Special Hearing on Ergonomics

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My qualifications to testify:

I am a physician and researcher with over ten years of experience in treating and studying occupational musculoskeletal disorders (MSDs). I am currently an Assistant Professor of Medicine at Washington University School of Medicine, where I am Chief of the Division of General Medical Sciences and the Richard and Elizabeth Henby Sutter Chair of Occupational, Industrial, and Environmental Medicine. As a medical researcher, I have published more than two dozen peer-reviewed journal articles, dealing primarily with the diagnosis and treatment of musculoskeletal disorders and the prevention of work-related injuries. I have also presented findings of my research at numerous scientific meetings, and have served as the chairperson of sessions at scientific meetings devoted to the prevention of occupational musculoskeletal disorders. I serve as a reviewer for several medical and public health journals. I have been involved in the national debate concerning ergonomics and work-related musculoskeletal disorders through my participation as an invited speaker at the 1998 National Academy of Sciences meeting on "Work-Related Musculoskeletal Disorders: A Review of the Evidence." I have also served as a member of the American National Standards Institute, Accredited Standards Committee on Control of Cumulative Trauma Disorders.

My interests in musculoskeletal disorders were shaped by my clinical experiences in treating injured workers. I was originally interested in occupational cancer research, but as I spent more time in the field of occupational health, I realized that musculoskeletal disorders were by far the largest preventable cause of morbidity and disability among the working populations which I treated. As a treating physician, I diagnose and treat patients every week who have work-related musculoskeletal problems such as back pain, tendonitis, and carpal tunnel syndrome. Over the course of my career, I have treated several thousand workers with musculoskeletal disorders related to their work. Many of these disorders could have been prevented or subsequent disability reduced through better job design and more timely medical treatment which took work factors into account.

I feel that I am fortunate to be involved in many aspects of work-related musculoskeletal problems - I treat individual workers, I advise employers on programs to prevent musculoskeletal problems, and I engage in research on the causes of these disorders and the effectiveness of interventions aimed at reducing their number and severity. There is no question that a great deal of suffering, job displacement, and economic loss is due to musculoskeletal disorders. It is also clear that many of these disorders are preventable, and that appropriate action can reduce this disease burden.

I have based my opinions on my professional background and training, which includes clinical experience treating patients with MSDs, research experience in performing and analyzing studies of work-related MSDs, and work on intervention programs to reduce MSDs in working populations. Based on the existing scientific evidence and my own professional experiences, I conclude that there is strong evidence that certain work exposures are causally related to carpal tunnel syndrome, tendonitis, back pain, and other MSDs among workers. This conclusion takes into account the strengths and limitations of existing studies, including issues of confounding, bias, and research design. The existing research base is also consistent with my clinical experience, where I have seen thousands of workers with clinically diagnosed musculoskeletal disorders associated with the same physical risk factors described in the scientific literature. Existing research and my own clinical and administrative experiences have demonstrated that ergonomic interventions can prevent injuries in a cost-efficient manner, and that improved medical treatment programs can prevent disability from work-related MSDs.

Adequate scientific and clinical basis exists to support an ergonomics standard:

The workforce of our nation incurs a large number of musculoskeletal illnesses and injuries which are caused by or related to workplace exposures. Many of these disorders are preventable. Both my academic and my clinical experiences indicate that MSDs can be reliably diagnosed using accepted clinical guidelines, that a substantial proportion of MSDs are related to exposure to workplace physical factors, and that a significant part of this burden is preventable.

Acute and chronic work-related musculoskeletal disorders (MSDs) affect an estimated 19 million persons per year in the United States and account for the majority of workers' compensation costs nationwide (Bernard 1997, Webster and Snook 1994). Over the past two decades, there has been considerable evidence presented in the scientific and medical literature which supports a causal relationship between work activities and musculoskeletal disorders, including back pain, carpal tunnel syndrome, and tendonitis. The available literature when taken as a whole strongly supports the presence of a causal association between exposure to certain workplace physical activities and the development of specific MSDs. The actions of health and safety professionals all over the country reflect the knowledge that workplace exposures should be reduced in order to reduce injuries and disability.

