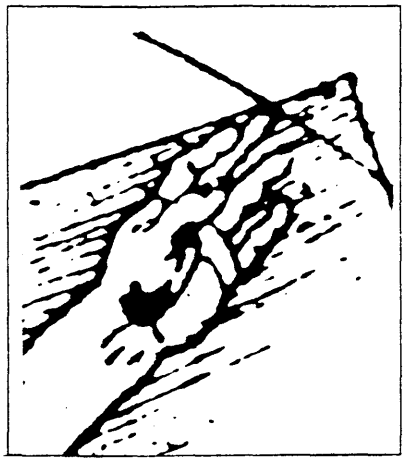
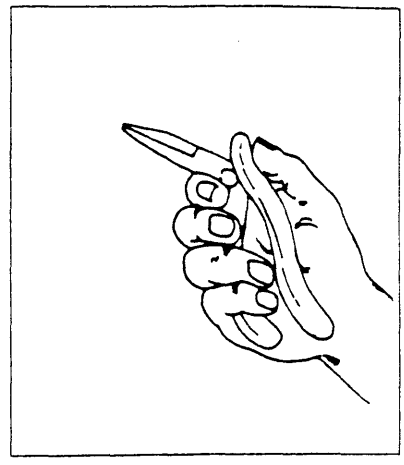


Ergonomics: Adapting the Job to Fit the Person



By Mary Lee Benton

What is Ergonomics?

The term "ergonomics" comes from the Greek words ergon (work) and nomos (law).[1] Ergonomics can be simply defined as the study of work. Industrial ergonomics deals with the interaction between people, machines, and their work environment. As a science, ergonomics matches work demands with worker strengths and limitations through proper design of jobs, products, workplaces, and equipment. It focuses on how people can effectively function in their work environment. For example, ergonomics considers the design and function of controls, displays, safety devices, lighting, temperature, workplace layout, tools, and work methods. Ergonomics helps adapt the job to fit the person, not force the person to fit the job.[2,3] Adapting the job to fit the worker can help reduce or eliminate many potential injuries or illnesses. A closer look at some jobs and how their demands may affect worker safety and health will provide a better understanding of the role and importance of ergonomics in protecting workers.

Meatpackers

Any job that requires continuous repetitive or forceful motions, placing stress or strain on the body, can be considered a high risk for worker injuries. The meatpacking industry is considered as one of the most hazardous industries in the United States, with an injury rate three times higher than that of manufacturing.[4,5]

Workers who debone meat make as many as 10,000 repetitive cuts per day, in an assembly line process, with no variation in motion. Since small numbers of workers perform specific tasks over and over, they are expected to make more cuts, causing stress and strain on the wrist and other parts of the body.

Hand tools, such as knives, account for half of the total number of injuries sustained in meatpacking and dressing plants. Workers are sometimes cut by their own knives and by other workers' knives during the butchering process.[6] Crowded working conditions and slippery floors, along with dangerously high noise levels, greatly increase the risk of injuries. Back injuries are also common, as a result of loading and unloading meat racks, or meat trees along overhead rails. Workers also are often exposed to extreme conditions of heat and cold within these plants.[7]

Garment Workers

The "sweat shops" of the early twentieth century produced more than just sweat. Most workers sustained disabling wrist, back and leg injuries from pushing large amounts of materials through machinery. It's not much better today.

Garment workers, in doing fast-paced piecework, suffer from crippling repetitive strain injuries. In piecework, the employee is paid according to the number of pieces that are produced in a workday. These demands push workers for more output, placing added strain on the wrists, arms, shoulders and legs from excessive repetition in performing tasks and in operating machinery.

Other reported environmental factors that affect worker health are humidity, air movement, lack of temperature controls, heat radiation, badly placed lighting, and excessive noise. Health researchers have found that workers develop allergic reactions, fatigue, colds, respiratory problems, dry skin, and high blood pressure from unhealthful work environments. Poor working conditions, in turn, affect work performance and morale among workers.[8]

Computer Operators

In the past, there was little emphasis on the need for providing workers with equipment or workspace that was properly designed with the physical limitations of the worker in mind. Over time, there has been an increased awareness of the importance of a safe and healthful work environment and the role work environment plays in reducing accidents and injuries. In recent years, the role of ergonomics has become increasingly important in helping to assure safe and healthful work and work places. This has become more apparent with the growing use of computers and video display terminals (VDTs).

According to the National Academy of Sciences,[9] in 1976, there were only 675,000 VDTs in U.S. workplaces. By 1986, there were about 28 million; by 1990, the number is expected to increase to more than 40 million. And

according to one source,[10] by the year 2000 half of the American work force will be using computers at work.

