Evaluation of Ergonomic Hazards at a Label Manufacturing Facility

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Contents

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The cover photo is a close-up image of sorbent tubes, which are used by the HHE Program to measure airborne exposures. This photo is an artistic representation that may not be related to this Health Hazard Evaluation. Photo by NIOSH.

Highlights of this Evaluation

The Health Hazard Evaluation Program received a request from managers at a label manufacturing facility. The employer was concerned about musculoskeletal disorder risk among employees in the finishing departments. We visited the facility in May 2012.

What We Did

- We looked at job tasks to find risk factors for work-related musculoskeletal disorders.
- We looked at logs of work-related injuries and illnesses.
- We spoke with 10 employees about work, medical history, health symptoms, and health and safety concerns.

What We Found

- Employees often reached long distances and worked below their knees and above their shoulders. These postures increased their risk for musculoskeletal disorders of the shoulders and back.
- Of the ten employees interviewed, seven reported no work-related health problems. The three with work-related health problems reported back pain from lifting pallets and repeated ankle sprains.

We evaluated ergonomic concerns among employees at a label manufacturing company. Employees used awkward postures and lifted pallets. We recommend redesigning workstations, rotating employees, and adjusting staffing or assigned work hours to allow employees time to rest and recover.

- Review of the OSHA Logs from 2008–2011 showed an ankle sprain in 2009 and 3 trauma-related incidents among machine operators.
- The company had no program to train new employees how to correctly and safely perform job tasks. There was no formal program to cross-train employees between workgroups on the production lines.
- Short staffing and lack of cross-training resulted in some employees being required to work longer hours. These practices result in shorter rest and recovery times.

What the Employer Can Do

- Design work areas to have a working height of 27 to 62 inches.
- Provide work tables that have adjustable heights so that employees can customize the height.
- Educate employees about musculoskeletal disorders and ergonomic hazards.
- Reduce mandatory overtime hours to allow for greater rest and recovery time. Greater recovery times decrease the risk of repetitive motion injuries.
- Implement a training program to show all new employees how to do their job tasks safely.

- Cross-train employees for multiple job tasks to increase the number of employees who can cover additional shifts.

What Employees Can Do

- Use a pallet lift, two-person lifting, or sliding techniques when handling pallets.
- Avoid working below the knees and above the shoulders or reaching across pallets or conveyor belts.
- Take part in safety and ergonomic committees.
- Report symptoms and injuries to supervisors and medical staff as soon as they happen.

Introduction

The Health Hazard Evaluation Program received a request from managers at a label manufacturing facility in Pennsylvania. The employer was concerned about the potential for musculoskeletal disorders among employees working in the film and paper finishing departments. In May 2012, we evaluated the facility. We provided a letter detailing our evaluation and preliminary recommendations to employee and employer representatives later that month.

Process Description

The company received large rolls of paper adhesive that were cut to size on the basis of the specific purchase order. The company also received large film and adhesive rolls, which they joined through a fully automated system, and then cut the resulting product to size as specified by the purchaser. Approximately 110 employees worked at this facility. We evaluated the paper and film finishing areas, specifically the areas where employees received finished rolls of material and used a piece of equipment called an upender. The upender transferred finished rolls from a horizontal conveyor onto a wooden pallet for shipping (Figure 1). Ten employees were trained to work at the upender; two employees were present during each shift.

Figure 1. The upender transferring a roll of labels from a horizontal conveyor (left side of the picture) onto a pallet for shipping (right side of the picture). Photo by NIOSH.

Methods

The objective of this evaluation was to determine the potential for musculoskeletal disorders among employees working in the film and paper finishing departments, particularly those working the upender. We observed workplace conditions and work processes and practices. A full description of the ergonomic evaluation criteria we used to determine risk factors for work-related musculoskeletal disorders is provided in Appendix A. All employees in the finishing department who could work the upender were invited to participate in voluntary, confidential medical interviews. The interviews provided an opportunity for employees to discuss work practices, medical history, and health and safety concerns. We also reviewed the facility's Occupational Safety and Health Administration Form 300 Logs of Work-Related Injuries and Illnesses from 2008–2011.

