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ABSTRACT

Title: Workplace Ergonomic and Psychosocial Factors in Occupational Back Disorders, Healthcare Utilization, and Lost Time: Cross-Sectional and Prospective Studies.

Steven M. Berkowitz, Candidate - Doctor of Philosophy

Dissertation directed by: Michael Feuerstein, Ph.D. Professor,

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Occupational back disorders represent a prevalent source of physical disability in active duty U.S. Army soldiers. An analysis of jobs associated with back disability has identified certain military occupations that appear to be at particularly high risk of these disorders. Differences in job-tasks among these military occupations suggest that soldiers in these jobs are potentially exposed to both ergonomic and psychosocial stressors. These physical and psychosocial stressors could contribute to increased levels of exertion, back disorder symptoms, and lost time from work or the need for limited duty assignments. If these exposures continue unabated, it is possible that symptoms can progress into recurrent and/or chronic back disorders and concomitant chronic work disability.

The present study is a cross-sectional and prospective investigation in 431 U.S. Army active duty soldiers (248 cases and 183 comparison subjects) of the relationship among ergonomic and psychosocial factors, and individual social problem solving ability, as correlates of back disorder symptoms, and predictors of lost work time, and healthcare utilization. While statistically controlling for potential confounding variables, the study determined the relative contribution of ergonomic and psychosocial factors in the workplace, and their interaction with problem solving ability, on levels of perceived exertion, back symptoms, lost work time, and healthcare utilization . The study found significant effects of ergonomic stressors and the psychosocial work environment associated with case status, however, the hypothesized effects of social problem solving on back disorders and lost time were not supported. Prospectively, symptom severity, length of time in military occupation, and frequency of aerobic exercise were modestly predictive of healthcare utilization. The variables that predicted lost time were symptom severity, frequency of aerobic exercise,

length of time in military occupation, and length of time in the Army. The demonstrated relationships among back disorders and disability, with ergonomic and psychosocial factors may have direct implications for prevention and management of these common and costly healthcare problems in the U.S. Army.

WORKPLACE ERGONOMIC AND PSYCHOSOCIAL FACTORS IN OCCUPATIONAL BACK DISORDERS, HEALTHCARE UTILIZATION, AND LOST TIME: CROSS-SECTIONAL AND PROSPECTIVE STUDIES

by

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INTRODUCTION

Prevalence of Work Disability

By the mid 1980's, the National Health Interview Survey estimated that 9.9 million Americans between the ages of 18-69 were either limited or unable to work due to chronic health conditions. (LaPlante, 1988). Back "impairments" and intervertebral disc syndrome accounted for 2.8 million disability cases (LaPlante, 1988). Data from the Bureau of Labor Statistics (BLS) (1991) indicate that occupational musculoskeletal disorders and related neuritis and neuralgia represent a relatively high percentage of all of occupational illnesses and that these problems have actually increased substantially through the 1980's (BLS, 1991). By 1989, even as the U.S. achieved modest reductions in the number of occupational injuries and illness, the number of lost work days related to such injuries and illnesses continued to increase (BLS, 1991). More recent data (U.S. Dept. of Labor, 1994) showed that in 1992 (among employees of private firms), of 2.3 million reported work-related injuries and illness, sprains and strains were the leading category of injury/illness, accounting for 40% of all cases. The area of the body most often affected (40% of the cases) was the back and trunk, and the most frequent cause of injury was overexertion, implicated in 30% of all cases.

Feuerstein, Berkowitz, and Peck (1997) analyzed 41,750 cases of U.S. Army soldiers, referred to the US Army Physical Disability Agency for disability determination over a five year period, from 1990 to 1994. The findings revealed that diagnoses related to musculoskeletal disorders comprised 51% of all diagnoses and lumbosacral strain and

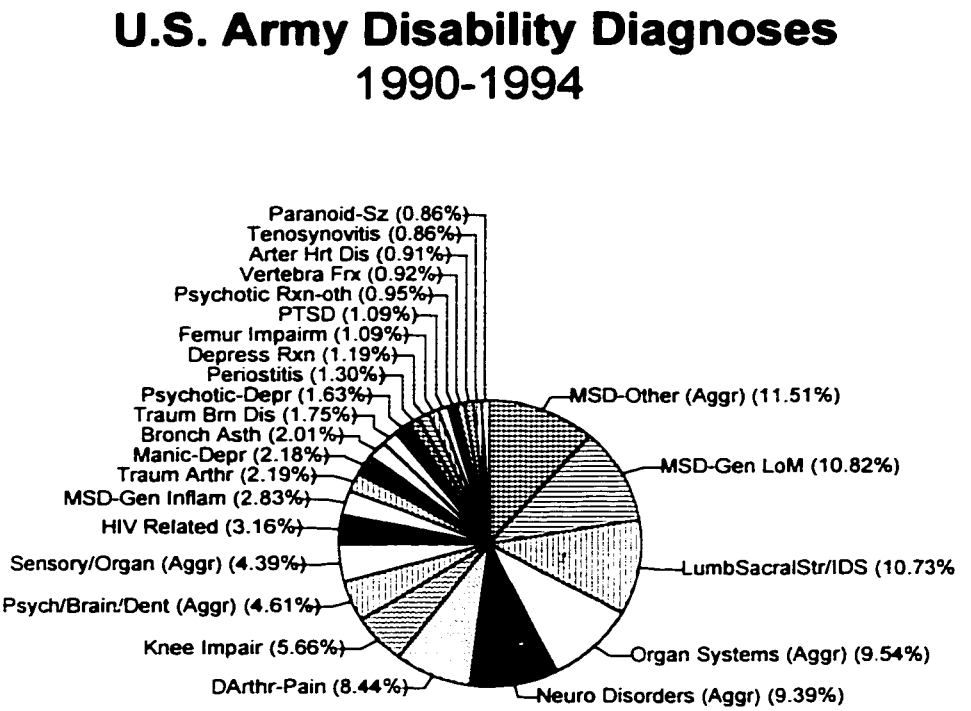

Figure 1: U.S. Army Physical Disability Agency (USAPDA) Data

intervertebral disc syndrome together accounted for 10.7% of diagnoses. Chesson and Hilton (1988) also reported a high prevalence for back related disorders in their study of the U.S. Navy's incidence of back-related hospitalizations and subsequent disability. While the Navy's back-related disability prevalence (as opposed to hospitalizations) was not determined, the study found that 76.5% of all previously hospitalized, back-related disability cases were diagnosed with either, vetebrogenic pain syndrome, intervertebral disc displacement, or back strain/sprain The continuing problem of back-related disorders and disability highlighted in these studies provided the impetus for a recent study of predictors of back-related disability (Feuerstein, Berkowitz, & Huang, in press).

Preliminary assessment of high back disability risk occupations suggest that they involve a range of physical demands and potential psychosocial stressors. It is possible that ergonomic and psychosocial stressors combined, set the stage for the development, exacerbation, or maintenance of various problems, including: overexertion, back symptoms, disorders, functional loss, episodic work disability and decreases in overall quality of life. This, in turn, can effect the productivity of the affected soldier, the soldier's unit and potentially contribute to prolonged disability, increased medical utilization and retention problems.

Cost of Work Disability

When a person is injured in the line of duty (i.e., at work), there are a variety of costs that result. These costs include: lost work/duty time, direct medical care costs, salary and benefits, disability payments, retraining/training costs, morale costs (both to the individual worker and, as the disabled worker's load is distributed, to other workers), and in the case of the military, reduced combat readiness (at least temporarily). In the United States as a whole, medical and workers compensation cost estimates alone range between $20 billion and $40 billion annually (Feuerstein, 1993), and these costs are increasing. One example of these increasing costs comes from New York State, where workers' compensation medical and indemnity payments increased from $607 million in 1980-81 to $2.1 billion in 1991-92 (Feuerstein, 1993).

In 1994, the U.S. Army is estimated to have spent over $500 million for disability

payments alone. Estimates for the Navy (including the Marine Corps) and Air Force suggest that these costs are equal, or possibly higher than the Army (Peck, 1995). While direct medical costs in the Army are generally absorbed by the existing infrastructure of the Defense Medical System, every soldier who becomes a casualty taxes that system, and limits its ability to provide required services to other beneficiaries. These essential services are then provided by either contracting-out or through TRICARE, increasing indirect Department of Defense medical costs, or through the Departments of Veterans Affairs, or Health and Human Services, increasing other federal government agency medical costs. It is likely that contracting-out services will increase as the various military services medical departments continue to shrink to optimally support primary combat missions.

Other hidden costs that frequently are not counted in the overall cost of disability are recruitment and training/retraining costs. A recent Government Accounting Office report, based on Department of Defense data, cited an average recruiting/training investment of $20,733 per soldier, for soldiers separated within 3-6 months of enlistment (Government Accounting Office, 1997). This investment cost is based upon an average recruit, undergoing twelve weeks of basic training and eight weeks of advanced individual training. This cost varies depending on the length of advanced required, since replacing soldiers in certain highly technological occupational specialties may require training as long as two years (Army Regulation 611-201, Dept. of the Army, 1994).

