.

Techniques can be used to identify high-risk jobs and quantify the required job demands.

Worker training and education:

- Training programs range from fundamental instruction on the proper use of tools and materials to instructions on emergency procedures and use of protective devices.
- Training should be job-specific and include exercise programs, stretching, etc.
- Strength and fitness training reduces compensation costs for most fit individuals.
- Back school educates workers in back care.

Rotating of employees, providing a short break every hour, or adding employees may be helpful.

Light work.

OTHER

Standing for extended periods places excessive stress on the back and legs. Solutions include a footrest or rail, resilient floor mats, height-adjustable chairs or stools, and opportunities for the employee to change position.

Sitting is preferable to standing, but the chairs or stools must be properly chosen.

Proper adjustable lumbar support may be provided.

Static seated postures with bending or reaching may have to be evaluated.

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APPENDIX VI:1-1. IN-DEPTH ANALYSIS

The usefulness of the information gained from the review of the OSHA 200 log is limited by internal practices of recording injuries and illnesses. Some plants record everything and some record only those cases that are sent to see a physician. With back disorders, these cases are not always recognized as being work-related and therefore are not recorded. Thus, the Compliance Officer must determine the internal procedure for recording on the OSHA 200, i.e., who records, what cases are recorded, and when cases are recorded (see Field Inspection Reference Manual).

The following is a systematic approach to identifying the extent and magnitude of a disease or injury and is based on epidemiological principles. The approach consists of records review, worker surveys, and job analysis respectively. This information may be used to determine which jobs pose a risk to workers.

WORKERS' COMPENSATION RECORDS

ADVANTAGES

Identify additional cases, departments, and job titles.

LIMITATIONS

Does not include cases where treatment is paid for directly by the employee or comprehensive health insurance.

Describes only most severe and advanced problems. May fail to identity problems in early stage of development.

PLANT MEDICAL RECORDS

In larger plants that employ health care providers, individual employee medical folders, or records, will be maintained and every visit to the health office may be recorded in the record. Such records can be accessed through a medical access order.

There may also be a first-aid log or health office sign-in log.

Entries in these records often include:

- Date of visit,
- Department or location where employee works,
- Description of injury or illness,
- Treatment given, including medications, and
- Work restrictions recommended.

Monthly summaries of employee visits to the health office are often compiled by health office personnel.

If there are too many records, review a random sample of records to identify cases of back disorders.

SAFETY AND ACCIDENT REPORTS

Internal reports that may be available in the health, safety or personnel office.

These cases may not be noted on the OSHA 200 Log or in worker compensation records. Employee may just want to report the injury or disorder and not seek treatment.

PAYROLL RECORDS (If available)

Used to obtain information on number of hours worked.

Serves as crude measure of exposure potential and can be used

to compare jobs in terms of incidence rates of all forms of back disorders.

Useful in identifying job titles or departments with high absentee or turnover rates.

AVAILABLE INFORMATION FROM RECORDS REVIEW

- Total number of back injuries and disorders reported to the company.
- Date each case reported.
- Department or specific job of those who are injured or ill.
- Number of workers on the same job or in the same department.

WHAT YOU CAN DO WITH THE INFORMATION

The incidence rate can be calculated for the entire establishment and for each department. This procedure allows comparison between and within the same departments from year to year.

Incidence rate = (Number of cases)/Total population at risk in a given time period.

- Numerator: Number of workers (cases) in specified group or department that experience a disorder in a specified time period.
- Denominator: Total number of workers in a specified group or department within the same time period.

Note: If counting system recognized only lost-time or Workers Compensation cases, relatively low incidence rates may be computed.

SURVEY THE WORKERS

PURPOSE

Assist in identifying new or early cases of back injury and disorders in the work force. Also useful in smaller facilities where data gathered from records review may be limited. The major reason for this is to collect data on the number of workers that may be experiencing some form of back injury or disorder. This is also a good method for identifying departments or jobs where potential back problems exist.

FACTORS TO BE CONSIDERED IN DESIGNING A QUESTIONNAIRE OR SURVEY

Reading level and primary language of workers if the questionnaire or survey is self -administrated. Wording is very important and must be geared to particular respondents.