Many computer operators express concern about radiation* emissions and often complain about poor lighting and ventilation and improperly designed work stations. Operators complain about headaches, backaches, stress, swelling and pain in the wrists, eye strain, and fatigue.

In fact, recent studies[11] verify that various environmental factors do affect these workers. For example, chair design did not accommodate the height and contours of the human body, eventually causing spinal damage and other musculoskeletal problems. Excessive overhead illumination produced glare from the screen, causing eye irritation, eye fatigue, headaches, and blurred vision. The computer components--the monitor and keyboard--were often positioned at uncomfortable heights, causing pain and stiffness in the neck, arms, back, shoulder, wrists and hands.[12,13] Work surfaces, including writing tables, were not adjustable for height, distance or easy manipulation.[14-16]

Health and safety experts agree that more needs to be done to correct ergonomic problems like those suffered in meatpacking, garment making and computer operations. Workers must be protected from developing repetitive motion disorders. Repetitive strain injuries or cumulative trauma disorders (CTDs) are a major occupational health hazard in America today.[17]

The Problems

Symptoms of CTDs include pain, stiffness, swelling and numbness of the back, hands, wrists or upper body due to repeated exertions and body movements. Although these illnesses can occur in nearly all tissues--the nerves, tendons, tendon sheaths, and muscles--the tissues in the upper areas of the body are the most frequently affected.

These painful and sometimes crippling injuries result from repeated twisting and bending of hands, arms and wrists, developing gradually over periods of weeks, months, and years.[18,19] A common risk factor among these disorders is use of force combined with repetitive motion over long periods of time.

The most common occupational diseases associated with CTDs are carpal tunnel syndrome, tendonitis, tenosynovitis, De Quervain's disease, trigger finger and Raynaud's phenomenon. Tendonitis and tenosynovitis are tendon disorders that cause inflammation of the tendon and tendon's sheath, respectively. With De Quervain's disease, the tendon sheath of the thumb is inflamed. Trigger finger is attributed to the creation of a groove in the flexing tendon of the finger.[20]

Raynaud's phenomenon is also known as "white fingers," and "vibration syndrome." It is associated with vibrating tools where the vibration damages the blood vessels of the hand. The skin and muscles are unable to get the necessary oxygen from the blood and eventually die. This condition is also intensified when the hands are exposed to extremely cold temperatures.[21]

Carpal tunnel syndrome (CTS) is becoming more frequently reported as a health hazard in the United States, especially among white collar workers. More than half of the work force is at risk of developing CTS.[22]

Anyone whose job demands a lot of repetitive wrist motion--and it needn't be strenuous wrist motion--might be a victim of CTS without being aware of it.

CTS is the compression and entrapment of the median nerve where it passes through the wrist into the hand--in the carpal tunnel.[23] When irritated, tendons housed inside the narrow carpal tunnel swell and press against the nearby median nerve. The pressure causes tingling, numbness or severe pain in the wrist and hand, often felt at night.[24] If it continues, it can damage the nerve, causing permanent loss of sensation and even partial paralysis.

Medical treatment for CTS is limited and may not be successful.[25] When all else fails, surgery is the last resort, and only when the disease has progressed to the stage where there is total numbness in the hand and wrist. Permanent disability can result even with surgery, and the condition often recurs if the worker returns to the same job.[26]

In recent years, the number of reported cases of CTS has increased dramatically, striking 23,000 workers a year, costing about $3,500 in benefits and rehabilitation per person, and about $30,000 in surgical fees per person.[27,28] Nationally, 73,000 work-related cases of the syndrome and similar disorders were reported to the Bureau of Labor Statistics in 1987.[29] The number of actual cases, many of which go undetected or untreated, may be as high as 250,000.[30] A Congressional study has indicated that an estimated 20 million workers are at an increased risk of developing CTS.[31] Today, more than half of all U.S. workers have jobs with the potential for CTS, according to the National Institute for Occupational Safety and Health (NIOSH).[32] But the syndrome is most common among meat and poultry workers, letter sorters, carpenters, garment and upholstery workers, shoe and boot workers, electronic assemblers and other assemblers, packers, product inspectors, some machine operators, typists, keypunch operators and cashiers.

Since the early 1980s, CTS also has been reported widely in many service-sector jobs. And now, it has struck thousands of office workers who use computers, including workers in dozens of newspapers and news services.[33]

Many employers are suspicious of workers complaining of CTS, because the employers have difficulty distinguishing between simple cases of discomfort and the disease.[34] Some companies frequently dispute CTS-related worker compensation claims, even when safety experts cite safety and health hazards in the workplace, and medical mismanagement as causes for such injuries. Employees, too, are often unaware of the causes of CTS and what to do about it. They don't associate their pain with their work. When workers finally do seek medical help, they are often given

* There is no conclusive scientific evidence that radiation causes adverse health effects. (See also NIOSH study, reference 11.)