Other important disability cost factors include morale and combat readiness costs. As the Army continues to shrink, unit manpower staffing becomes critical. In the past, first echelon units could be staffed at 100% strength (or more), with second and third echelon units at somewhat lower staffing levels. Typically, at present, this is no longer feasible. In a smaller Army, with fewer people and fewer units, the opportunities to move people around quickly to fill critical shortages are few. This reduced personnel flexibility means that each soldier becomes a more crucial resource. Anytime a soldier who is not able to perform his or her full duties, those duties must remain either not discharged, or be distributed to others, which becomes then, a potential combat readiness liability.

Overall, occupational musculoskeletal disorders and occupational back disorders can exert a significant effect on an individual's functional capacity, work productivity, and overall quality of life. Most research to date related to musculoskeletal disorders in military personnel has focused on training injuries (Knapik, Ang, Reynolds, & Jones, 1993; Jones, Bovee, Harris, & Cowan, 199). Other types of musculoskeletal injuries/ symptoms/disorders related to daily work tasks (i.e. strain and overuse) also represent a potential health problem for military personnel and readiness problem for the military services.

Multidimensional Disability Models Applicable to Occupational Back Disorders

The National Center for Medical Rehabilitation Research has proposed using a multidimensional model of disability (National Institutes of Health, 1993). Despite this

recommendation, which is based on the wide variety of factors that have been associated with occupational back disorders and disability, traditional medical models of work disability are still widely followed. These medical models tend to be based on the assumption that identifying and correcting physical impairments will remedy a patient's disability (Cyriax, 1981; Goodman & Snyder, 1990; Cailliet, 1988). This assumption is rooted in the classic biomedical model of injury and disease that suggests a direct correlation between physical pathology, pain, impairment, functional limitation, and disability (Zigmond, 1976; Haldeman, 1990).

This conventional biomedical perspective suggests that disabled workers fall into one of two categories, 1) those with chronic, disabling medical conditions, and 2) those who are malingerers, whose disability is maintained by their disability payments (Weighill, 1983). Epidemiological studies have not confirmed this dichotomy (Fitzgerald, 1992). Notably, in some back pain cases, the level of pathology and impairment may not be well correlated with reported pain, functional limitation, and physical disability (Haldeman, 1990; Waddell, Somerville, Henderson & Newton, 1992). While medical conditions do exert some influence on work-related disability, a variety of other factors appear to be involved as well. Some of those other factors, which account for most variance in disability outcomes, are, demographics, workplace ergonomics, work-related psychological factors, and work-related social factors (Fitzgerald, 1992). From these factors, newer models of physical disability have been developed to help us better understand this phenomenon and to better predict rehabilitation outcomes associated with

various treatments.

One recent model, which focuses primarily on psychological aspects of the individual, is the Self-Regulatory Model (Fitzgerald, 1992). In this model, self-efficacy (Bandura, 1977, 1986) as viewed as the central mediator in the self-regulatory mechanisms governing the individual's motivation and actions. Perceived self-efficacy in a patient's ability to manage pain, to self-regulate health habits, and to perform required work tasks may play an important part in determining a patient's willingness and ability to return to work. While the self-efficacy/self-regulation model has been tested in a number of studies, (Fitzgerald & Prochaska, 1990; Gattuso, Litt, & Fitzgerald, 1992; Fitgerald & Feuerstein, 1992), it appears that its practical value lies as a component of other multifactor models (Fitzgerald, 1992).

Another model that focuses primarily on psycho-behavioral aspects of the individual is the Glasgow Illness model. This model suggests that the discriminator between disabled and non-disabled workers is a heightened appraisal of pain and disability. Waddell and his colleagues (Waddell, 1987) view disability as an interaction between psychological distress and physical impairment, and have shown empirical support for this model in studies of psychological factors related to spinal surgery outcomes (Waddell et al., 1986). While Waddell's findings show that psychological distress and abnormal illness behavior were better disability predictors than demographic and personality factors, there is still additional variance left unaccounted (Fitzgerald,

1992). While both of these models contributes to our understanding of the problem, neither seems to adequately conceptualize the interaction between the numerous factors having some disability predictive power.

Another multidimensional model of work disability emphasizes the role of different agents/agencies in the employee's environment. The Low Back Disability Model for Health at Work (Hollenbeck, et al., 1992) is a bio-psycho-social model of work disability and focuses on the individual employees, their work and health experiences over time, and the various agents who influence those experiences (see Table 1). According to this model, employees cycle through three stages of health, illness, and recovery. While recognizing that medical personnel play a role in disability, the Low Back Disability Model emphasizes the large role that non-medical "agents" play in determining associated work-related disability duration and costs. Significant factors include: the employee's biologic predisposition back pain, behaviors, and attitudes toward low back pain; the social influences of friends and family on the employee's subjective experience and perception of the problem; and the organizational/managerial efforts to educate supervisors and employees on various task/work-group-related behaviors that serve to exacerbate or prolong low back problems (e.g., task/workstation ergonomics, decision latitude, job security, health agency).

Table 1: ***A Longitudinal and Bio-Psycho-Social Model of Lower Back Disability*** **(Hollenbeck, et al., 1992)**

	Individual's health status stages		
	Healthy	Illness	Recovery
Critical actors in each stage of individual's health status	employees	employees	employees
	friends/family	friends/family	friends/family
	supervisors	health care staff	supervisors
	human resources staff	rehabilitation specialists	human resources staff

The Health Information Model (Fiske & Owens, 1994) represents another multidimensional model of work disability. The Health Information Model attempts to shift the focus from rehabilitation, to prevention and early detection of "at-risk" individuals. The model proposes that the assessment should include: current health functional status, psychosocial systems status, occupational history, and health history, which is then used to identify incentives and motivations to prevent or reduce lost time and benefits use. During this assessment, occupational health staff members inform/educate workers in effective problem solving processes to help them better understand and appropriately manage any physical limitations they experience. In this model, it is proposed that improved decision making skills taught in the workplace have a carry-over effect which assists the worker in all aspects of life.

Fordyce (1994) argues that non-specific LBP should be considered to be a biopsychosocial phenomena by the healthcare community. If physicians rely on a medical

disease model of LBP, they are likely to overlook patients' experiences, moods, and reinforcing factors in their environments that influence the presentation of pain symptoms (Fordyce, 1994). Given the multiple factors associated with disability, perhaps work-related disability is best conceptualized as a complex interaction between the disease condition, the social environment, and the patient's psychological condition (Frymoyer, Haldeman, & Andersson, 1991). One model that does address each of these areas is the Rochester model of work disability (Feuerstein, 1991; Fitzgerald, 1992). This model looks at work reentry from the interaction of four broad areas: 1) medical status, 2) physical capabilities, 3) workplace demands, and 4) psychological/ behavioral resources (see Figure 2).

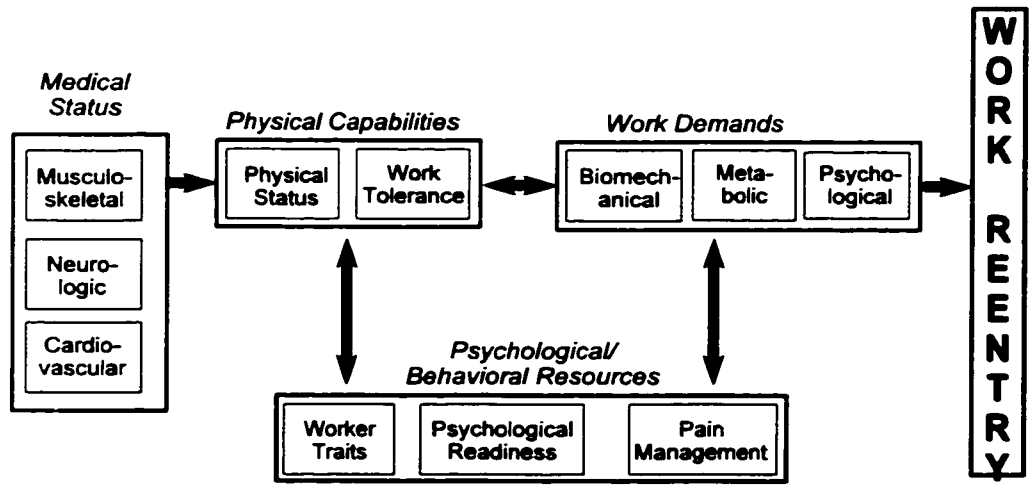

Figure 2. The Rochester model: A multidimensional heuristic for understanding musculoskeletal work disability.

