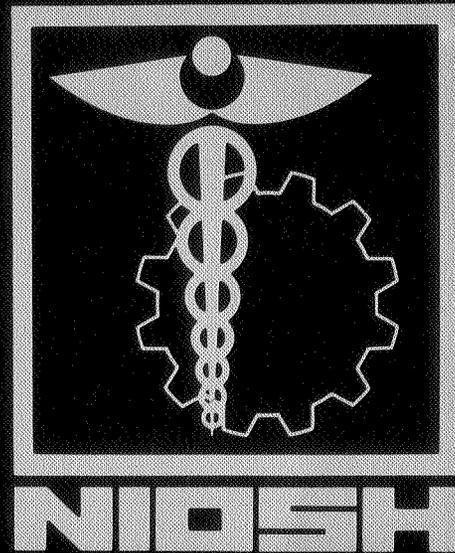


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**Proposed
National Strategies
for the
Prevention of
Leading Work – Related
Diseases and Injuries**

- **Musculoskeletal Injuries** •

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

**Proposed
National Strategy
for the
Prevention of
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Introduction

This document, *A Proposed National Strategy for the Prevention of Musculoskeletal Injuries*, summarizes what actions need to be taken to prevent occupational musculoskeletal injuries. It was developed in 1985 at a conference sponsored by the National Institute for Occupational Safety and Health (NIOSH) and The Association of Schools of Public Health (ASPH), which brought together over 50 expert panelists and 450 other occupational safety and health professionals.

In addition to the strategy for musculoskeletal injuries, NIOSH and ASPH have published strategies for the other nine leading occupational diseases and injuries: occupational lung diseases, occupational cancers, severe occupational traumatic injuries, occupational cardiovascular diseases, disorders of reproduction, neurotoxic disorders, noise-induced hearing loss, dermatological conditions and psychological disorders.

The proposed strategies were originally published in a two volume set, *Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries, Part 1 and Part 2*. These proposed strategies are not to be considered as final statements of policy of NIOSH, The Association of Schools of Public Health, or of any agency or individual who was involved. Hopefully, they will be used in the quest to prevent disease and injury in the workplace.

To learn of the availability of the complete texts of Part 1 and Part 2, or to obtain additional copies of this or other Strategies, contact NIOSH Publications, 4676 Columbia Parkway, Cincinnati, Ohio 45226. Telephone (513) 533-8287.

A Proposed National Strategy for the Prevention of Musculoskeletal Injuries

I. Musculoskeletal Injuries: Problems and Goals

The Surgeon General's Report on Health Promotion and Disease Prevention in 1979 adopted the Canadian Health Fields Model (HFM) as a useful concept for identifying the elements that contribute to death and disease. Four elements were identified:

- Environmental hazards
- Human biologic factors
- Behavioral factors or unhealthy lifestyles
- Inadequacies in the existing health care and ancillary systems

The Surgeon General originally used this model to analyze the ten leading causes of death in 1979. By analyzing the risk posed by each element, the Surgeon General concluded that the prevalence of many diseases could be reduced if the Nation focused on preventive activities; i.e., reducing hazards and avoiding unhealthy lifestyles.

When applied to problems of occupational health, the health field model emphasizes that an individual's illness or injury is the result of several occupational and nonoccupational influences; these influences differ among individuals. The elements can also be applied to work-related musculoskeletal injuries, and each element offers an opportunity for prevention:

- A. Environmental Hazards: Hazards to the musculoskeletal system associated with work are described as workplace traumatogens. A *traumatogen* is defined as a source of biomechanical stress stemming from job demands that exceed the worker's strength or endurance, such as heavy lifting, or repetitive, forceful manual twisting. Traumatogens can be measured by determining the frequency, magnitude, and direction of forces required in relation to body posture and the point of application.