The evidence for a causal association between work exposures and musculoskeletal disorders has been well summarized by researchers at the National Institute for Occupational Safety and Health (Bernard 1997) as well as by international scientific panels and by regulatory agencies in other countries. (Kourinka and Forcier 1995) The National Academy of Sciences convened a multidisciplinary international expert panel in 1998 to review available evidence on work-related musculoskeletal disorders. I was one of the invited participants in this process. After thorough review of available scientific evidence, including conflicting points of view, the National Academy of Sciences concluded that musculoskeletal disorders were a major source of disability and economic loss, that workplace physical exposures were an important cause of these disorders, and that interventions to reduce workplace physical exposures could reduce the number of musculoskeletal disorders. Multiple expert panels and individual scientists reviewing the scientific evidence have arrived at these same conclusions, as has a second review completed by the National Academy of Sciences, released earlier this year.

The conclusions of this second panel report by the National Academy of Sciences unambiguously support important arguments in favor of an ergonomics standard. The panel found strong and consistent evidence from both epidemiologic studies and biomechanical studies to support a relationship between workplace physical exposures and the occurrence of MSDs of the low back and upper extremities. The panel found that existing research demonstrated the effectiveness of appropriate ergonomic interventions in reducing the risk of low back pain and upper extremity symptoms. The panel found that work-related musculoskeletal disorders are a major source of costs and morbidity, and that some of this burden to society and to individuals is preventable.

A number of non-governmental groups have taken actions based on the evidence available. After concluding that sufficient evidence existed to promote a standard intended to protect worker health and safety, the American Conference of Governmental Industrial Hygienists (ACGIH) recently announced exposure limits for physical exposures in order to reduce musculoskeletal disorders. The ACGIH is a respected and authoritative non-governmental body which publishes exposure limits for chemical and physical hazards which are widely used in industry. The American College of Occupational and Environmental Medicine has published practice guidelines which clearly link workplace physical exposures to musculoskeletal disorders. The American National Standards Institute has a committee charged with creating a national industrial standard to reduce work-related musculoskeletal disorders. These and other groups have acted because of the scientific evidence showing that MSDs are a serious problem, that workplace exposures are related to many MSDs, and that the risk of harm to employees can be diminished by reduction in physical exposures.

My own reviews of the scientific literature (Evanoff 1999, Evanoff and Rempel 1998) have found that musculoskeletal disorders have been studied in a variety of work settings. Numerous studies have shown that higher rates of these disorders are seen among workers whose jobs demand repetitive or forceful movements, or who are subject to vibration or prolonged awkward postures. Systematic review of the medical and scientific literature shows that there is evidence of a causal relationship between work factors and carpal tunnel syndrome, tendonitis of the hand and wrist, epicondylitis, neck disorders, shoulder disorders, and low back disorders.

Opponents of an ergonomics standard have attacked the scientific basis of the standard by suggesting that MSDs do not represent "objectively" diagnosed entities, and consist only of worker-reported aches and pains. On the contrary, most MSDs fall into well recognized and commonly accepted diagnostic classifications which utilize both

symptoms and specific signs detected on physical examination by a health care provider. It must be recognized that "MSD" is not a diagnosis itself, but a term used to group many different diagnoses affecting different body parts. For example, the practice guidelines promulgated by the American College of Occupational and Environmental Medicine list "Diagnostic Criteria" for more than fifty separate musculoskeletal disorders. These conditions include such diagnoses as lateral and medial epicondylitis, ulnar and radial nerve entrapment, shoulder impingement, rotator cuff tear, wrist tendonitis/tenosynovitis, DeQuervain's tenosynovitis, trigger finger, and carpal tunnel syndrome. These diagnostic criteria include mechanism of injury, patient symptoms, physical examination maneuvers, and for some disorders, diagnostic test results. The described mechanisms of injury for over two dozen listed disorders include repetitive use, chronic overuse, or repeated trauma.

Good quality epidemiologic studies have used definitions of MSDs which require combinations of symptoms and physical examination findings which are similar or identical to the information used to diagnose patients in clinical practice. Many of the MSD definitions used in the epidemiologic studies are the same definitions of MSDs described in medical textbooks and in practice guidelines. The work exposures described in the scientific literature are reflected in the work exposures reported by my patients with musculoskeletal disorders, and by the work exposures which I have observed on visits to workplaces with high rates of musculoskeletal disorders. These same work exposures are the ones cited by the American College of Occupational and Environmental Medicine in their practice guidelines and by the ACGIH in their threshold limit values for physical exposures.