Medical status includes not only the individual's musculoskeletal condition, but also any neurologic and cardiovascular conditions that may affect capacity to work. Physical capabilities include the workers physical status (fitness level) and their work tolerance (or ability to perform certain work related tasks). The "work demands" area looks at the biomechanical, metabolic, and psychological demands of the work environment. And finally, psychological/behavioral resources focuses on how worker traits, psychological readiness, and pain management contribute to work reentry (Feuerstein, 1991). This model proposes that the likelihood of work reentry for an affected worker is a function of a complex interaction among medical status, the discrepancy between physical capabilities and work demands, which in turn, can be influenced by the psychological/behavioral resources the injured worker brings to bear on existing medical conditions and capability-work demands discrepancies. This model has formed the basis for a multidisciplinary rehabilitation approach directed at back and upper extremity disability (Feuerstein & Zastowny, 1996; Feuerstein, Callan-Harris, Hickey, Dyer, Armbruster & Carosella, 1993). Additionally, the psychological/behavioral resource component of the model emphasizes the importance of self-management and problem solving skills. The development of integrative, multidimensional models such as the Rochester model, facilitates an understanding of how various factors can interact to result in work-related disability.

All of these models have several common factors. First, each emphasizes the

multidimensional nature of work disability. Secondly, they all incorporate factors from physical health, psycho-social/behavioral resources, and occupational history, with the Low Back Disability Model and Rochester models adding organizational and ergonomic factors. Finally, each of these models emphasizes problem solving as one potential moderator of other factors contributing to work disability. Despite the number of models available, there are few empirical studies that prospectively determine the influence of the multiple factors proposed to influence symptoms, work status, and healthcare.

The Rochester model was used as the basis for the model of occupational back disorders and disability used in the present study (figure 2). In the present study's model, medical status (back symptoms), metabolic (perceived exertion), ergonomic and psychosocial work demands, and psychological resources (social problem solving ability) are used as predictors of healthcare utilization and temporary disability, controlling for physical fitness (aerobic fitness), social support (family environment) and other factors.

Factors Affecting Occupational Back Disorders and Disability

Research on factors associated with back-related symptoms/disorders indicate that in addition to medical factors, ergonomic and psychosocial stressors can contribute to their development, exacerbation, and maintenance (Marras et al, 1995; Armstrong et al, 1993; Bongers, De Winter, Kompier & Hildebrandt, 1993). Those factors influencing occupational back disability are particularly important from an individual quality of life perspective, however, to employers, the most important issue is frequently whether a

back disorder has an adverse impact on an employee's ability to continue to work. As multiple factors have been shown to influence back disorders, it is reasonable that multiple factors would also influence back disability and as such, researchers have utilized a variety of statistical methods to develop empirical multifactor models of work disability. Some are regression models, based on the percent of variance accounted for by each parameter (e.g., Gervais et al., 1991; Cheadle et al., 1994).

Deciding which factors to include in a multidimensional model can be a difficult task as many factors have been implicated in workplace disability. Some of these factors include: *medical status* (musculoskeletal disorders, neurologic disorders, cardiovascular fitness, individual injury/illness risk), *employee physical capabilities* (physical status, work demands exceed individual capabilities, work tolerance), *work history* (short time in job, unemployed prior to current job), *psycho-behavioral resources* (worker traits, psychological readiness, pain/symptom management, high stress levels, depressed mood, workload perceptions, perceptions of work aggravating problem, minimal coping ability, *perceptions of the work environment* (lack of task enjoyment, little control over tasks or pace of work)), and *work or workplace demands* (job characteristics, physical ergonomics, type of job & equipment, postural demands, unsafe work practices, number of employees in workplace, metabolic, *employer practices* (failing to monitor injured workers or encourage return to duty, failing to modify work environment to permit return to duty, failing to encourage employee participation in problem solving/decision making).

The factors to be discussed here will apply primarily to occupational back disorders, however, some upper and lower extremity factors will also be addressed when those factors appear to apply to musculoskeletal disorders more generally, or in particular, to military populations. Since a long range objective of the present research is to develop interventions to reduce the impact of occupational back disability in the military, the factors that will be focused on are those that are potentially modifiable.

Medical Status

One of the reasons that some may still believe in a limited, physical factor disability model is the apparent importance of the medical status of the individual as a determining factor. For example, one of the best physical predictors of future back pain, is a history of current or recent back pain and/or injury (Bigos, et al., 1986, 1991). One study, however, which may be particularly applicable to soldiers, did not support this relationship. Rohrer, Santos-Eggimann, Paccaud, and Haller-Maslov (1994) followed a group of 1,398 Swiss army inductees for a period of seven years (age nineteen to twenty-six) and found that a history of low back pain (LBP) or pathological physical examination at age nineteen was not predictive of LBP prevalence or incidence at age twenty-six.

Although the presence of physical abnormalities or deformities may be an important medical risk factor, the degree to which these contribute to symptoms and disability is unclear (Ross & Woodward, 1994; Jensen, et al., 1994; Rohrer, et al., 1994). A study of Magnetic Resonance Imaging studies from individuals <u>without</u> back pain

(Jensen et al., 1994) found that fifty-two percent of all asymptomatic subjects had either spinal bulges, protrusions, or intervertebral disk abnormalities, similar to the findings for back pain patients. The authors concluded that due to an unclear relationship between disc degeneration and LBP (Jensen, Kelly, & Brant-Zawadzki, 1994) and the similar physical findings for symptomatic individuals and asymptomatic subjects, these physical findings may be coincidental rather than causal. Another study which examined physical findings and return to work rates in LBP patients, found no significant differences between those who returned to work and those who did not when comparing myelograms, Computed Tomography scans, or radiographs (Lancourt & Kettelhut, 1992).

Employee Physical Capabilities

Physical Status

Another factor that shows up fairly consistently in the injury/disability literature deals with physical capabilities and/or capacity of the worker. Civilian studies and studies of military recruits and of infantry soldiers show that both low aerobic capacity and low physical conditioning seem to have an inverse correlation with injury prevalence (Frymoyer & Cats-Baril, 1987; Linenger & West, 1992; Knapik, et al., 1993; Jones, et al., 1993), although Jones and colleagues also found that very high levels of physical training become a risk factor for development of musculoskeletal disorders. This suggests that there exists some optimum level of physical training, training beyond which is associated with overexertion injuries, but with no significant increase in physical condition. The reduced physical capacity and increased injury relationship has been shown to be

particularly strong in lower extremity injuries (Jones, et al., 1993).

Employee physical fitness has also been shown to play a part in the disability equation. Several studies have found significant differences in back-related pain/disability based on the fitness level of the subjects (Cady, et al., 1979; Dehlin, et al., 1981; Rohrer, et al., 1994). In the Cady study, higher physical fitness for firefighters was associated with lower incidence of back injuries, and in the Dehlin study, nurses who received physical training experienced more rapid recovery from back problems that did occur. Additionally, exercise programs designed to improve back flexibility tend to decrease back pain perceptions (Donchin, et al., 1990). In a seven year, prospective study of Swiss recruits, Rohrer and colleagues (1994) found that respondents with no lifetime incidence of low back pain were characterized by a more active general lifestyle than those with low back pain, although sport and leisure activities were essentially the same for both groups. In a recent prospective study of disability in U.S. Army soldiers (Feuerstein, Berkowitz, & Huang, in press) self-reported infrequent aerobic exercise was a significant predictor of permanent disability with a diagnosis of lumbosacral strain. An extensive review of interventions designed to prevent low back pain (Lahad, Malter, Berg, & Deyo, 1994) found that exercise "may be mildly protective against back pain," and that aerobic exercise is most likely as effective as trunk muscle strengthening exercises.

Work History

One of the employee factors that has been associated with higher levels of

disability claims is that of worker inexperience. Habeck and colleagues (1991) conducted a study of firms with records of high and low worker disability claims and found that firms with large numbers of employees with less than two years of experience on the job had significantly higher disability claims. This finding may be particularly salient to the military in that a high proportion of military personnel remain in the service for a relatively short period of time. Preliminary analyses of data in the Feuerstein and colleagues (in press) study, showed that soldiers with fewer than four years in the service have the highest number of disability claims. Habeck and colleagues suggest that a high rate in less experienced workers may conform to the conventional wisdom that most accidents occur when employees are new to their jobs. Additionally, if an employee has been unemployed for a period of time prior to his/her current job, there appears to be a greater likelihood of lost work time due to musculoskeletal disorders (Deyo &Tsui-Wu, 1987; Reisbord & Greenland, 1985).

Workplace Psychosocial Environment and Employee Psycho-Behavioral Resources

Research has also suggested that back pain and/or disability is associated with certain dimensions of self-reported work demands (monotonous work), time pressure, worry about mistakes, mental strain, and limited supervisor and coworker support (Bongers, De Winter, Kompier & Hildebrandt, 1993). Recent studies in office environments have indicated that work organization factors such as: increasing work pressure, workload surges, routine work lacking decision making opportunities, high information processing demands, varying tasks with few standards, are associated with

symptom presence and severity (Hales et al, 1994). Despite several studies investigating a range of psychosocial variables, the majority of these studies, did not control for physical job demands, or when adjustments were made, they were based on self report measures rather than an job/task analysis by independent observers. In many studies, potential confounding variables such as history of back pain/problems, age, gender, education, and level of problem solving and coping skills, were not controlled for statistically or in study design. To accurately identify etiologic factors, studies should control for the potential effects of confounding variables, and self-report measures, when used, should demonstrate concurrent validity with other non-self-report measures.