Results and Discussion

During our visit, employees selected and retrieved the appropriate pallet for purchase orders on the basis of the size of the label roll. Common pallet sizes were 29 inches by 54 inches and 40 inches by 48 inches, but a wide variety of sizes was available for each client's request. Pallets weighed 30 to 45 pounds. Pallets are awkward to move and moving them increases the risk of shoulder and back strains [Eastman Kodak Company 2004]. Empty pallets were stacked around the work areas at heights ranging from floor level (3 inches) to above shoulder height (58 inches). Pallets in the film area were located around the perimeter of the work area and provided good access to the upender. Pallets in the paper area were also located around the perimeter, but some were stacked close to the upender, resulting in limited access to the upender. The paper area had an overhead pallet manipulator; however, some employees would maneuver the manipulator over the pallets stacked close to the upender rather than maneuver the manipulator around these pallets. This activity increased the number of reaches above shoulder height.

Employees had to build a wedge form on the pallet to hold the label roll in place. The form consisted of cardboard or plastic wedges attached to a thick piece of paper (Figure 2). Employees built the forms in different locations depending on their preference. Some built the form on a stack of pallets, which ranged in height from 22 to 36 inches, while others built the form on the upender, between 22 and 26 inches off the floor. Employees frequently bent low at the waist and reached across the pallet when building or attaching a form to a pallet (Figure 2). These postures often resulted in excessive bending of the back and produced extended reaches of 29 inches to over 40 inches. Building forms with the pallet positioned on the center of the upender required employees to reach even further when making the form.

Figure 2. Employee making a form to hold a roll of labels. Photo by NIOSH.

After building a form to hold the label roll, employees moved the roll of labels from a conveyor onto the upender. The upender was equipped with a ball transfer system to ease moving the roll into the correct position. The employee then pressed a button, and the upender automatically transferred the roll from the horizontal conveyor to the pallet for shipping. Employees strapped the roll to the pallet with nylon banding that they inserted through the center hole in the paper roll. For large rolls, employees attached the strapping band to a pipe that the company had designed to help pull the band through the center hole in the paper roll. Because the upender conveyor was larger than even the largest pallet, we observed that employees had to use an extreme forward reach during the process of attaching strapping bands to the rolls and pallets for shipment. In the film area, a step had been constructed to ease stepping onto the upender during this task. However, the step was not always used. Employees who did not use it had to stand behind the step, bend low at the back, and reach forward (Figure 3). After strapping, the band on the roll was tightened and cut with a powered strapping tool.

Figure 3. Employee installing a strap to hold a paper roll on the pallet. Photo by NIOSH.

After a roll was strapped to the pallet, a conveyor moved it to an automated wrapping machine that wrapped the roll in plastic film. Afterwards, an employee used a forklift to remove the pallet from the conveyor and place it in the shipping area. Usually there were dedicated employees using the forklifts. When upender employees had to make the pallets and move them with forklifts, they were concerned about sprains and strains from getting in and out of the forklift multiple times per shift.

Ten employees representing all three shifts participated in confidential interviews. All but one was male with ages ranging from 27 to 61 years of age (median age 43 years). Duration of employment at the facility ranged from 2.5 to 29 years (median 6.5 years), and duration at the current position at the facility ranged from 1 month to 7 years (median 2.5 years). Current positions represented were line packing, upending, forklift driver, team manager, and rewinder machine operator. The health problems that three employees felt were related to their job included back pain from heavy lifting and multiple ankle sprains from getting in and out of the forklift multiple times a day. The medical interviews of these ten employees indicated that two had symptoms consistent with work-related health problems, specifically, back pain from heavy lifting.

Work organization issues and task training were also discussed during the interviews and closing conference. Employees reported that there was no formal training program regarding use of lift assist devices or instruction on the musculoskeletal disorder risks of their jobs. We observed employees bending and reaching at awkward angles when they secured forms on the pallet and placed the strap through the middle of the roll. These actions were repeated for every label roll that came down the conveyor belt. Each job took between 2 and 3.5 minutes to complete. It has been estimated that application of good ergonomic design can prevent up to half of all work-related musculoskeletal disorders [Snook et al. 1978; Snook 1987].

