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Diagnostic Corner - Occupational Ergonomics

David P. Gilkey

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DIAGNOSTIC CORNER

Occupational Ergonomics

David P. Gilkey, DC, PhD

Dr. David Gilkey graduated from Los Angeles College of Chiropractic in 1979 (now the Southern California Health Sciences University). He earned his master's degree from the University of Denver in environmental policy and management with a specialization in environmental health and safety, then his PhD in environmental health at Colorado State University (CSU) with a concentration in occupational safety and health, industrial hygiene and a dissertation specialization in construction ergonomics. Dr. Gilkey joined the faculty of CSU in the Department of Environmental and Radiological Health Sciences (ERHS) as an assistant professor. He is the current Director of Undergraduate Education for the ERHS bachelor's program in environmental health. He teaches extensively in the areas of environmental and human health and ergonomics.

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INTRODUCTION AND SUMMARY

Joseph Sweere said, "The ultimate challenge to a physician is to prevent what he treats."[1] There exists an increasing interest among many health care providers to address prevention of chronic disease[2] and injury rather than solely focusing on treatment.[3] Occupational ergonomics is an area of expertise and practice open to chiropractic doctors through advanced training and involvement with business and industry.[4] Doctors of chiropractic are well equipped and positioned to contribute to the prevention of musculoskeletal disorders through patient education and applied ergonomics. This brief introduction and overview of applied occupational ergonomics is meant to inspire the reader to seek available specialty training, get involved with businesses, and prevent what he or she treats. Ergonomics is about what chiropractors know and practice every day in their offices; if the demands of life, including work, exceed the capabilities and limitations of the patient, they will suffer decrements in quality of life and become more susceptible to injury and/or disease. While ergonomics is much greater than injury prevention, this article focuses on applied musculoskeletal ergonomics and the prevention of musculoskeletal disorders (MSDs) of the upper extremities and back.

KEY CONCEPTS

- MSDs and Ergonomics
- Human Variability
- Homeostasis
- Systems Approach
- Fitting the Job to the Worker

MUSCULOSKELETAL DISORDERS (MSDS) AND ERGONOMICS

Musculoskeletal disorders are multifactorial in causation and rarely due to any one single event or cause. The majority of MSDs are ergonomic in nature, related to worker characteristics, job-task demands, and poorly designed systems, and are cumulative over time due to many exposures, factors and responses.[5,6] Instantaneous events may occur from a single dynamic effort, such as lifting a heavy box, which results in a back "injury." More likely, the effects are cumulative from repeated exposures day after day, resulting in damage to tissue and are reported as "illnesses."[7] Confusing as it may be, all back events are reported as injuries while most MSDs of the upper extremities (UE) are reported as illnesses. Back injuries comprise the single most frequent and expensive workplace injury that cost employers upwards of $100 billion per year in the US.[8–10] Back pain affects 60 to 90% of all people at some time in their lives and, on some level, affects up to 42% at any given time.[11–13] Guo[8,9] estimates that over 22 million Americans suffer back pain annually, with 65% being job-related. Experts agree that back claims comprise approximately 25% of all reported worker injuries and result in more lost workdays than all other illness and injury except the common cold.[8,9,14,15] Terms used to describe MSDs include cumulative trauma disorders (CTDs), repetitive strain injuries (RSI), repetitive motion injuries (RMI), strain, sprain, and even slipped discs or herniated nucleus pulposus (HNP). Injury data from 1980 through 1993 revealed a 770% increase in upper extremity CTDs, a trend attributed to increased public awareness of CTDs, broader definitions of compensable claims, increased numbers of service industry workers, and increased use of video display terminals (VDT).[16]

Beginning in 1994, changes in monitoring by the Bureau of Labor and Statistics included portions of back injuries with MSDs. After 1999, UE injuries were recorded separately. Since 1994, reported MSD injuries have trended downward for both UE and backs, but still represent the single largest proportion of occupational illness and injury in America's workplaces.[17]

MSDs affecting upper extremities and back

1994	705,800 cases reported[18]
1995	705,000 cases reported[19]
1996	647,344 cases reported[20]
1997	603,096 cases reported[21]
1998	593,000 cases reported[22]
1999	598,000 cases reported[23]