Psychological Readiness/Perceptions of Work Environment

There are a number of psychological and perceptual factors that relate to an employee's readiness (and willingness) to continue to work, rather than assume a disabled role. Not unsurprisingly, research has found that if workers lack job satisfaction, they are more likely to become disabled (Bigos, et al., 1991; Lancourt & Kettlehut, 1992). And while it may seem that there is little that can be done to improve job satisfaction, it may not be the work tasks themselves, but other work environment factors which may contribute to this lack of satisfaction. For example, if an employee is experiencing high stress levels prior to/following their medical problems (Frymoyer, et al., 1983; Greenwood, et al., 1990), their stress levels, and/or their medical problems may distract from whatever task enjoyment they may have had previously. Another factor that follows from workers' stress levels is their having only a minimal ability to cope with the

stressors they experience, occupational or personal (Frymoyer & Cats-Baril, 1987; Lancourt & Kettlehut, 1992). Depressed mood prior to a medical problem (Frymoyer, et al., 1983; Lanier & Stockton, 1988) which may or may not be stress related, has also been associated with increased disability.

Perceptions of the workplace also figure prominently into psychological work readiness. If workers perceive that their work loads are too great (or for that matter, too small), and if they have little control over decision making, their work tasks, or the pace of their work (Karasek, et al., 1981; Habeck, et al., 1991), they may experience an unwillingness to work in that particular job or environment. Brown and Leigh (1996) have hypothesized a model of psychological climate and it's effect on job performance. In this model, the authors posit that psychological climate has a direct effect on effort, and an indirect effect on effort through job involvement, with effort then directly affecting performance. Furthermore, if employees have been injured and believe that their workplaces are unsafe and contributed to their injury, those employees are less likely to want to continue performing potentially hazardous tasks, in a potentially hazardous environment (Frymoyer & Cats-Baril, 1987). Certain hazards are, of course, endemic to the military (combat for example), however, the perception of workplace safety in a peacetime environment can enhance a workers desire to continue to work.

If the workplace is perceived as a stressor, this factor can also play an important part in employee willingness and desire to continue working. In a case-controlled study,

Feuerstein and Thebarge (1991) found that perceptions of disability and occupational stressors discriminated between disabled and non-disabled chronic pain patients, a majority of whom suffered from back pain. Disabled patients viewed their work environment as higher in psychological stress and lower in social support than non-disabled patients. Specifically, their environments were high in work or time pressure, urgency, and management control, and low in co-worker cohesion, job autonomy, and supervisor support. Additionally, occupational stress can serve as a risk factor for development of Musculoskeletal disorders, or it may be a factor in effecting return to work outcomes in rehabilitation (Feuerstein & Thebarge, 1991).

Symptom/Pain Management

Another important factor affecting disability is self-reported pain severity. Higher levels of pain severity are associated with an increased likelihood of disability, regardless of the existence or level of physical findings (Frymoyer & Cats-Baril, 1987; Singer, et al., 1987), however, the specific link between pain and disability remains unclear (Lackner, Carosella, & Feuerstein, 1996). As with disability, pain can be influenced by a number of physical and psycho-behavioral factors including: injury, fitness level, pain onset, age, gender, marital status, education level, smoking, drinking, pain experience (and fear), perceptions of work/family, perceptions of function/disability, stress and coping, and self-efficacy. While some demographic factors may help predict pain and disability, many are not readily modifiable (e.g., age, gender, marital status). There are however, several other factors that are more amenable to change (e.g., smoking, fitness level, workplace/family

perceptions, workplace/family reactions to an injured worker, pain, fear, stress/coping, and self-efficacy), and are therefore of greatest interest from an intervention perspective.

While general education levels are modifiable, and higher formal education levels are associated with lower incidence of back pain and disability (Rohrer et al., 1994; Frymoyer & Cats-Baril, 1987), the mechanism through which this relationship operates is unclear, although it is possible that education may relate to problem-solving ability. Increasing education is generally considered a positive step for almost anyone, but its utility in disability prevention and/or rehabilitation is uncertain. Back specific education provided through "back schools" on the other hand, have shown inconsistent results in preventing or reducing pain and disability, from no effect (Hollenbeck, et al., 1992) to dramatic improvement, reducing back-related injuries by 95% (Brennan, 1985). In a well controlled study (Moffett, et al., 1986) back school rehabilitation effects were no better than traditional physical therapy, however, both were significantly better than the placebo control group. As with education, smoking is another factor which has been associated with back pain and disability, however, the mechanisms are also unclear (Linton, 1990; Jamison, et al., 1991; Andersson & Pope, 1991). Therefore, while smoking cessation is a highly desirable health behavior, it's effects as a pain and disability intervention is uncertain. Some other modifiable factors may have greater intervention potential.

Psychosocial perceptions (i.e., the way individuals perceive their pain and their environment) can play an important part in pain and disability experiences. Waddel and

colleagues (1993) found that high scores on the Fear and Avoidance Beliefs Questionnaire was the strongest predictor of work disability from low back pain. Fear of pain and/or re-injury was also shown to be associated with increased distress and expectations of future physical functioning (Papciak & Feuerstein, 1991). Another related psychological factor is fear of movement and/or re-injury, which can affect an employee's willingness to perform certain task-related motions. A recent study by Vlaeyen and colleagues (1995) found that this fear of motion and/or re-injury was the best predictor of self-reported disability levels, even when compared to physical findings, pain intensity, or catastrophizing as a coping strategy. This motion/re-injury fear may contribute, not only as a psychological readiness factor, but also as a factor in pain behaviors. Other perceptions, such as the way the workplace and the family are viewed, can also contribute to the incidence, severity and course of back pain (Feuerstein & Beattie, 1995).

Research suggests that stress, coping, self-efficacy, fatigue, and mood have all been associated with the pain experience. In a large scale, national study of pain (Sternbach, 1986), higher stress and "daily hassles" were strongly associated with greater incidence, frequency, and severity of pain reports. In a prospective study of low back pain patients, Lancourt and Kettlehut (1992) found that patients who returned to work reported fewer job, personal, of family problems than those who remained off work. Interestingly, Feldman (1995) reports in a preliminary study developing a Work Related Injury Survey of Beliefs Scale, that although the majority of his chronic pain patients agreed that their

"pain is purely physical, it has nothing to do with my emotions," they will still also agree that "stress in my life can increase my pain." In a study of stress, fatigue, and mood in non-disabled low back pain patients, Feuerstein, Carter and Papciak (1987) found that pain patients experienced higher levels of tension, anxiety, and fatigue, and lower levels of vigor than normal controls. While anxiety (proxy measure for exposure to stressors) did not predict pain onset or pain severity levels, fatigue levels increased 24 hours after pain episodes, suggesting that pain increased fatigue. Fatigue was then related to increased pain magnitude.

Pain self-efficacy relates to a patient's expectations regarding ability to perform specific behaviors or implement necessary coping skills to influence pain experience and secondarily, function (i.e., reduced pain, increased function). Patients' self-efficacy expectations also have been shown to affect both pain and function in low back pain cases (Dolce, Crocker, & Doleys, 1986; Papciak & Feuerstein, 1991, Lackner et al, 1996). As it relates to changing behaviors and attitudes needed to improve rehabilitation, lower pain self-efficacy levels are generally associated with poorer outcomes (Jensen, et al., 1991). An alternative to pain self-efficacy may be functional self-efficacy, i.e., a person's belief in their ability to perform certain tasks, and may be a better predictor of functional impairment and disability. A recent study (Lackner, Carosella, & Feuerstein, 1996) found that lower functional self-efficacy levels are associated with decreased task performance, even controlling for pain and re-injury expectancies. Another cognitive factor affecting pain and disability is pain coping strategy or how people attempt to deal

with their pain and related problems. These strategies can include: diverting attention, reinterpreting pain sensations, coping self-statements, ignoring pain sensations, praying and hoping, catastrophizing, increasing activity levels, and increasing pain behaviors. In general, more active coping strategies (e.g., increasing activity levels, reinterpreting pain sensations, diverting attention) are associated with more positive outcomes than passive coping strategies (e.g., catastrophizing, praying and hoping) (Feuerstein & Beattie, 1995; Lackner, Carosella, & Feuerstein, 1996).

A study that ties these concepts together introduced the constructs of pain "intrusion and accommodation," which relate to the controllability and predictability of pain (Jacob, et al., 1993). Patients who scored high on "intrusion" generally reported their pain and emotions as being inversely related and predictable. High pain intrusion was related to greater depression symptom severity, more frequent affective distress, and pain behaviors. "Accommodation," however, refers to altering the patient's self-concept, allowing acceptance of chronic pain or functional limitations without changing self-esteem or mood (Jacob, et al., 1993). Patients scoring high on "accommodation" reported greater self-control, viewed themselves as problem-solvers, had fewer depressive symptoms, and fewer affective distress pain behaviors. These studies on psychosocial factors suggest that the way people view their pain, their environment, and their abilities to cope and function can have substantial impact on pain experience, functional limitation, and disability.