There were no written standard operating procedures for the facility and new employees were taught specific job tasks by shadowing another employee until they felt comfortable functioning on their own. There was no formal assessment of employee task competency before new employees were allowed to work independently. There were no back injury prevention programs in place. A good back injury prevention program should include an evaluation of several factors, including the physical and psychosocial characteristics of the work, as well as the management of work environment and equipment [Berthelette et al. 2012].

During interviews, upender employees reported recurrent ankle sprains that they attributed to repeatedly climbing in and out of the forklifts. Ankle and foot problems have been associated with the number of times that truck/forklift operators get in and out of a vehicle, as well as foot biomechanics, age, and gender [Werner et al. 2010].

Employees were not cross-trained between job tasks and only a few people were qualified for each job task. Employees stated they were often asked to work mandatory overtime to compensate for short staffing, which resulted in the same small group of employees working longer hours. Employees reported that rotation among the repetitive tasks did not occur. Allowing adequate recovery periods is a vital aspect of preventing repetitive motion injuries. Prolonged periods of mandatory overtime from an already undersized employee pool may place those employees at increased risk for musculoskeletal disorders due to a lack of an adequate rest and recovery period. The National Institute for Occupational Safety and Health recommends using administrative controls to incorporate rest and recovery periods into the workday by rotating workers through several jobs with variable level of physical demands or use of different muscle groups. Reducing shift duration and overtime hours can help to ensure employees have an adequate period to rest and recover [NIOSH 1997a].

Review of the Occupational Safety and Health Administration Logs from 2008–2011 showed an ankle sprain in 2009. There were 3 trauma-related incidents among machine operators. No incidents were reported in 2011.

Conclusions

Our observations indicate that workstations at this facility were not designed so that most people could safely perform job tasks. Employees were working in awkward postures that put them at risk for developing work-related musculoskeletal disorders. Specifically, hand working heights were too low or too high, reach distances were too long, and employees had to continually bend at the waist to perform their work functions. Employee concerns during interviews about back pain were consistent with the ergonomic findings. Lack of a formal training program on job tasks resulted in a workforce that had inconsistent knowledge of how to do its job safely. Some employees were required to work long hours, which put them at an increased risk of injury because of lack of adequate recovery time.

Recommendations

On the basis of our findings, we recommend the actions listed below. Many of the recommendations were obtained from The Handbook of Ergonomic Design Guidelines [Humantech 2009]. We encourage the label manufacturing facility to use a labor-management health and safety committee or working group to discuss our recommendations and develop an action plan. Those involved in the work can best set priorities and assess the feasibility of our recommendations for the specific situation at this facility.

Our recommendations are based on an approach known as the hierarchy of controls. This approach groups actions by their likely effectiveness in reducing or removing hazards. In most cases, the preferred approach is to eliminate hazardous materials or processes and install engineering controls to reduce exposure or shield employees. Until such controls are in place, or if they are not effective or feasible, administrative measures may be needed.

Engineering Controls

Engineering controls reduce employees' exposures by removing the hazard from the process or by placing a barrier between the hazard and the employee. Engineering controls protect employees effectively without placing primary responsibility of implementation on the employee.

1. Provide pallet stack heights that match ergonomic design guidelines [Eastman Kodak Company 2004]. In general, employees should not work below the knees or above the shoulders. Employees should not remove pallets from a stack more than nine pallets high.
2. Use a pallet lift to move pallets instead of manual handling. Two-person handling is an alternative.
3. Remove obstructions between the origin and destination of the pallet.
4. Redesign the area around the paper finishing upender to better accommodate the pallet lift assist. The current layout requires the employee to either walk around the pallets or maneuver the lift over stacks of pallets. Avoiding congestion will minimize maneuvering time and reduce the potential for shoulder injuries.
5. Place pallets on platforms that adjust so that pallets are at appropriate working heights when employees attach wedge forms. These platforms should rotate to position the pallet close to the employee especially when the employee attaches wedges to the pallet.
6. Provide workstation dimensions that match ergonomic design guidelines [Humantech 2009]. Hand working height should be 29 to 62 inches for standing work. In general, employees should not work below the knees or above the shoulders. Reach distances should be less than 16 inches for frequent reaches and less than 22 inches for infrequent reaches.
7. Reduce the width of both upenders, taking into consideration the size of the largest pallet. This change will reduce reach distances and bending.
8. Replace the steps on either side of the upender in the film area with steps that can be folded up when not in use. This change should reduce bending at the waist and reaching forward over the step when it is not in use.