Hand tools, such as knives, account for half of the total number of injuries sustained in meatpacking and dressing plants.

medical help, they are often given the wrong diagnosis and find the road to recovery takes more time and money than they had anticipated.

For persons in occupations involving the use of heavy equipment, such as a truck or bus driver, farm vehicle operator or mold-shakeout operator, the entire body can be exposed to excessive vibration. Whole-body vibration has been associated with musculoskeletal problems such as slipped discs. If the job requires extensive use of vibrating tools, a worker's hands, arms, and back can sustain irreversible damage. According to NIOSH,[35] the problems associated with whole-body vibration affect about 6.8 million workers. Another 1.2 million workers are exposed to hand-arm vibration when using chain saws, riveters, chippers and grinders, lawn maintenance tools, nail guns and jackleg type drills.

One of the oldest and best recognized occupational health problems in the world is back injuries. It is estimated that eight out of ten Americans will suffer a back problem. Disabling back injuries are one of the leading causes of job-related disabilities in the United States, affecting 8 percent of the population--or 20 million people each year.[36]

Insurance experts estimate that lower back injuries account for 25 percent of all workplace injuries and 33 percent of compensation costs.[37] In 1986, OSHA reported that back problems result in an estimated 96.5 million lost workdays, at a total cost of $18 billion.[38]

Back injuries are frequently caused by working or lifting with poor posture, twisting and bending, handling loads that are too heavy or too big, even when seated, and performing tasks in one posture/position for extended periods.

Truck drivers tend to have the highest incidence of back injuries. But any workplace, from construction sites to factories, hospitals to offices, can present the danger of back injury. Twisting and bending are the main cause of work-related back injuries--only 30 percent of workplace back injuries are caused by lifting alone.[39]

Another factor to consider is that most disabling back problems result from chronic or repeated strains to the back--not just from one specific incident. The initial injury to spinal discs, muscles or ligaments may not be noticeable on a day-to-day basis. Once the back is injured from repetitive pulling and straining, however, the back muscles, discs and ligaments can become scarred or weakened, making the worker susceptible to still more back injury. When a muscle or ligament is injured, it causes pain, which results in muscle spasms or tightening. The more spasms, the greater the pain.[40]

Some Solutions

Experts believe that at least half of all occupational injuries could be eliminated by changing ergonomic conditions. Safety supervisors, engineers and other trained individuals can learn to anticipate what can go wrong and alter the tools and environment to make the task safe in ergonomic terms.

Although there are many environmental factors to consider, one of the easiest but most important is providing frequent rest breaks and job rotation from work that involves highly repetitive motion.

Maximum flexibility should be designed into equipment. A good illustration is detachable keyboards and adjustable furniture for VDT operators. Work tables and chairs should be height adjustable to provide proper back and leg support.

Proper lighting and anti-glare devices should be installed to prevent glare. Work areas should have tem-

perature controls and adequate ventilation. High noise levels can be lowered by using engineering controls and by isolating or enclosing noisy equipment.

Until recently, machine and tool design has been based almost entirely on factors like speed, quality of production and comparative cost,[41] with little consideration of the machine's repetitive motion demands on operators.

Employers can prevent many cumulative trauma illnesses by selecting tools that are light-weight with long or specially designed handles that allow for a relaxed grip and permit the wrists to remain straight.[42] Whenever possible, the weight of the tool should be counter balanced to make it easier to handle and reduce vibration. Employees should be taught how to properly hold and manipulate tools so stress on the hands and wrists can be minimized.

Anti-vibrational equipment and pneumatic tools can help reduce whole-body and hand and arm vibration. Control dials and switches should be placed on machinery in a convenient area for easy access to reduce the need for excessive reaching and bending.[43]

Also, using mechanical material handling equipment rather than requiring workers to manually lift and carry materials is an effective way to reduce lower back pain and other musculoskeletal injuries.

What Works?

Today, as workers are becoming more aware of the hazards of poorly designed equipment and work processes, they are becoming more insistent that the hazards be more fully considered and avoided.

A cooperative approach invariably works best. Unions and management can work together to establish joint ergonomic programs, make recommendations for change and implement them as necessary. In the long run, attention to ergonomic issues will save employers money by reducing compensation costs. Employees benefit, too. They are healthier, absenteeism is lower, and morale improves.

OSHA Efforts

While change will necessarily take place in the nation's workplaces as a result of employer and employee actions, there is a vital role for OSHA as well.