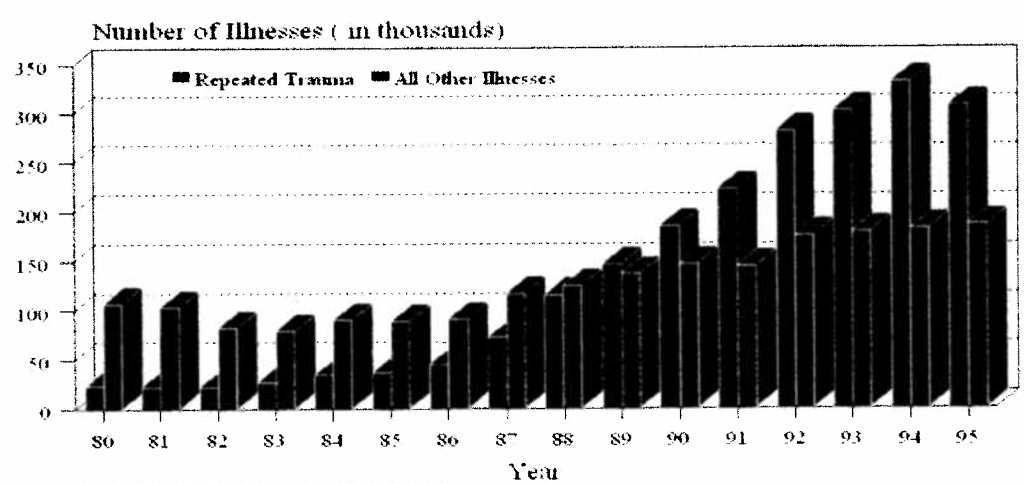
MSDs affecting upper extremities

2000	242,000 cases reported[24]
2001	216,400 cases reported[25]
2002	223,820 cases reported[26]
2003	202,125 cases reported[17]

INTRODUCTION TO OCCUPATIONAL ERGONOMICS

Occupational ergonomics is the study of people at work performing job-tasks within a given environment.[6,2728] The scope of ergonomic study considers the infinite list of unique human characteristics, as well as the highly-variable job-task demands within a myriad of possible environmental conditions. Environmental conditions such as high altitude, temperature extremes, too little or too much light, loud noise, adequate airflow, and poor layout and design of the workplace all may impact worker performance and health. Good ergonomics is about compatibility of humans to work environments, demands and conditions. In the most recent decades, occupational ergonomics has focused on understanding causation and prevention of neuromusculoskeletal (NMS) injury and disease.[6] "Individuals" have different capabilities and limitations that must be compatible to work demands and environmental conditions, or decrements in worker performance and health are likely to occur. A key concept in applied occupational ergonomics is to "fit the job to the worker," rather than force the worker to fit the job.[6,28] Good ergonomics seeks to improve worker comfort, health and well-being, performance and productivity through well-designed jobs and businesses that optimize the human-work interface. Ergonomists apply scientific principles and practices to measure, evaluate and understand the characteristics of humans, thus enabling recommendations and guidelines for

Number of Occupational Illnesses



good designs with acceptable demands, expectations and outcomes for work and pleasure.[6,27,28]

ROLE OF ERGONOMICS IN THE DESIGN OF WORK

Occupational ergonomics has its greatest impact in the initial design of work. The inclusion of ergonomic principles in the design of tasks, jobs and systems is imperative.[28–30] In all areas that humans interface with work systems, ergonomics can play a vital role in optimizing that experience and outcomes. The application of ergonomics is essential in the design of products, workstations, information systems and the environment in which people will work.[27–34]

ERGONOMIC DEFINITIONS AND KEY CONCEPTS

The Greek derivation of the word *ergonomics* comes from two words: *ergos* meaning "work" and *namos* meaning "natural law." So, *ergonomics* was meant to describe "the natural laws of work."[6,27] In modern day, many definitions have been offered by a variety of experts.[6,27,35] Stephan Pheasant[6] writes, "ergonomics is the scientific study of human work." I have modified the definition to "ergonomics is the study of humans in the workplace; it considers individual capabilities and limitations." Individuals vary in many ways and ergonomists must study them at work to understand the mental and physical demands required to complete job tasks within the work environment to perform optimally without suffering injury. The three fundamental concepts that underpin ergonomics are human variability, homeostasis and systems theory.

KEY ERGONOMIC PRINCIPLE: HUMAN VARIABILITY

Individuals vary greatly in many ways, some obvious and others not so apparent.[27,36] Humans come in all sizes, shapes, ages, and states of health with highly variable attitudes and dispositions. Humans vary from person to person in countless ways. Think of the nearly infinite physical, biological and/or mental and emotional parameters in which people are different from one another, arising from the 25,000 or so genes that can combine in millions of different ways. Our fingerprints, as our genetic code, are unique to each non-twin human on earth.[37] Individual capabilities and limitations must be considered to design optimally healthy work environments and systems to achieve the best possible outcome.[6,27] Anthropometry is the measurement of people focusing on dimensional patterns of the human body such as stature, limb length and reach distances, etc. Body and population anthropometrics are frequently used by ergonomists to accurately provide specifications for designing access, reach and clearance in workstations, buildings and systems to accommodate users.[6,32,38]

KEY ERGONOMIC PRINCIPLE: HOMEOSTASIS

The human organism is in a state of dynamic flux striving to achieve physical, mental and biochemical balance.[32,39] Static balance is only a moment in time before the organism is perturbed by yet another force or process acting on the body and system. Work affects the balance of the human organism in such a manner that can result in great impacts to human health and productivity outcomes.[32,38] Work must be designed not to exceed the capability of the worker or to push the system too far out of balance and to allow adequate rest and recovery from task demands and environmental exposure to achieve balance, thus supporting worker well-being, healthy optimal functioning, and performance outcomes.[6,27,32,38]