The importance of early recognition and appropriate treatment of MSDs

The proposed OSHA ergonomics standard required early access to appropriate medical treatment, evaluation of workers' jobs when there has been a MSD, and the provision of limited or modified work duties when necessary, including when recommended by a health care provider. Each of these individual provisions is supported by current research and clinical practice. In addition, there is good evidence that comprehensive programs which integrate ergonomic changes and medical treatment are effective in reducing the incidence and severity of work-related musculoskeletal disorders.

Early recognition and treatment of musculoskeletal disorders is essential because it allows earlier treatment of affected workers, at a time when treatment can prevent progression to a more severe condition. Workers who are treated in the early stages of a disorder have a better prognosis, and are less likely to have prolonged disability, than workers who receive appropriate medical attention only after prolonged duration of symptoms. The medical literature consistently supports the observation that conservative management is most effective when begun in the early stages of these disorders, and that patients who are treated only after a prolonged symptomatic period are less likely to respond favorably than those treated earlier (Gelberman et al., 1980; Dellon, 1989; Stern, 1990; Rystrom & Eversman, 1991). With some disorders, such as carpal tunnel syndrome, patients can often be treated conservatively in the early stages of disease, while surgery is often necessary when patients present with advanced disease. Early detection is necessary to ensure that signs and symptoms of work-related MSDs are recognized and treated appropriately through medical management, administrative controls, and job evaluation.

Both healthy and injured workers can potentially benefit from evaluation of their workplace for identification of physical stressors that can be eliminated. Simple modifications can often be made to a workplace which enable the work to be done with less effort on the part of the worker. Such modifications, where possible, can prevent injury and can enable injured workers to safely return to their usual jobs more quickly. Clinical experience demonstrates that ergonomic evaluation and intervention is effective in the treatment of workers being treated for a work-related MSD, since earlier safe return to work is facilitated when clinicians have more information about a patient's job demands and exposures, and when worksite modifications reduce physical exposures. A number of authors have advocated the importance of ergonomic changes in treating workers with work-related musculoskeletal disorders (Melhorn 1996, Higgs and Mackinnon 1995, Norris 1993, Feuerstein et. al. 1993, Halpern 1992, Travers 1992, Herbert 2000).

Comprehensive ergonomic programs which incorporate primary prevention of MSDs through ergonomic changes in jobs, early detection of MSDs through surveillance, and early treatment of MSDs with an emphasis on early return to modified work have been endorsed by many corporations and by medical professionals. The American College of Occupational and Environmental Medicine, the world's largest group of Occupational Health physicians, has recently released "Occupational Medicine Practice Guidelines" which describe what the College recommends as best medical practice in the diagnosis and treatment of work-related disorders. These practice guidelines explicitly recommend many of the elements which are contained in OSHA's proposed regulation as representing best medical practice. These include endorsement of the application of ergonomic principles to job design in order to

prevent MSDs, and the use of workstation or tool adjustment to avoid further aggravation of a disorder once it has begun. Return of workers to modified work which has reduced physical exposures is strongly recommended as part of treatment - the guidelines note that the best success with return to work is seen when workers go back to their original job with modifications to reduce physical exposures. The guidelines list "substantive associations" between physical risk factors and a variety of MSDs including shoulder tendonitis, hand/wrist tendonitis, carpal tunnel syndrome, neck muscle tension, and low back pain. Specific job modifications are recommended for these and other disorders. The guidelines also note that delayed presentation (not receiving early recognition and treatment) is a risk factor for delayed functional recovery in patients with a MSD.

My own experiences from over ten years of treating injured workers have shown me the importance of early treatment and the importance of modifying job duties to facilitate return to work. The proposed ergonomics standard addressed these important aspects of disability prevention. While the main focus of prevention efforts should be on primary prevention - the reduction or elimination of workplace risk factors it is also important to ensure that workers have access to appropriate and timely medical care if they do become injured. The goals of a medical management program should be to reduce or eliminate symptoms, prevent progression of MSDs, reduce the duration and severity of functional impairment, and prevent or reduce the severity of disability. Important elements to such a program include surveillance, timely access to appropriate health care providers, job evaluation of injured workers, and the availability of appropriate job modification. Follow-up of treated workers and coordination with primary prevention efforts are also important.