On June 6, 1989, the Department of Labor's Acting Assistant Secretary for Occupational Safety and Health, Alan C. McMillan, testified before the employment and housing subcommittee of the House Government Operations Committee that OSHA will implement a national special emphasis program in ergonomics directed first at the red meat (beef processing) industry.

The purpose of this program is to encourage companies to undertake a feasible ergonomics program by identifying and correcting ergonomic problems in the workplace. OSHA will follow up with inspections, focusing primarily on larger corporations. As part of this program, the agency's enforcement teams for these inspections will be given additional training in the recognition and correction of ergonomic hazards.

In addition, OSHA plans several other programs to help employers and employees recognize and correct ergonomic hazards in the workplace. The programs include an information outreach that will make available fact sheets on back injuries, heat stress and the use of video display terminals. The agency has also made available a "Safety and Health Guide for the Meatpacking Industry"[44] and a pamphlet on "Working Safely with Video Display Terminals."[45]

Training and educational aids are available through OSHA's Training Institute. Many of these instructional aids were developed with the assistance of OSHA's New Directions training grant program.** Some of the grantees include the United Food and Commercial Workers, the New Hampshire Safety Council, the University of Oregon, and the International Ladies' Garment Workers Union.

OSHA also funds consultation projects in each state to offer free advice to employers at their request. Consultants provide information and guidance in recognizing and eliminating hazards, as well as developing an effective occupational health and safety program.

OSHA provides funding to states with safety and health programs approved under section 18(b) of the Occupational Safety and Health Act (P.L.91-596, December 29, 1970). States with OSHA-approved plans must have standards and enforcement requirements at least as effective as the federal standards. OSHA approves and monitors these plans. Currently, there are 25 states with their own safety and health programs: 23 cover private and public (state and local government) sectors and 2 cover public sectors only.

OSHA also gives special recognition to companies that have strong safety and health programs under the Voluntary ProtectionProgram (VPP). The goal of VPP is to encourage American industries to develop a comprehensive and effective job safety and health program, including ergonomics issues, that results in improved safety and health conditions.

These and other cooperative efforts have as their basis employer and employee participation in recognizing and correcting workplace hazards. Consideration of ergonomics in the workplace is an essential step in preventing potential hazards and in advance worker protection.

According to Roger Stephens, Ph.D., an OSHA ergonomist, "Basically, ergonomics is telling people to look at three things: the individual from a physiological and biomechanical perspective, realizing we all have fragile limitations that traditionally people have not understood; the tasks people have to do and the tools they work with; and last is the design of the workplace itself."

"It's cost-effective to do ergonomic analysis. It's a proactive endeavor where workers, management, government, and academia can work together to try and improve the quality of methods, tools, work stations and lastly, the work itself."

** Under the New Directions Program, OSHA awards grants to organizations for the development of training and related programs for their members.

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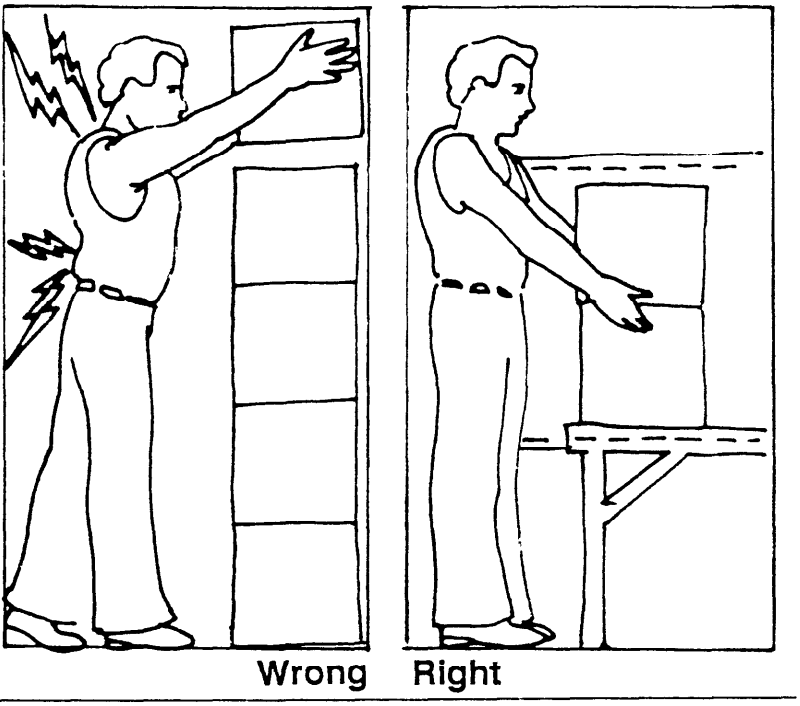

Disabling back injuries are one of the leading causes of of job-related disabilities in the United States.

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