KEY ERGONOMIC PRINCIPLE: SYSTEMS THEORY

Every individual work effort is part of a larger system. Rarely does any one person truly work independent of others, devoid of affecting persons who may use their product or be influenced by the work product. Humans are linked directly and indirectly to each other and, more often than not, dependently in the workplace. All intention and effort are influenced by the world around us. Ergonomists strive to design systems that promote optimal interactions, activities and intentions. The application of sound ergonomic principles in the design of systems has a positive impact on the efficiency, usability, worker comfort, health, satisfaction and productivity outcomes.[27,31] If one process or part of a system is not well designed, the consequence will impair the system efficiency and degrade worker performance with potential physical, mental, quality and productivity costs.[31] Optimization and ergonomics are one and the same. "If a product is intended for human use, then its design should be based on the characteristics of its users." "Much of the scientific basis of ergonomics is thus concerned with defining the limits of human adaptability and human diversity."[6]

ERGONOMIC RISK FACTORS

Ergonomic risk factors have been identified and discussed by scientists, clinicians, safety and health professionals, public servants, business owners, managers and workers, etc. Bernardino Ramazzini wrote about problematic work exposures such as awkward postures and excessive forces over 300 years ago.[6] Exposure to injurious agents occurs in the work place and may include chemicals, dusts, mists, fumes, vapors, micro-organisms, allergens, heavy metals, etc. Adverse environmental conditions exist in many workplaces and may include excessive heat, cold, noise, ultraviolet radiation, ionizing radiation, etc. Likewise, physical activities are highly variable in intensity, frequency and duration. The following is a short list of physical activities that have been associated with work-related MSDs:[5,33]

- Excessive effort or overexertion (dynamic straining effort)
- Excessively repeated movements (repetition)
- Prolonged static postures (lack of movement)
- Awkward positions (deviations from neutral)
- Contact stress (pressure from surface contact)
- Exposure to cold (temperatures below 62° F)
- Exposure to vibration (greater than 16 Hz)

UNHEALTHY LIFESTYLE

Unhealthy choices about lifestyle habits such as sedentary inactivity, poor diet, obesity, tobacco, alcohol and drug abuse may all predispose individuals to MSDs, as well as other occupational and non-occupational diseases.[40] Wellness in the workplace has momentum in America and is supported by many of the partners in occupational and public health.[2,40] The work experience provides a host of exposures that needs to be complemented by good lifestyle habits away from the job that support one's ability to manage the exposures from the workday.

ERGONOMIC EVALUATION

Ergonomic evaluation is typically carried out in a two-step process: passive and active evaluation to identify potential risk factors for MSDs and yield an estimation of risk. The evaluation is the basis for controls and interventions.[6,31]

- Passive evaluation or analysis is preliminary surveillance of company loss records, OSHA and WC data and rate calculations to identify problem areas, activities and outcomes followed by a "walk-through" to view the workers, workplace and work-process.
- Active evaluation or analysis is the quantitative assessment of workers, workstations, environmental conditions and systems through activities such as interviews, surveys, checklists and measurements of the worker-work interface and its demands and exposures. Examples of important measurements might include temperature, humidity, air quality and noise levels, as well as forces, repetitions, posture angles, reach or clearance distances. Many ergonomic tools and resources are available today on the Internet and through professional organizations within the profession and outside chiropractic.

ERGONOMIC INTERVENTIONS

Ergonomic interventions incorporate design principles to optimize the human-work interface, "fitting the job to the worker."[6,28,32] If designed correctly, risk factors are eliminated or minimized from the start. Interventions made to existing workstations and systems are also intended to eliminate or reduce risk factor exposure to workers. Interventions are frequently targeted at reducing forces and repetitions, correcting awkward postures or excessive reaching, as well as simply making workers more comfortable in their jobs. The preferential order of interventions is (1) engineering or designing out the hazard or risk factor, (2) limiting exposure through administrative controls, (3) using personal protection equipment to safeguard from exposure, and (4) training employees on safe-work practices.[41,42] Ergonomists favor design and engineering interventions to reduce and/or eliminate risk factors.

TRAINING AND EDUCATION FOR CHIROPRACTORS IN ERGONOMICS

Postgraduate education in occupational health is available within the profession to train chiropractors as consultants and advocates for patients and industry as fully equipped members of the health and safety team with the mission of injury and illness prevention.[43] The occupational health (OH) diplomate program is taught as a series of postgraduate seminars at Council on Chiropractic Education accredited chiropractic colleges. The curriculum is divided into three major phases of 100 hours each, with 24 learning modules and a year-long mentored project in an actual workplace. At the completion of all three phases of study, doctors are then eligible to take the diplomate examination from the American Chiropractic Board of Occupational Health. Topics in the OH diplomate program include:[44]

- The Field of Occupational Health
- Pre-Placement/Biomechanical Stress Index
- Biomechanics/Ergonomics
- Injury Prevention
- Sitting in the Workplace
- Physical Rehabilitation
- Stress Management
- Cumulative Trauma Disorders
- Chemical & Environmental Hazards
- Chronic Pain
- Narrative Report Writing
- Occupational Multidiscipline Teams
- Legal Considerations in Occupational Health
- Independent Medical Examiner's Role
- Communications
- Safety Engineering

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