My clinical experience clearly indicates that effective treatment of work-related musculoskeletal disorders frequently requires a reduction in workplace physical exposures for the affected employee. The vast majority of injured employees are able to return to productive work very quickly, as long as their work is modified to reduce physical exposures to the affected body part. Job modifications which reduce physical exposures are frequently inexpensive and simple, and can help an employee safely return to work sooner, as well as preventing risk of future injury. Examples of job modifications include training or retraining, simple job changes to prevent awkward postures (such as a step stool or tilted work surface), changes in tool design or maintenance, or changes in procedures (such as job rotation). Where there is no simple fix for a physical exposure which is causing or exacerbating a musculoskeletal condition, temporary job transfer or restrictions are important to allow the patient's injury to heal. Examples of temporary restrictions include reduction in pace or quantity of work, restriction of certain tasks, or limitation of hours worked. If an employee is to be transferred to a different job, the new job should be assessed by the employer and the healthcare provider to be sure that the employee will not be exposed to relevant physical risk factors When this cannot be accomplished, temporary removal from work will allow time for healing. In most cases, I feel that keeping an injured employee at work in an appropriate modified position is preferable to time loss. What OSHA is requiring in the standard is common medical practice among occupational health professionals.

In my experiences of treating patients and advising the administration of employee health programs, I have found that choice of a healthcare provider for injured workers is important. Ideally, healthcare providers should have training or experience in ergonomics and the role of work modifications in the treatment of work-related musculoskeletal disorders. Effective diagnosis and treatment requires knowledge of specific job duties. The best way for a healthcare provider to get knowledge of job duties is through a worksite visit. Since this is impractical in some clinical settings, information about exposures and job duties can also be obtained through a written work description, or a videotape of the job task. Employers should have a contact person with knowledge of job activities and the ability to coordinate appropriate job placement during a recovery period. Working knowledge of the industry and the specific workplace is also needed in order to make appropriate recommendations regarding temporary or permanent job modifications. In my experience, some employers readily provide detailed information about job duties and physical exposures to the treating physician. It is more difficult to provide optimal care for injured workers when this information is not available.

The medical literature has examples of successful programs which have decreased the length or severity of disability resulting from injuries through integrating ergonomic interventions as part of medical treatment of injured workers. One such study evaluated work-related back pain among workers from a variety of industries who had been away from work for more than four weeks due to their back injuries. (Loisel et. al. 1997). Workers were randomly assigned to receive an ergonomics intervention, an intensive clinical and rehabilitation intervention, neither, or both. The ergonomics intervention consisted of a worksite ergonomics evaluation that included labor and employer representatives in determining the need for job modification. After observation of a worker's tasks in conjunction with a trained ergonomist, these parties determined the need for modifications to improve the worksite. Implementation of the recommended solutions remained the employer's responsibility. The clinical and rehabilitation intervention consisted of patient education ("back school"), referral to a back pain specialist, and a

multidisciplinary work rehabilitation intervention. Combination of the rehabilitation intervention along with the ergonomics intervention was the most successful in returning injured workers to work. The ergonomics intervention was the most successful element of this program, resulting in more than a two-fold increase in the rate of return to usual work. By facilitating return to usual work, the ergonomics intervention appeared to reduce progression to long term disability. In this study, the intensive clinical and rehabilitation intervention did not significantly reduce the time of absence from regular work when applied separately from the ergonomics intervention.

Another example of an integrated program was reported among sheet metal workers at an aircraft manufacturer. This program combined pre-placement evaluations of workers with ongoing surveillance for symptoms and signs of upper extremity musculoskeletal disorders in order to ensure early medical evaluation of affected workers. Job modification was implemented for those with signs of early disorders, through restriction of work hours and restriction of use of vibrating hand tools. This program reported decreased workers' compensation costs, decreased time loss, and decreased severity of injury following the implementation of this program for screening, surveillance, early medical evaluation, and job modification. (Melhorn JM 1999)