- B. **Human Biologic Factors:** These include the anthropometric or innate attributes that influence a worker's capacity for safely performing the job. Examples include the worker's physical size, strength, range of motion, work endurance, and the integrity of the musculoskeletal system. These factors partly account for variability in performance capability in the population and the potential mismatching of worker and job. Hence, when job demands habitually exceed the worker's capacities as defined by such physical attributes, the health and safety of the worker are compromised.
- C. **Behavioral Factors or Unhealthy Lifestyles:** This element refers to acquired behaviors or personal habits that increase the worker's risk of incurring musculoskeletal strain or injury. Such behavioral factors may include insufficient sleep or recovery from exertion, the perception of the job as being excessively demanding or hazardous, job dissatisfaction, and mental lapses due to response interference. Lifestyle factors can include obesity or lack of adequate physical fitness, unhealthy diet, and substance abuse either during or outside work. Recent studies have also focused on personality factors predictive of permanent disability.
- D. **Inadequacies in the Existing Health Care and Ancillary Systems:** These factors include a lack of medical knowledge and appropriate training for health care personnel on the etiology, diagnosis, and treatment of musculoskeletal problems that result from biomechanical strain. Management, design engineers, and workers need special health and safety training in recognizing traumatogens and in understanding the role of biologic and behavioral risk factors for musculoskeletal injuries. Such groups would also benefit from training in the principles of prevention and health promotion.

II. Conditions to be Addressed

The National Institute for Occupational Safety and Health (NIOSH) has identified work-related musculoskeletal injuries as one of ten leading occupational health problems affecting workers. Musculoskeletal injuries as considered here encompass both acute and chronic injury to muscles, tendons, ligaments, nerves, joints, bones, and supporting vasculature; injury is understood as a component of the overall classification, disorder. Descriptive examples of the term injury include sprains, strains, inflammations, irritations, and dislocations. In contrast, mishaps resulting in injuries in which the skin or bones are broken, such as from the transfer of high energy, are defined as traumatic injuries. These occupational traumas are the subject of the Proposed National Strategy for the Prevention of Severe Occupational Traumatic Injuries.

Injury resulting from exposure to continued trauma is often defined according to the structure thought to be inflamed, irritated, or strained, for example, tendonitis, synovitis, bursitis, nerve entrapment, and lumbar pain. Collectively these terms are applied to a broad class of physical symptoms or complaints that are commonly labeled in the medical literature as wear-and-tear disorders, overuse injuries, osteoarthritis, degenerative joint diseases, chronic microtraumas, and cumulative trauma disorders.

Because few of the musculoskeletal injuries that stem from exposure to long-term trauma are universally accepted as uniquely occupational in origin, defining a work-related musculoskeletal injury often depends on identifying a hazardous antecedent condition in the workplace.

Much remains to be learned about the causes for work-related musculoskeletal injuries. A current theory holds that continued exposure to excessive physical stress accelerates the onset or aggravates the course of regional musculoskeletal injuries. Indeed, the sources of the high physical stress can often be traced to ordinary work activities that include repetitive or sustained lifting, bending, twisting, climbing, reaching, gripping, pinching, rubbing, kneeling, and squatting as well as vibration from equipment. Moreover, these activities are often performed in awkward postures and involve high forces. When the job demands inherent in these activities repeatedly exceed the biomechanical capacity of the worker, the activities become trauma-inducing. Hence, traumatogens are workplace sources of biomechanical strain that contribute to the onset of injuries affecting the musculoskeletal system.

The difficulty in discovering the etiology of this class of regional musculoskeletal injuries parallels the difficulty in defining the mechanism responsible for the symptoms. One notion is that the accumulated microtrauma caused by repetitive motion can set up a symptomatic inflammatory response, which may in turn be responsible for the symptoms and the restricted motion associated with aging. Furthermore, if the accumulated microtrauma is not given enough time to heal, a secondary risk of tissue failure may result. This process may account for conditions such as tendon ruptures or even stress fractures. Similar outcomes may occur in response to single traumas or to a few exposures to extremely high levels of biomechanical stress. Such postulates, however, are heuristic when applied to many common regional musculoskeletal injuries where no demonstrably pathoanatomic abnormalities can account for the symptoms. Regardless of the cause, abnormal anatomy, physical fitness, previous injury, or age-related changes can also alter one's physical capacity and thus can contribute to the injury.