Length of the questionnaire (usually should not exceed 20 minutes).

Instructions: Are they clear?

Important questions should be asked first.

Sensitive or personal questions should be asked later in the survey.

Multiple-choice questions are easier to evaluate but limit the potential responses of the person being questioned.

MASS MEDICAL SCREENING

Mass medical screening could be useful.

JOB ANALYSIS AND OBSERVATION

Each job in which workers have a greater incidence of back disorders might be subject to a job analysis after an appropriate records review and worker survey.

WORK-METHODS ANALYSIS

Observe employees at work:

- Notice what employees are doing to make themselves more comfortable in the workplace. For example, look for improvised foot rests, padding, or homemade tools and devices.

- Watch for repeated motions and the position of the arms, wrist and trunk. (e.g., overstretching or unusual posture).

Record the movements, possibly with a videotape camera for later slow-motion analysis.

Describe the positions seen.

An ergonomic check-list can be helpful on inspections.

Work station and tool evaluation may be necessary.

APPENDIX VI:1-2. EVALUATION OF LIFTING TASKS

NIOSH WORK PRACTICES GUIDE FOR MANUAL LIFTING

LIFTING BOUNDARIES

Below the Action Limit represents nominal risk to most industrial work forces. More than 99% of male workers and 75% of female workers can lift loads up to the Action Limit. Lifting in this range is acceptable.

Between the Action Limit and the Maximum Permissible Limit (MPL). When exceeding the Action Limit, compression forces on the lower back are more than 770 pounds, which most young and healthy workers may tolerate. Administrative controls or engineering controls are required.

Above the Maximum Permissible Limit. When exceeding the Maximum Permissible Limit, compression forces on the lower back exceed 1,430 pounds. Only 25% of male workers and 1% of female workers can perform at this level. Both administrative and engineering controls are required for lifting in this region.

CALCULATIONS

Action Limit (AL) in pounds is algebraically represented by:

$$\mathbf{AL\ (\#\ lb) = 90\ (6/H)(1 - 0.01|V - 30|)\ (0.7 + 3/D)\ (1 - F/F_{max})}$$

where:

- H = horizontal location (in inches) forward of midpoint between ankles at origin of lift.
- V = Vertical location (inches) at origin of lift.
- D = vertical travel distance (inches) between origin and destination of lift.
- F = average frequency of lift (lifts/minute).
- F_{max} = maximum frequency which can be sustained (see Table VI:1-1)

MPL = 3 x AL.

For the purpose of this guideline, these variables are assumed to have the following limits:

- H is between 6 inches and 32 inches. Objects cannot, in general, be closer than 6 inches without interference with the body. Objects further than 32 inches cannot be reached by many people.
- V is assumed between 0 and 70 inches, the range of vertical reach for most people.
- D is assumed between 10 inches and (80 - V) inches. For travel less than 10 inches, set D = 10.
- F is assumed between 0.2 (one lift every 5 minutes) and F max (See Table VI:1-1). For lifting less frequently than once per 5 minutes, set F = 0.

Application of the NIOSH guide to lifting tasks assumes the following:

- Lifting task is two-handed, smooth, in front of the body, moderate-width loads, and unrestricted lifting postures. Moderate-width loads are those which do not substantially exceed the body width of the lifter.
- No twisting occurs during lift.
- There is a minimal amount of other manual material handling, such as pushing, pulling, carrying, and holding.
- One-hand lifts are not evaluated with this approach.

- Temperatures outside the 60E - 70E F range may increase risk of injury.

The computed values of the Action Limit and Maximum Permissible Limit are used by the CSHO as a guide to estimating risk. The numbers by themselves do not identify a hazardous activity. The employer's incidence of injuries and development or of lack of programs for training, work practice controls, and engineering controls are elements used to determine the seriousness of the hazard.

Examples of the application of the above lifting formula are available through the Directorate of Technical Support.