Other authors have described comprehensive initiatives to manage the incidence and cost of occupational injuries that included an ergonomics component directed specifically toward injured workers. One such program has been described among hospital employees at an academic health center (McGrail et. al. 1995). This study showed decreases in musculoskeletal injuries, time loss (change from 10.4 days to 6.6 days average time loss), and total case costs (18% reduction) following the implementation of a comprehensive intervention that included case management, treatment by physicians experienced with work injuries, and the use of ergonomic worksite evaluation and modification. A later report from this group described elements of the program aimed at the early diagnosis and treatment of work-related upper extremity MSDs. The program included ergonomic assessment and abatement of the affected employees' work areas, and close coordination between the treating physicians and the ergonomists. The program resulted in pronounced decrease in the number of work-related upper extremity MSDs and a virtual elimination of cases which required surgery. The authors concluded that a coordinated program of medical care, ergonomic assessment, and intervention can be effective in the prevention of MSDs. (Bernacki 1999)

These and other peer-reviewed studies clearly indicate that a multi-element program can reduce the cost and burden of MSDs in different working populations. There are also numerous industry case reports where the introduction of ergonomic or medical management interventions have reduced costs and injury rates. Most major corporations have ergonomics programs, in recognition that such programs are effective in reducing injuries. Successful approaches have most often used a combination of ergonomic principles for prevention, as well as improved recognition and management of those disorders which have occurred.

I have also studied the effects of ergonomic assessments and interventions as part of the care of workers with WRMSD. As the result of a "natural experiment," we have collected pilot data on cost outcomes of ergonomic intervention in active workers' compensation patients employed by a local educational institution. Prior to September of 1996, ergonomic evaluations requested by the treating physician were not covered by the workers' compensation insurance carrier and requests for this service were denied. This policy changed, and ergonomics evaluation and intervention was then allowed under workers' compensation when ordered by the treating physician. These cases were predominantly neck and upper extremity disorders among office employees; the ergonomic interventions consisted of changes in workstation layout. We compared 11 consecutive cases referred by the treating physician to the ergonomist prior to the administrative change with 20 consecutive cases after coverage was allowed. These cases were all ones in which the treating physician thought that work factors were important in causing disease or retarding healing. Comparison of total workers' compensation costs for these cases showed a median cost of $5,130 among the patients referred for ergonomic evaluation who did not receive it, compared to a median of $4,082 among patients who did receive the physician recommended ergonomic evaluation. Costs included medical treatment, time loss, and permanent disability payments. Cost in the intervention group included the cost of the ergonomic evaluation and intervention, which averaged $280. Although these data do not come from a randomized study, they represent a series of cases from the same workplace referred by the same group of treating physicians, differing only in the fact that the ergonomic intervention was denied to the first group and given to the second. Based in part on this study, we are currently conducting a randomized trial funded by NIOSH to assess the effectiveness of an integrated ergonomics and case management intervention on cost and disability outcomes among injured workers.

The effectiveness of ergonomic interventions

Review of the scientific literature demonstrates that workplace ergonomic interventions can prevent injuries and reduce days lost due to injuries. This evidence comes from a number of studies published in the peer-reviewed literature which show the effectiveness of ergonomic interventions at various worksites and employers. The 1998 report by the National Research Council stated that "The literature provides evidence that interventions, of various types and complexity, can prevent the development of musculoskeletal disorders in specific industries and occupational groups." The NRC report concluded that "Research clearly demonstrates that specific interventions can reduce the reported rate of musculoskeletal disorders for workers who perform high-risk tasks. No known single intervention is universally effective. Successful interventions require attention to individual, organizational, and job characteristics, tailoring the corrective actions to those characteristics." Examples of published intervention studies familiar to me are given below; the background information provided by OSHA gives over 100 examples of successful ergonomic interventions.

The effectiveness of ergonomic interventions in the prevention of musculoskeletal disorders was shown by a study in a telecommunications equipment manufacturing plant, where workstations were re-designed to reduce postural stress on workers. Following this intervention, time loss was reduced by over 40% and employee turn-over was reduced by 75%. Cost-benefit analysis showed that the return on investment for the ergonomic interventions was 9 to 1. (Aaras 1994). Another study in telecommunications manufacturing sought to control the incidence and severity of repetitive trauma disorders associated with hand tool operations in a manufacturing facility with 6,600 employees. Repetitive trauma disorders were the leading cause of lost time and workers' compensation expenses at this plant. The incidence rate of OSHA reportable repetitive trauma disorders was 2.2 cases per 100 full-time equivalent workers (FTE) and resulted in 1,001 lost workdays in 1979. In the spring of 1981, the plant safety and health committee undertook a control program that included creation of a task force, a training program, improvements in the design of workstations and tooling, and management of restricted workers. During 1982, the incidence rate of repetitive motion disorders has decreased to 0.53 cases per 100 FTE and resulted in only 129 lost workdays. (McKenzie 1985)