III. Scope of the National Problem

Our present knowledge of the national scope of work-related musculoskeletal injuries is clearly inadequate, providing at best a limited and fragmented view of the extent of such problems. A main reason is that current estimates of the problem have been extracted from existing data bases that were not designed for the surveillance of occupational musculoskeletal injury. As such, the existing reporting systems confound occupational- and nonoccupational-related disorders, fail to differentiate chronic and acute injuries, and lack standard terminology and diagnostic criteria for defining cumulative trauma-related musculoskeletal disorders.

Despite the absence of accurate national prevalence data, there is a growing awareness among researchers and practitioners that musculoskeletal injuries account for a highly significant amount of human suffering, loss of productivity, and economic burden to the country. Support for these views comes in part from the following sources:

- Musculoskeletal injuries are the leading cause of disability of people in their working years, afflicting 19 million persons (National Center for Health Statistics, Health Interview Survey, 1977). High risk industries include manufacturing, construction, and food processing. Nearly one-half the Nation's workforce are affected at some time during their working life.
- Musculoskeletal injuries rank first among health problems in the frequency with which they affect the quality of life, as indicated by the extent of activity limitation (National Center for Health Statistics, Health Interview Survey, 1977).

- The cost of musculoskeletal injuries, based on lost earnings and worker-compensation payments, exceeds that of any single health disorder. Low back problems alone cost American industry an estimated \$14 billion per year (1976).
- Musculoskeletal injuries account for one-third of annual worker compensation claims. Claims for sprains and strains are the most prevalent—with the back accounting for almost 50 percent of such disorders—followed by disorders of the ankle, knee, and shoulder.
- Musculoskeletal injuries also represent a significant accessory or causal factor in a large number of acute traumatic injuries.
- The frequency and impact of musculoskeletal conditions on the workforce are expected to increase over the next several decades as the average age of the workforce increases.

A projected increase in musculoskeletal injuries and disorders is already evident despite the move toward more sophisticated automation and the shift away from physical to mental work, for example, processing of information and service-related jobs. Remarkably, the introduction of modern office technology, such as computers, video display terminals, and optical scanners, designed to reduce physical labor, has generated claims of new, pervasive, and even more insidious sources of biomechanical stress to the musculoskeletal system. The majority of these claims are attributed to chronic repetitive motion and static and constrained postures. The magnitude of these problems is only now beginning to emerge.

IV. Potential for Prevention and Control

Prospects for reducing work-related musculoskeletal injuries depend on progress in four methodologic areas.

- Identifying accurately the biomechanical hazard.
 - Developing effective health-promotion and hazard-control interventions.
 - Changing management concepts and operational policies with respect to expected work performance; i.e., working smart, rather than working hard.
 - Devising strategies for disseminating knowledge on control technology and promoting their application through incentives.
- A. Determining the causes of musculoskeletal injuries continues to be problematic, as with all disorders associated with trauma and aging. This difficulty results partly from the complexity and number of potential etiologic factors, the long latency periods, and the interaction with the effects of aging. Moreover, no standardized set of diagnostic criteria and techniques or medical signs and symptoms is yet available to reliably identify many of the disorders. More vigorous and focused longitudinal research is needed to identify occupational and nonoccupational causes.
 - B. Developing interventions has a practical, problem-solving focus. The recommended interventions for reducing work-related musculoskeletal injuries involve an engineering approach; i.e., redesigning the work process or tool to impose less

biomechanical stress. Without complete information on causes, reasonable assumptions must be made based on biomechanical models of physical trauma so that answers to problems can be tested by judging both their feasibility and effectiveness.

Information is already available from ergonomics and allied fields to suggest that many of the biomechanical hazards associated with occupational musculoskeletal injuries could be eliminated if such knowledge were put into practice. Field validations of biomechanically based prevention strategies are needed to determine those that work.