Worker Traits

A potentially important individual work trait is an employee's tendency to take an adverse view of being placed in a "limited duty" status. While the Army officially acknowledges and accepts the fact that injuries and illnesses occur, and that there is a need and value in placing soldiers on limited duty, there may exist a perception among career-minded soldiers that they will be considered "less capable" (compared to their peers) or actually desire to avoid their duties, if they become injured, require treatment, and/or are placed on limited duty. Consequently, soldiers may avoid seeking treatment for conditions which, if identified at an early stage, could be more successfully rehabilitated. When these minor conditions persist, they may become recurrent or chronic conditions in the future.

Recently, Feuerstein (1996) proposed a construct referred to as "workstyle," described generally as an individual pattern of cognitions, behaviors, and physiological reactivity, relating to how employees perform their work, both psychologically and bio-mechanically. Repeated physiologic reactivity might contribute to the development, exacerbation, and/or maintenance of recurrent or chronic occupational back disorders, and might predispose a worker to increased risk of back disability. Problem solving ability and/or aptitude (addressed below) is a potential moderator of an adverse workstyle in that individuals with high problem solving ability may be better able to resolve negative job task/organizational psychosocial and biomechanical stressors. If the workstyle construct holds in future research, knowledge and understanding of this work dimension may

provide a key to identifying (and modifying) the workstyles of those workers at increased risk of physical disability.

Social Problem Solving

The back symptoms and disability associated with ergonomic and psychosocial stressors may be moderated by social problem solving. In a prospective study (Marx et al, 1984), an intervention designed to help college students deal with life challenges, and improve interpersonal problem solving behavior reduced illness episodes, illness days, and disability days over the course of two semesters. In a study that specifically measured problem solving ability (Elliott & Marmarosh, 1994), self-appraised "effective problem solvers" reported fewer physical symptoms, before, during, and after assessment. Social problem solving has been studied as a component of coping (D'Zurilla & Chang, 1995), as a stress management strategy (Nezu, 1986a; Nezu, Nezu, Saraydarian, Kalmar, Ronan, 1986; D'Zurilla, 1990), as a factor in depression, anxiety (Nezu, 1986a; Nezu, 1986b, Nezu & Ronan, 1988; D'Zurilla & Sheedy, 1991), and affective states (Elliott, Sherwin, Harkins, & Marmarosh, 1995), and as a factor in health outcomes (Marx, Somes, Garrity, Reeb, & Maffeo, 1984; Elliott & Marmarosh, 1994; Wilkinson & Mynors-Wallis, 1994), and disability (Marx, Somes, Garrity, Reeb, & Maffeo, 1984). It is possible that when confronted by stressors that are potentially modifiable through some type of effort, individuals with higher levels of social problem solving ability perceive an increased opportunity to effectively modify the stressor potentially affecting them.

Work Demands and/or Job Task Ergonomics

In activity-related spinal disorders, of which the majority involve degenerative disc disease and sprain/strain etiologies (Spitzer et al. 1987), workplace factors such as awkward posture, repetition, and excessive force, particularly related to lifting tasks, have been associated with increased risk of frequency and intensity of back disorders. Manual materials handling activities that involve lifting, carrying, static work postures, frequent and repetitive bending and twisting, and pushing/pulling objects has been related to low back disorders in retrospective (Bigos et al, 1986) and injury/disability in cross-sectional studies (Marras et al, 1995). A recent cross sectional study of 403 industrial jobs using a well defined case definition of low back disorder risk, lost time, and quantitative worksite analysis (tri-axial dynamic trunk motions) during occupational lifting, indicated that increases in lift frequency, load moment, trunk lateral velocity, trunk twisting velocity and trunk sagittal angle were associated with increased risk of low back injury and lost time (Marras et al, 1995).

A variety of different jobs have been associated with higher risk of occupational musculoskeletal disorders, especially back related problems. These occupations include: truck driving, nursing, materials-handling jobs, heavy equipment operators, mechanics, maintenance workers, manual laborers, protective services, and typists (Frymoyer, et al., 1983; Kanner, 1981; Frymoyer & Cats-Baril, 1987; Bureau of National Affairs, 1988). Some of the workplace factors that may be associated with higher risk of occupational back disability in these occupations include vibration exposure and job postural demands

(Pope, Andersson, & Chaffin, 1991).

Other workplace demands which may contribute to physical injury (either acute or cumulative) include: physical demand and capabilities mismatches (lifting, pushing, or pulling), awkward or prolonged postures and motions (e.g., bending & twisting) (Frymoyer & Cats-Baril, 1987; Rohrer, 1994; Marras, et al., 1995), high physical training demands (Jones, et al., 1993), high task repetition (Rohrer, 1994), machine paced work (Rohrer, 1994), increased force, and inadequate break/recovery periods. Lifting has long been recognized as a risk factor in low back injuries. The National Institute of Occupational Safety and Health (NIOSH) lifting guide (Waters, Putz-Anderson, Garg & Fine, 1993) cites several factors that increase injury rates and severity rates, including: 1) lifting heavy objects, 2) lifting bulky objects or object can't be held close to the body, 3) lifting from the floor, and 3) lifting frequently. Pope and colleagues (1991) also note that when lift loads exceed lifter capacity, or when improper lifting techniques are used, the chances of injury are greatly increased. This study also found a that increased pulling requirements tended to be associated with increased low back pain severity. Overall, a variety of workplace biomechanical and metabolic demands (Garg & Moore, 1992) appear to have an important discriminatory ability in predicting worker pain and disability.

Employer Practices

Several employer practices have been implicated in higher company rates of

employee disability claims. Once an employee has been injured, firms that failed to monitor those injured workers or encourage them to return to duty experienced significantly higher rates of compensable lost work time (Habeck et al., 1991). Another important factor from the Habeck, et al. study, appears to be using limited duty as a means to allow an employee to return to work more quickly, even though that work may need to be modified due to the employees temporary functional limitation. This strategy is used widely in the military, although how well limited duty personnel are accepted in the military workplace is undetermined.

Perhaps more important than employers' responses to injuries are employers' practices associated with reducing the incidence of employee injuries or illnesses. In firms with lower rates of disability claims, company leaders model safe behavior and monitor employee work practices, reinforcing those practices that contribute to safety (Habeck et al., 1991). These low risk companies also took a proactive approach to job-related health problems by providing periodic screening to ensure early detection of health or disability risks, be they physical, psychological or behavioral. Further, once those risks have been identified, either through company screening or employee reporting, employee assistance programs are available to help employees reduce those risks (e.g., alcoholism, stress, personal problems) (Habeck et al.,1991).

The organizational management climate also appears to be an important factor in occupational musculoskeletal disorders. Companies that experienced lower levels of

disability claims were also those companies that encouraged employee participation in problem solving/decision making (Habeck, 1991). This finding is interesting in that it coincides with prospective research suggesting that worker decision latitude over their work processes is an important factor in overall levels of occupational stress (Karasek, et al., 1981) and resultant chronic disease risk. These results were even stronger when low job decision latitude was paired with high work demands. Additionally, a study by Westman (1992) found that the decision latitude effect on occupational stress appears to be stronger at lower hierarchical levels. In the military, this would suggest that providing greater opportunity to participate in decision making and problem solving might particularly benefit our junior enlisted and officer personnel.

One final study of particular interest looked broadly at self-reported physical task demands, task ergonomics, and workplace psychosocial factors in Sweden (Johansson & Rubenowitz, 1994). Of all factors considered, for blue-collar workers, the only significant factors associated with occupational back disability were: high psychological workload, poor supervisor climate, low work stimulation, and high levels of extreme work postures. For white-collar workers, only high levels of "monotonous working movements" were associated with occupational back disability, however there were multiple psychosocial or ergonomic factors associated with neck (i.e., control, psychological workload, bent work postures, monotonous movements, & twisted postures) and shoulder (i.e., control, supervisor climate, work stimulus, co-worker relations, psychological workload, light materials handling, monotonous movements, & twisted postures) symptoms.

Limitations of Previous Research:

Conceptual Limitations

One major conceptual issue in existing studies that complicates efforts to identify the causes of back disability is that, while there is a recent trend toward multidimensional conceptualizations of work disability, there are differing etiological schools of thought (Frank, Pulcins, Kerr, Shannon, & Stansfeld, 1995; Bombardier et al, 1994) that continue to focus on only one or two dimensions.

For example, the clinical pathology (medical) model attributes most occupational low back pain to subtle sprains and strains of soft tissue. The symptoms associated with these types of injuries, which do not usually appear as hard physical findings, normally resolve within a few weeks of onset. When an employee is unable to work because of work-related LBP the medical model suggests that either there is a more severe physical injury, or that there is secondary psychopathology that is presenting as physical complaints (Rossignol, Lortie, & Ledoux, 1993; Reilly, Travers, & Littlejohn, 1991).