A study at Gold Kist poultry (Jones 1997) reported results of an intervention undertaken due to high rates of upper extremity MSDs - 47.7 per 1000 workers in 1990. This plant instituted a corporate ergonomics program which utilized ergonomic committees at each facility. Key program elements included training, worksite analysis and task design, and the implementation of medical management procedures. This combination of worksite task analysis and medical management is similar to the program elements proposed by OSHA. This program resulted in a 46% decrease in upper extremity MSD rates over a five year period.

Another study evaluated a back injury prevention program undertaken in municipal workers in California. The program consisted of a combination of worker education, training in safer work practices, physical fitness activities, and ergonomic interventions including making safety equipment more available and improving the design of work facilities (through such measures as safety flooring, improved furniture, and rearranging storage space to minimize transport distances). Comparison of an intervention group and a control group of employees who did not receive the intervention showed a decline in back pain prevalence and a reduction in injuries among the intervention group. This study evaluated cost savings due to the intervention as well as documenting the reduction in back pain and injuries. Cost-benefit analysis showed a net savings of over $160,000 resulting from decreased workers' compensation and medical claims, and reduction in sick days. Return on investment was estimated at 179%. (Shi 1993)

One of my own studies (Evanoff 1999) examined work injuries and other outcomes before and after the implementation of a participatory ergonomics team among hospital orderlies, a group at high risk for injuries of the back, shoulder, and knee. This team designed and implemented changes in training and work practices, which included standardization of lifting procedures, an apprenticeship program for new workers, and use of mechanical lifting and transfer aids. The two year post-intervention period was marked by a 50% decrease in OSHA recordable work injury, a 74% decrease in lost time injury, and an 81% decrease in injuries with three or more days of time loss. Total lost days declined from 136.2 to 23.0 annually per 100 full-time worker equivalents (FTE). Annual workers' compensation costs declined from $237/FTE to $139/FTE. The proportion of workers with musculoskeletal symptoms declined as well. Other researchers using participatory ergonomics teams have demonstrated the abilities of such teams to work effectively to address musculoskeletal hazards (Moore and Garg 1996, Moore and Garg 1997).

I have directed a second study which has been presented as an abstract but not yet published. This was an ergonomics intervention among 117 workers employed in a hospital billing office, who were offered an educational session and individual workstation evaluations, with changes in workstation layout where appropriate. Changes included adjustments in computer keyboard and monitor setup, adjustments in seating, and changes in desk layout. Lost work days and total costs for workers compensation decreased dramatically in the two years following this intervention, compared to the two preceding years. Annual lost work days declined from a rate of 51 days per 100 full-time equivalents (FTE) to a rate of 25 days per 100 FTE. Annual workers' compensation costs declined from a high of $578 per FTE to a low of $120 per FTE. The total cost of the intervention was $255 per FTE; return on investment over 18 months following the intervention was over 2 to 1.

Other studies (Kukkonen 1983, Ohara 1976, Parenmark 1988,, Oxenburgh 1985, Lutz 1987) have also demonstrated reductions in symptoms, signs, or lost time following the implementation of interventions to reduce exposure risk factors for musculoskeletal disorders. Ergonomic job design clearly offers great potential for preventing musculoskeletal disorders of the low back and upper extremities. (Garg & Moore 1992).

My personal experience agrees with the literature cited above. I am personally aware of many local worksites where ergonomic analysis and job changes have led to improvements in symptoms or reductions in injury rates among workers. I have seen dozens of case reports of industries where the implementation of ergonomics programs have resulted in reductions in injury rates or lost time. These industry case reports offer important additional information to the peer-reviewed scientific literature, given the daunting logistical and other barriers to performing true "experimental" studies of workplace ergonomic interventions. I have served as the medical director of an ergonomics program aimed at reducing injuries among the 23,000 employees of a large health system. Musculoskeletal injuries and lost days have declined since the implementation three years ago of a system-wide ergonomics program. A NIOSH funded project within five nursing homes in our health system has demonstrated a marked decline in lifting injuries following an ergonomics intervention which consisted of training and the purchase of mechanical patient hoists.