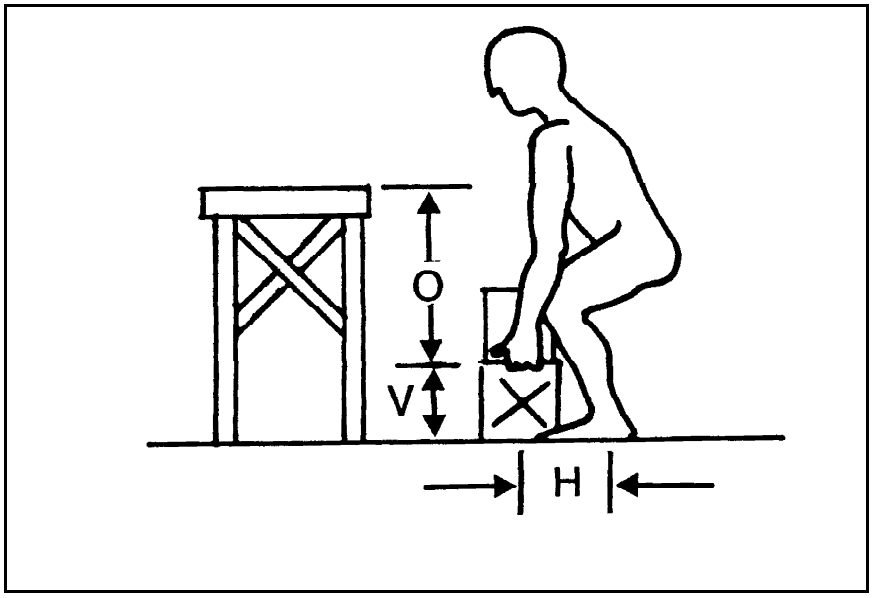

Figure VI:1-1.

TABLE VI:1-1. VALUES FOR F_{MAX}

Time period	*V>30 in Standing lifts/min*	*V≤30 in Stooped lifts/min*
1 hour	18	15
8 hours	15	12

APPENDIX VI:1-3. VIDEO TAPE GUIDELINES AND ANALYSIS

When preparing a video tape of an employee in a work situation, it is important to be aware of the type of analytical tools and analyses which will be applied to the video tape images. It is assumed that a consultant will base their opinion primarily on the use of the NIOSH Work Practices Guide (WPG) and generally accepted principles of manual material handling ergonomics. (A biomechanical model analysis will not be performed.)

Use a stable tripod support for the camera. Record the subject employee from the side and from the front for at least five minutes during normal performance of the task. The picture frame area should include the employee's entire body and the load being handled. Try, also, to record the performance of sporadic task elements. These might include the loading and emptying of machines or parts bins, moving of pallets, and so forth. (While these activities may not be part of the WPG analysis, they will assist in the overall determination of the task hazards.)

Measure and record the following data for use in the direct WPG analysis:

- Horizontal and vertical location of the hands at the beginning of the lift or lower. This distance should be relative to the center of a line connecting the ankles (IAW the NIOSH WPG).
- Vertical distance that the load travels during the lift or lower. This can be measured directly or determined from V (origin) - V (destination).
- Frequency that the load is lifted or lowered.
- Period that the task is performed.
- Weight and dimensions of the load.

To assist with the WPG analysis, also note if the following occur during the lift or lowering:

- Horizontal distances larger than H (origin) at any point during the lift. If these occur, then record when and note the horizontal distance.

To determine if the task complies with the constraints of the WPG, note if the following task criteria are met and explain deviations:

- Is it a smooth lift or lower? (No jerks.)
- Is the lift or lower two-handed and symmetric in the sagittal plane?
- Does the worker have unrestricted working posture? Is it necessary for the worker to stoop because of low ceilings or lean far to the side or front, and so forth?
- Is the load of moderate width? (30 inches or less?)
- Does the worker have good couplings at the hands and feet? (Good grip at hands and low slip potential at the feet.)
- Is the environment favorable? (Are there high or low temperatures, high humidity, high noise levels? Is it necessary for the operator to wear gloves, boots, bulky or encumbering clothing?)

Other information for an analyst:

- Anthropometry of the worker(s), if available.
- Age(s) of the worker(s), if available.
- Distance that the load is carried.
- Is the task performed relatively constantly, or is the task sometimes frequent and other times infrequent?