The ergonomic exposure model suggests that occupational low back pain is the result of exposure to adverse ergonomic factors such as lifting, pushing, or pulling demands that exceed capacity, excessive vibration, awkward postures, and/or frequent repetition. Prevention can be achieved by modifying workstations or work tasks to reduce adverse exposures (Chaffin & Park, 1973; Herrin, Jaraiedi & Anderson, 1986; Waters et al, 1993).

The perverse incentives (Frank et al, 1995) model suggests that occupational LBP is a combination of worker, workplace, and/or organizational psychosocial/ regulatory factors, such as low job satisfaction, low autonomy, and workers compensation availability. The suggestion here is that psychosocial and organizational factors can have a mediating, moderating, or maintaining effect (Battie & Bigos, 1991; Nachemson, 1992).

While studies have provided some evidence of risk factors in these three primary areas, no single area has accounted for more than a small portion of the total variance (Bigos et al, 1991; Bigos et al, 1992; Feuerstein, Berkowitz, & Huang, in press; Haldeman, 1990; Cats-Baril & Frymoyer, 1991). Few, if any, studies have investigated multiple risk factors across all three of these models. In order to circumvent this conceptual problem, the present study conceptualized occupational back symptoms and lost time as determined by multiple risk factors and investigated these risk factors across several domains.

Methodological Limitations

There are also a number of methodological problems in the literature on back-related disability. One problem is the variability in back disorder/disability definition. In defining back disorders and disability, it is not clear which factors are most important for etiology and/or for prognosis. The clinical pathology model will frequently use evidence of specific physical pathology, however, since many back disorder cases lack hard

physical findings, this definition may not be useful in terms of the larger population of back disorder-affected workers. Researchers primarily interested in work-disability frequently use a definition that incorporates some sort of lost work time and/or limited duty. If workers choose to continue to work with unreported symptoms and cases are defined on the basis of lost time, an entire class of symptomatic workers may be excluded (Frank et al, 1995), thereby limiting the utility and generalizability of the results.

The present study used a back disorder definition that considered both symptoms and lost time over a 12 month period, which should have captured a more representative sample of back disorder-affected subjects (than a point prevalence definition). Further, it is believed that the military medical system permitted using a lost time component more effectively than in civilian studies. Military members have free access to the medical system so that healthcare cost should not influence healthcare seeking behavior, and "no duty/limited duty" is prescribed based entirely on the healthcare providers' judgement. Absent a determination of permanent disability, there are no short term monetary incentives provided to soldiers, such as indemnity or medical payments to influence continued disability. As the present study required a minimum of only one day "limited duty or no duty," it is believed that this definition included the vast majority of soldiers affected by occupational back disorders.

Rationale for the present study

To counter the adverse effects of occupational back disorders in the workplace

(e.g., lost time, healthcare costs, morale), a better understanding of their etiology is required. As lost time and healthcare costs may have a more significant impact on readiness than symptoms alone, use of these factors as outcomes of interest have the potential to identify etiological factors of greatest importance to both the worker and the organization. The existing literature suggests that occupational back disorders are multiply influenced by a combination of workplace ergonomic and psychosocial factors. The physical interface between workers and their equipment and/or the biomechanical/ metabolic demands of workers' tasks (e.g., prolonged sitting, awkward postures, frequent twisting, exposure to vibration, frequent/heavy lifting, pushing, pulling), have been implicated in occupational back disorders (Rohrer, 1994; Pope et al, 1991 Pope, Wilder, & Frymoyer, 1980; Frymoyer & Cats-Baril, 1987; Marras, et al., 1995; Jones, et al., 1993). Workplace psychosocial stressors (such as job satisfaction, work load, task pacing, decision making control, and perceived job stress) have also been associated with occupational back disorders and disability, (Bigos, et al., 1991; Lancourt & Kettlehut, 1992; Greenwood, et al., 1990; Lanier & Stockton, 1988; Karasek, et al., 1981; Habeck, et al., 1991; Vlaeyen et al, 1995; Feuerstein & Thebarge 1991; Feuerstein, Berkowitz, & Huang, in press). While studies have frequently found associations between these factors and occupational back disorders, few studies have investigated these factors prospectively so as to demonstrate their predictive value. In a recent prospective study, Feuerstein, Berkowitz, and Huang (in press) found that infrequent aerobic exercise, low social support, high levels of worries and high levels of work stress, predicted approved permanent disability claims submitted one to three years after initial assessment.

Social problem solving ability has been linked both to health outcomes and disability (Marx, Somes, Garrity, Reeb, & Maffeo, 1984; Elliott & Marmarosh, 1994; Wilkinson & Mynors-Wallis, 1994) and as a moderator of stress, anxiety, and depression (Nezu, 1986; Nezu, Nezu, Saraydarian, Kalmar, Ronan, 1986; Nezu & Ronan, 1988; D'Zurilla, 1990; D'Zurilla & Sheedy, 1991). In the present study, employee social problem solving is hypothesized to moderate the effects of workplace ergonomic and psychosocial stressors on back-related symptoms, lost time, and healthcare utilization. If confronted by an ergonomic stressor that is potentially modifiable by the employee, higher levels of social problem solving ability should increase the employee's opportunity to effectively modify the ergonomic exposure. Similarly, if perceived workstress is high (Feuerstein, Berkowitz, & Huang, in press), then more effective social problem solvers should be better able to resolve the psycho-social and/or organizational problems that contribute to higher perceived workstress, thus reducing its potential effects on lost time and healthcare costs. As a higher level of worries is a risk factor for back disability (Feuerstein, Berkowitz, & Huang, in press) and since social problem solving ability has been inversely associated with anxiety, more effective social problem solvers should experience lower perceived levels of worry. Finally, as lack of social support is also predictive of back disability (Feuerstein, Berkowitz, & Huang, in press), and as social support can be a substantial resource to aid in problem solving, it may be reasonable to assume that more effective social problems solvers will also be better able to access social support to assist them in resolving problems in their work or personal environment. If, as is hypothesized in the present study, workplace ergonomic and

psychosocial stressors predict lost time/limited duty and healthcare use, then factors such as problems solving, which potentially moderate ergonomic and psychosocial stressors, should also moderate lost time and healthcare use.

In order to understand how workplace factors interact to contribute to occupational back disorders, reduced readiness, and healthcare utilization, it is important to investigate such factors in personnel performing their military jobs. As previous studies have identified military jobs at high risk of musculoskeletal and back disability (Feuerstein, Berkowitz & Peck, 1997; Berkowitz, Feuerstein, Lopez, & Peck, in press), it seems logical to utilize soldiers working in high risk jobs in order to determine how various work-related exposures might influence symptoms and disability. Despite the findings that back disorders are caused and/or influenced by both biomechanical and personal/organizational factors (Frank et al, 1995), few studies (e.g., Johansson & Rubenowitz, 1994, Dionne et al, 1997) have investigated both workplace ergonomic and psychosocial factors simultaneously.

The design of the present study was intended to resolve some of the methodological and conceptual difficulties that limit the conclusions from existing studies and to begin to identify common pathways and mechanisms. The independent variables include demographics, workplace ergonomic and psychosocial factors, and potential confounds. The outcome variables include both personal (back disorder symptoms), as well as organizational (lost time/healthcare utilization) factors. While the

presence of symptoms is frequently necessary to seek medical treatment, previous research has shown it to be an insufficient predictor of return to work (Lancourt & Kettelhut, 1992; Feuerstein & Zastowny, 1996). As the military medical system essentially controls assignment to "no duty" or "limited duty" status, it is reasonable to believe that soldiers who perceive themselves to be less able to work will seek more medical care than those who do not. As workplace ergonomic and psychosocial factors have been predictive of disability (Johansson & Rubenowitz, 1994; Lancourt & Kettlehut, 1994; Feuerstein, Berkowitz, & Huang, in press), investigating disability and healthcare utilization prospectively (moderated by social problem solving), has the potential to demonstrate the relative contributions of each to the others. As this investigation used both case-control and longitudinal methods, it was anticipated that causal relationships would be more readily identifiable. Investigations of the roles and relative contribution of these factors in the workplace are necessary to improve understanding of these disorders, their associated disability, and to develop effective interventions.

General Study Objectives

The first general objective was to identify cross-sectionally, the relative contributions of workplace ergonomic and psychosocial factors, and their interaction with social problem solving ability, to the correlation with back disorder symptoms and lost work time over the previous twelve months. The second general objective was to identify prospectively, the contribution of those same factors (adding symptom severity) to the prediction of future lost time and healthcare utilization. Phase I of the study determined

whether a multivariate model (figure 3) which considers ergonomic exposure, the work environment, and social problem solving ability is associated with perceived exertion and back disorders/lost time. Phase II of the study determined wether the same model was predictive of future lost time/limited duty and healthcare utilization at three months after measurement of predictor variables (i.e., workplace ergonomic/psychosocial stressors, social problem solving ability, and symptom severity). The study controlled for a number of potential demographic and lifestyle factors.