My personal experiences with research studies of ergonomic interventions, as well as my experience with ergonomic programs in industry, have convinced me that appropriately designed ergonomics programs can reduce injuries and disability in many workplace settings.

Summary

Based on my knowledge of the relevant scientific literature, my observations of best practices among employers and physician groups, and my own clinical and administrative experiences, I conclude that there is ample evidence to support specific program elements proposed by OSHA. Physical exposures in the workplace are clearly a significant cause of musculoskeletal disorders. Reduction in physical exposures through training, workplace design, or change in practices can reduce disability due to musculoskeletal disorders. Appropriate medical treatment early in the course of work-related musculoskeletal disorders can lead to better functional outcomes and reduced disability. Though future research findings will no doubt refine and better inform our actions, we need not wait to begin action. Effective solutions are available now, and a large burden of disability can be prevented by using what we currently know.

Appendix – Refutation of some common arguments against an ergonomics standard

Critics of the conclusion that work activities are causally related to musculoskeletal disorders raise a number of arguments which are not convincing on closer examination. Four common arguments are addressed below.

Argument 1: Epidemiology or observational studies cannot demonstrate causation; only randomized prospective studies can do this. While experimental studies where humans are randomly assigned to receive or not receive some treatment provide the strongest evidence for a health effect, it is obviously impossible to perform this type of study for exposures we think may cause harm. There are well-established ways to link observational data to a decision about causation of illness which can be valid in the absence of experiemental data. For example, the vast majority of the scientific community concluded that tobacco smoking caused a number of health problems based on observational studies which showed much higher rates of some diseases among smokers. It was not necessary to do an experiment where people were randomly assigned to smoke or not smoke. Data on the health effects of most occupational exposures such as lead or asbestos also rely on observational studies, which can demonstrate causality in a scientifically acceptable fashion.

Argument 2: Work can't be the cause of MSDs since some workers get these disorders and other workers doing the same job don't have any problems. This argument is specious. People vary in their susceptibility and resistance to disease and injury, and people with identical exposures frequently have different health effects. Exposures clearly interact with personal factors to produce disease in some but not others - this does not change the importance of the exposure in causing the disease. A minority of heavy smokers die from lung cancer, yet we readily accept that smoking causes lung cancer because heavy smokers are much more likely to get this disease than non-smokers. Though genetic makeup and other personal factors are clearly important in determining which smokers die from lung cancer, in the absence of smoking the vast majority of these cancers would never have occurred.

Argument 3: Work can't be a major cause of MSD since there are so many other conditions which contribute to MSD risk. As with most diseases, MSDs are multifactorial in origin. It is nonetheless possible to study the effects of risk factors in isolation. Consider, for example, heart disease. There are many risk factors for heart disease which cannot be changed, including age, gender, and genetic makeup. There are other risk factors that can be changed, such as high blood pressure, blood lipids, exercise, and smoking. Most individuals have more than one risk factor, yet we can study the amount of heart disease that is caused by smoking, or hypertension, or lack of exercise. We can also direct interventions at reducing heart disease risk by targeting one or more of these risk factors. Changes (positive or negative) in one risk factor can significantly alter the risk of disease, even if other risks do not change. Similarly, in MSDs, personal risk factors such as obesity, age, gender, and other medical conditions account for some fraction of the total disease burden. In many workers, however, workplace exposures are the primary determinant or cause of the disorder. Comparisons of working populations which do not differ substantially in non-work risk factors have shown substantial differences in MSD rates linked to workplace exposures. The intervention studies cited above show that prevention efforts targeted at workplace physical exposures can reduce the risk of MSDs.

Argument 4: Research shows only that work may cause some symptoms of discomfort, but does not show that work causes diagnosable diseases. High quality studies of work-related MSDs have defined these disorders through the same methods used by clinicians to diagnose MSDs – a combination of history, physical examination findings, and, in some cases, nerve conduction studies. The NIOSH review (Bernard 1997) only considered studies where clinical case definitions included the use of physical examinations as well as symptoms. The case definitions used in much of the research on musculoskeletal disorders are similar to the diagnostic methods used every day by clinicians.

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