- C. Changing management concepts of productive work is important because managerial concepts and practices often become main contributors to musculoskeletal injuries. Many jobs enter the high-risk category because demands for production put pressure on supervisors to “get things moving.” Like football coaches, many managers are convinced that a 125 percent effort is better than an 85 percent effort. However, this work ethic may not be valid for certain tasks. Managers who establish operating policies, such as “working smarter is better than working harder,” in the worker’s mind, may most effectively maintain production levels by reducing lost time due to worker injuries. However, unless workers understand this policy, little chance exists to improve the cautionary responses needed for prevention.
- D. Dispensing and applying accumulated knowledge is essential for overcoming resistance to change and reconciling the initial costs of proposed interventions with anticipated long-term benefits. The disparity of backgrounds of key professional people who must cooperate in advocating and evaluating interventions must also be overcome. For example, in the musculoskeletal area most engineers are not trained in ergonomics or biomechanics and health care personnel are not knowledgeable about manufacturing technologies, yet they must work together. The problems in cooperation common to all health and disease-prevention programs are now being recognized as most formidable and potentially the chief roadblock in any prevention-oriented program. Probably the most direct approach to this issue is to fund targeted, controlled, intervention trials. Resistance to change might fade in the face of substantial data.

Despite these difficult issues, the Nation cannot ignore this growing occupational health problem or the significant volume of information on musculoskeletal injuries emanating from such fields as biomechanics, clinical research, and ergonomics. Hence, a first national strategy is offered for preventing or reducing the incidence of work-related musculoskeletal injuries and disorders.

V. Addressing Broad Tactical Areas of a National Strategy for Prevention

A. Refining Surveillance Systems

1. Health Surveillance

Strategies designed to prevent or mitigate musculoskeletal injuries require sensitive and verifiable surveillance schemes for identifying and reporting specific musculoskeletal conditions. Such systems should provide an analysis by occupation to target those occupations that display disproportionate incidence. New occupations and emerging technologies in which workers may be at risk from exposure to unprecedented biomechanical stresses also need to be identified.

Existing data clearly indicate major deficiencies in surveillance systems for identifying work-related musculoskeletal injuries. Because existing data sources were not designed for surveillance of occupational musculoskeletal injury, they do not separate chronic from acute injuries, and they lack a standard terminology for defining the acute and chronic medical conditions in general.

2. Hazard Surveillance

Coupled with needed refinements of health surveillance is a similar need for improved surveillance to define the types and ranges of biomechanical stresses that exist in the workplace. The ultimate value of hazard surveillance lies in prevention because it can provide an early warning of potential cumulative trauma.

Hazard surveillance would make use of ergonomic-type surveys, worksite inventories, or biomechanical profiles of various job conditions to identify the types of biomechanical job demands that pose a risk of musculoskeletal injury. Evidence of workplace-related hazards is particularly important because the hazard may be the only reliable way of classifying a musculoskeletal disorder as work-related.

Without some form of workplace data to identify the presence of biomechanical stress, nonspecific chronic health symptoms, such as joint pain and loss of mobility, may be incorrectly diagnosed as nonoccupational and go unreported. In addition to the obvious value for enhancing the validity of surveillance data, information on sources of biomechanical stress for a given occupation can be used to build models that predict the occurrences of musculoskeletal injuries.

3. Essential Elements for Surveillance of Occupational Musculoskeletal Injuries

- a. Guidelines should be set for data collection and diagnostic criteria established for classifying all musculoskeletal disease conditions experienced by workers, whether job-related or not. Definitions should be standardized for characterizing discomforts, injuries, and hazards.
- b. Objective criteria should be determined to differentiate occupationally from nonoccupationally related disorders. The system should also identify the methods of reporting.
- c. Multilevel data bases at national, state, and local levels should be established and supplemented with specific longitudinal epidemiologic evaluations. Multilevel recording is important because the long induction periods for many of the musculoskeletal injuries separate the hazard from the effect. A multilevel health reporting system could track health status across jobs, across geographic relocations, and through retirement.

In general, a positive byproduct of an effective surveillance program would be the renewed awareness within the medical community of the prevention benefits to be derived from a standard reporting system. Such a system would also assist occupational health providers in correctly diagnosing, recording, and treating musculoskeletal injuries.