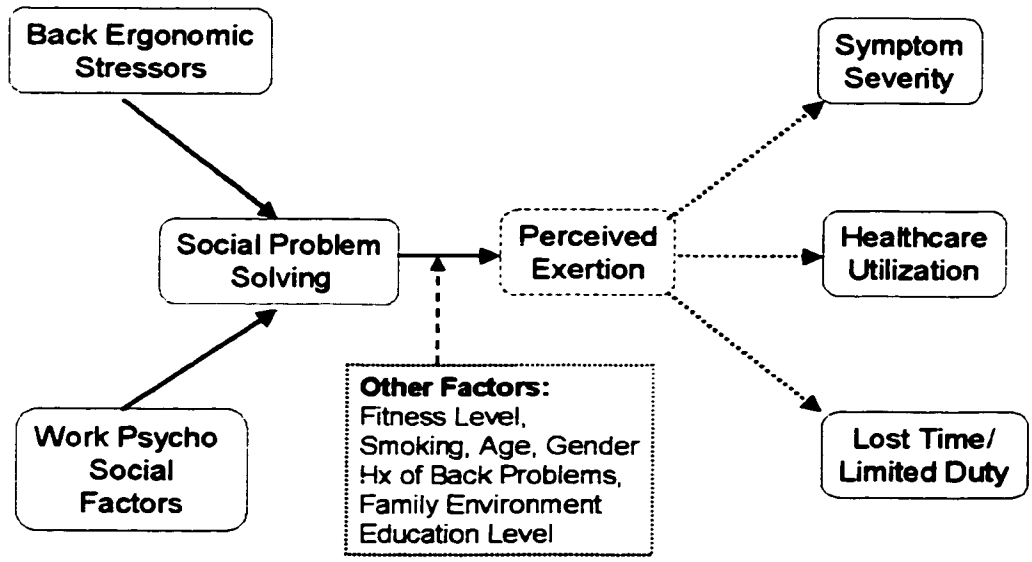

Figure 3: Hypothesized Model of Occupational Back Pain

Note: While direct effects of ergo/psychosocial factors may exist, they are not shown in this model so as to highlight the potential moderating role of social problem solving ability.

Specific Hypotheses:

Phase I: Cross-Sectional Study.

1. That ergonomic stressor exposure will be positively associated with case classification and symptom severity.

2. That workplace psychosocial stressors will be positively associated with case classification and symptom severity.

3. That social problem solving will be negatively associated with case classification and symptom severity.

4. That perceived exertion will be positively associated with case classification and symptom severity.

5. That interactions among ergonomic exposure, workplace psychosocial stressors, and social problem solving, will contribute significantly to case classification and symptom severity. The effect of social problem solving on case classification and on symptom severity is hypothesized to be greater in jobs with high ergonomic and psychosocial stressor exposure than in jobs with low exposure.

Phase II: Prospective Study (T1 = survey date, T2 = three months post survey).

(In a sample of soldiers with back symptoms and lost time, previous year)

1. That ergonomic stressor exposure measured at T1 will be positively associated with/predict back symptom lost time/limited duty and healthcare utilization from T1 - T2.

2. That workplace psychosocial stressors measured at T1 will be positively associated with and predict back symptom lost time/limited duty and healthcare

utilization from T1 - T2.

3. That social problem solving measured at T1 will be negatively associated with and predict back symptom lost time/limited duty and healthcare utilization from T1 - T2.

4. That back disorder symptom severity measured at T1 will be positively associated with and predict back symptom lost time/limited duty and healthcare utilization from T1 - T2.

5. That perceived exertion measured at T1 will be positively associated with and predict back symptom lost time/limited duty and healthcare utilization measured from T1 - T2.

6. That the interactions among ergonomic exposure, workplace psychosocial stressors, and social problem solving, measured at T1, will contribute significantly to predicting lost time and healthcare utilization measured over T1 - T2. The effect of social problem solving on lost time/healthcare utilization is hypothesized to be greater in jobs with high back ergonomic exposure and work pressure than in jobs with low exposure.

METHOD

General Procedural Overview

Potential participants were contacted through their local commanders. They were invited to attend group sessions at their local installations and were provided information on the importance of musculoskeletal health and prevention of workplace musculo-skeletal problems. Inclusion/exclusion criteria were explained and those who met inclusion criteria and who desired to participate completed the consent form (Appendix B). Screening continued until 250 soldiers with back symptoms and lost time over the past year consented to participate. Asymptomatic soldiers served as the comparison group. Participants completed a questionnaire that measured covariates and independent variables. The 281 item survey (approximately 60-70 minutes duration) assessed demographics, ergonomic exposure in the workplace, upper and lower back symptoms, perceived exertion, workplace psychosocial factors, family environment, and the individuals' social problem solving abilities and orientation. The surveys were administered and scored via a scan-able form (developed and scanned with Teleform {version 5}, Cardiff Software) to simplify and standardize the data entry process. The three month follow-up data collection consisted of a review of medical/administrative records for cases to determine lost time/limited duty and healthcare utilization.

Subjects

In order to obtain sufficient cases (n=248) and comparison subjects (n=183), over

1000 soldiers were contacted through their local commanders and asked to participate in the study. Soldiers asked to participate were assigned or working in the following occupations (which had been identified as high risk for back disability): Infantry (11B), Wheeled Vehicle Driver (88M)*, Heavy Construction Equipment Operator (62E), Construction Equipment Repairer (62B), Wheeled Vehicle Mechanic (63B)*, Multi-channel Transmission Systems Operator (31R)*, and Practical Nurse (91C)* (*occupation is also high risk for women, compared to men) (Berkowitz et al, in press). The following installations were identified as having adequate numbers of soldiers in the Military Occupational Specialties (MOS) of interest available for potential participation: Ft. Bragg, NC, Ft. Meade, MD, Walter Reed Army Medical Center, DC, Ft. Eustis, VA, Ft. Story, VA, Ft. Lee, VA, Ft. Myer, VA, and Ft. Belvoir, VA.

Inclusion criteria:

Volunteers were accepted for the study provided they are currently working in one of the occupations listed above, have not had a non-occupational accident, sports injury, or acute trauma that had resulted in back-related symptoms, and had not been pregnant during the previous 12 months.

Case Definition:

Cases were defined as any subject who had experienced back-related symptoms and at least one day of lost time during the previous 12 months. Symptoms and lost time were defined as: 1) back-related symptoms (pain, aching, stiffness, burning, tingling, or

numbness in the lower back, upper back, or neck regions) during the past 12 months, and 2) "no duty" or "limited duty," for at least one day, during the past 12 months due to any of the symptoms above.

Comparison Subjects Definition:

Comparison subjects were defined as any subjects who had not experienced any back-related symptoms (see case definition above) or lost time from back-related symptoms over the previous 12 months.

Independent Variables

The independent variables used in the present study fall into four general categories of data (demographics/lifestyle, ergonomics, workplace psychosocial, and social problem solving) which were collected and used initially to classify cases with pre-existing back disorder symptoms and lost time (versus asymptomatic comparison subjects), and at three months, to predict subsequent "no duty/ limited duty" and healthcare utilization. The survey, consisting of 281 questions, was used to obtain baseline measures in each of the following categories: Demographics/Lifestyle Factors, Workplace Ergonomic Exposure, Perceived Exertion, Workplace Psychosocial Factors, Social Problem Solving, and Back Symptom Severity and Lost Time. A breakdown of study measures and associated variables is contained in Table 2.

Demographics/Lifestyle Factors:

Information on age, gender, race, military rank, marital/family status, education level, and length of service (in occupational specialty), and total length of service, smoking status, and fitness level were obtained. Questions on demographics/lifestyle factors were included as findings in the literature have shown associations between these factors and either back disorders or back disability (Bigos, 1991; Cheadle, 1994, Lancourt & Kettlehut, 1992; Feuerstein et al, 1997; Feuerstein, Berkowitz, & Huang, in press)

Workplace Ergonomic Exposure:

Each subject completed a series of questions, extracted from the U.S. Air Force Job Requirements and Physical Demands Survey (JRPDS) (Marcotte et al, 1997), related to their job requirements and job physical demands. The reliability and validity of the JRPDS has been determined (internal consistency sample, n = 198, test-retest sample, n = 31) (Feuerstein, Haufler, Lopez & Berkowitz, 1998). The internal consistency of the JRPDS back scale was computed with Cronbach's alpha = .82. The test-retest reliability was computed with Eta^2 = .66.

Workplace Psychosocial Factors:

The Work Environment Scale (WES) (Moos, 1981) was used to provide a multidimensional assessment of the work environment. This measure has 90 questions divided into 10 subscales along three dimensions: ***Relationship*** (involvement, peer cohesion, and supervisor support subscales), ***Personal Growth*** (autonomy, task orientation, and work pressure subscales), and ***System Maintenance and Change*** (clarity,

control, innovation, and physical comfort subscales). The WES has been shown to have test-retest reliability (.69 - .83) and internal consistency (.69 - .86). The WES has been used to measure the work environment and its association with pain among ambulatory low back pain patients (Feuerstein, Sult & Houle, 1985).