9. Install another ball transfer system on the conveyor after the upender to allow employees to rotate the pallet in different directions while completing the strapping process.

Administrative Controls

The term administrative control refers to employer-dictated work practices and policies to reduce or prevent hazardous exposures. Their effectiveness depends on employer commitment and employee acceptance. Regular monitoring and reinforcement are necessary to ensure that policies and procedures are followed consistently.

1. Write standard operating procedures for each job task. The procedures should include the following to reduce overexertion injuries:
    a. Require that employees handling pallets slide the pallet off the horizontal stack, and then slide it onto the conveyor. Employees should never carry the full weight of the pallet alone. When a pallet lift is not available or feasible, two-person handling is an alternative.
    b. Require that all papers and wedges be attached to the pallet at the appropriate heights and reach distances (listed above) before the pallet is placed on the upender. This practice will eliminate extended reaching. Reaching across conveyor belts/pallet widths to hammer in forms should be discouraged as this motion could increase risk for back injury.
2. Revisit the slotting procedures for pallets in each finishing area. Keeping only the most frequently used pallets will eliminate unnecessary materials around the workspace.
3. Increase rest and recovery times for specific job tasks by increasing staffing, cross-training employees for multiple tasks, and implementing a rotation pattern at each break or lunch (i.e., every 2 hours). Rotate employees between jobs that use different muscle groups.
4. Use dedicated forklift drivers so employees working the upender can focus on upender tasks. Dedicated forklift drivers should move pallets so upender operations do not back up.
5. Design and implement a formal training program for new employees that includes a formal skills and safety evaluation by a supervisor before the employee is permitted to work unsupervised. Supervisors should perform periodic work task evaluations to ensure employees continue to perform job tasks in the prescribed manner after their initial training is complete.
6. Provide ergonomics training to all employees on an annual basis. This training should include recognition of workplace musculoskeletal disorder risk factors, signs and symptoms of musculoskeletal disorders, and best practices to perform tasks (some of which are listed above for inclusion in the standard operating procedures).
7. Encourage employees to report symptoms early to the facility's on-site occupational health clinic so they can be addressed before they develop into a long-term disability.

Appendix A: Evaluation Criteria and Health Effects

Musculoskeletal disorders are conditions that involve the nerves, tendons, muscles, and supporting structures of the body. They can be characterized by chronic pain and limited mobility. Work-related musculoskeletal disorder refers to (1) musculoskeletal disorders to which the work environment and the performance of work contribute significantly, or (2) musculoskeletal disorders that are made worse or longer lasting by work conditions. A substantial body of data provides strong evidence of an association between musculoskeletal disorders and certain work-related factors (physical, work organizational, psychosocial, individual, and sociocultural). The multifactorial nature of musculoskeletal disorders requires a discussion of individual factors and how they are associated with work-related musculoskeletal disorders. Strong evidence shows that employees whose work tasks involve high levels of static contraction, prolonged static loads, or extreme working postures involving the neck/shoulder muscles are at increased risk for neck/shoulder musculoskeletal disorders [NIOSH 1997b]. Further strong evidence shows job tasks that require a combination of risk factors (highly repetitious, forceful hand/wrist exertions) increase risk for hand/wrist tendonitis [NIOSH 1997b]. Finally, evidence shows that low-back disorders are associated with work-related lifting and forceful movements, awkward postures such as bending and twisting, and whole body vibration [NIOSH 1997b]. A number of personal factors can also influence the response to risk factors for musculoskeletal disorders: age, sex, smoking, physical activity, strength, and body measurements. Although personal factors may affect an individual's susceptibility to overexertion injuries/disorders, studies conducted in high-risk industries show that the risk associated with personal factors is small compared to that associated with occupational exposures [NIOSH 1997b].

In all cases, the preferred method for preventing and controlling work-related musculoskeletal disorders is to design jobs, workstations, tools, and other equipment to match the physiological, anatomical, and psychological characteristics and capabilities of the employee. Under these conditions, exposures to risk factors considered potentially hazardous are reduced or eliminated.

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