Social Problem Solving:

The Social Problem Solving Inventory - Revised (SPSI) (D'Zurilla et al, in review) was used to assess individuals' social problem solving style and abilities. The SPSI consists of 52 items organized into 5 subscales; Positive Problem Orientation, Negative Problem Orientation, Rational Problem Solving, Impulsivity/Carelessness Style, and Avoidance Style. A total social problem solving score was obtained (D'Zurilla et al, 1996). The SPSI has been shown to have adequate to high reliability both in internal consistency (.76 - .92) and in test-retest reliability (.72 - .88). The structural, concurrent, predictive, and convergent/ discriminant validities of the SPSI have been evaluated (Maydeu-Olivares & D'Zurilla, 1996; Francis & D'Zurilla, 1993; Sadowski et al, 1994; Chang & D'Zurilla, 1996).

Outcome Variables:

Case - Comparison Group Classification (Phase I):

Cases and comparison groups met criteria as indicated in subject selection above. The percentage of correct classification of cases and comparison groups was computed using multivariate logistic regression.

Perceived Physical Exertion (Phase I):

The Borg scale of perceived exertion (Borg, 1990) for a "typical work day" was obtained during the initial screen. The scale is an ordinal numerical list ranging from 0 to 10 with adjectives describing increasing levels of physical exertion. The Borg scale has been used extensively to measure perceived exertion both in exercise tasks (Ceci & Hassmen, 1991; Whaley, Woodall, Kaminsky, & Emmett, 1997) and in manual work tasks (Putz-Anderson, Waters, Baron, & Hanley, 1993). Reliability and validity studies have shown that the Borg scale has good test-retest reliability (Avg. $r \geq .92$) (Eston & Williams, 1988) and that there are significant correlations between perceived exertion and physiologic exertion measures such as oxygen uptake (Eston & Williams, 1988) and heart rate (Borg, 1982, 1990).

Back Symptom Severity (Phase I):

A modified form of the NIOSH symptom survey, used in the Big Bear Grocery Warehouse (Putz-Anderson et al, 1993) and other health hazard evaluations, was used to measure back symptom presence, frequency, duration and intensity. Studies have shown a relationship between self-reported musculoskeletal symptoms and stressful ergonomic work environments (e.g. Marras et al, 1995; Putz-Anderson et al, 1993). Symptom severity was analyzed as a composite score (duration x intensity x frequency). Such a composite index provided a single value to capture the variability in the pain experience.

Healthcare Utilization (Phase II):

Each subject's health care utilization at three months post-survey was obtained through the Department of Defense Ambulatory Data System (ADS) (EDS, 1996). Data were extracted from ADS for each subject to obtain standardized data concerning outpatient healthcare episodes and return to duty disposition during the follow-up period. The ADS collects data concerning specific diagnoses, treatment provided using a standardized coding system, duration of visit, and patient disposition status (i.e. "return to duty without limitations" (full duty), "return to duty with work/duty limitations" (limited duty), "sick at home/quarters" (no duty), or "admitted"). The inclusion decision tree required that a) the subject must have had at least one incident of care with a back-specific diagnosis. If a), then b) all back-specific incidents of care, and c) all back-related incidents of care within 30 days of a back-specific incident were used in healthcare cost computation. If no diagnosis was provided, then Current Procedural Terminology (CPT) codes were used to determine if that visit was included in the computation. Inclusion criteria by diagnosis and by CPT code are at Appendices C and D.

Examples of types of visits included were: troop medical clinic, general outpatient/acute care clinic, family practice clinic, sports medicine clinic, emergency room, orthopedic clinic, neurology clinic, physical medicine & rehabilitation clinic, chiropractic clinic, physical therapy service, occupational therapy service, psychology clinic, psychiatry clinic, or behavioral medicine clinic. Examples of types of procedures included were: therapeutic exercise, physical therapy, occupational therapy, chiropractic manipulation, radiographs, computerized tomography, spinal magnetic resonance

imaging, and electro-myelograms. Once these data were obtained, a composite dollar value of healthcare utilized was calculated based on data provided by the U.S. Army Medical Command (Ashby, 1998) (Appendix E).

Lost Work Time and Limited Duty Records (Phase II):

Initial data on these variables were obtained from questions on the symptom survey. Using the same visit/procedure inclusion criteria as in the healthcare cost computation, three-month follow-up data on limited duty and no duty were extracted from ADS records. The lost time (LT) outcome was computed (LT = LD + 2ND +2A; where LD = # of healthcare episodes w/ "Released w/work/duty limitations", ND = # of healthcare episodes w/ "Sick at home/quarters", and A = # of healthcare episodes w/ "Admitted"), analyzed as an ordinal variable.

Potential Covariates:

Data on subjects' 12 month prior lost time, fitness level, education level, age, time on specific job, and family environment were collected during the initial survey period. These measures were used as covariates in the regression analyses to determine their relative influence on the relationship among ergonomic and occupational stress, social problem solving, and back disorder symptoms, lost time, and healthcare utilization. Fitness Level was originally planned to be measured using the two mile run score from each soldier's Army Physical Fitness Test (APFT) however, difficulties were encountered in obtaining data for all subjects. As a proxy for Fitness Level, another variable, self-

reported "Frequency of Aerobic Exercise" was utilized. Frequency of Aerobic Exercise previously has been shown to predict permanent disability in soldiers with either back disorders or upper extremity disorders (Feuerstein, Berkowitz & Huang, in press; Huang, Feuerstein & Berkowitz, in press).

The Family Environment Scale (FES) (Moos & Moos, 1981) was used to control for the effects of both stressors and social support in the family environment. The reliability of the FES subscales has been determined to range from .68 to .86 (Moos & Moos, 1981). The FES has been used to measure the familial environment for chronic LBP patients (Feuerstein, Sult & Houle, 1985) with a finding that the pain group experienced greater family conflict and control than did healthy controls.

Table 2: Study Measures

Measure	Variable/Group	Survey Questions	Variables
Demographics	Demographics	16	9
Job Requirements & Physical Demands Survey	Back Ergonomic Stressor Exposure	38	1
Work Environment Scale	Workplace Psychosocial Factors	90	3
Social Problem Solving Inventory -Rev.	Social problem solving	52	1
Borg Scale	Perceived Exertion	1	1
NIOSH Symptom Survey (modified)	Back Disorder Symptoms	52	1
Family Environment Scale	Family Psychosocial Factors	27	3
Frequency of Aerobic Exercise	Aerobic Fitness	1	1
Lost Time/Limited Duty - T1	Lost Time/Limited Duty	4	1
Healthcare Utilization	Healthcare Utilization	0	1
Lost Time/Limited Duty - T2	Lost Time/Limited Duty	0	1
Total		281	22

Data Analyses

Phase I: Cross-sectional study of back symptoms, lost time, and perceived exertion

Symptoms/Lost Time (past 12 months):

The symptoms/lost time outcome was analyzed as a dichotomous variable (present or absent, based on the case definition above). Initially, each independent variable was entered into a univariate logistic regression to determine the association of that variable with symptoms/lost time, in the absence of other independent variables. Examination of univariate regression results determined which variables from each set would be entered into the multivariate logistic regression, using a minimum univariate significance level of $p < .1$. The only exception to the minimum significance level criteria was the SPSI positive problem solving orientation score ($p =< .15$), which was included based upon apriori hypotheses. Once the multiple logistic regression variable set was determined, the analysis determined whether, and how well demographic factors, ergonomic and psycho-social stressors, and social problem solving ability classified cases (i.e., symptomatic with lost time), and yielded significance levels (determined by *Wald* statistic) and relative risk ratios for each variable. The regression analysis used a hierarchical set procedure, with an "enter" procedure within each functional set. The sets and their entry order were: Set "D," (demographics) age, gender, education, rank, time in service, time in MOS, aerobic exercise, Set "E," (ergonomics) JRPDS back score, and Set "W," (WES) involvement, supervisor support, and work pressure, followed by Set "P," (SPSI) positive problem orientation, with the two way interaction terms (social problem solving X ergonomic exposure, social problem solving X work stress exposure) and three

way interaction terms (social problem solving, ergonomic exposure, and work stress exposure) entered last. Once the multivariate logistic regression results were examined, variables that failed to reach a minimum significance level of $p < .05$ were eliminated, and the regression was run one last time.

Perceived Exertion - Borg Scale

Upon finalizing the regression model with demographics and the primary variables of interest, the perceived exertion variable (Borg scale) was added as a final stage. As it was unclear what role perceived exertion would play in this extended model, all variables and their statistics were reported in order to be able to examine the effect of adding the perceived exertion variable to the model. Perceive exertion was also analyzed as an outcome using multiple regression with a hierarchical procedure. The variables and order entered were identical to that used in the logistic regression.

Symptom Severity:

The symptom severity outcome was analyzed (for cases only) as an ordinal variable (duration X intensity X frequency), using multiple regression. The regression analysis determined whether, and how well, ergonomic and psycho-social stressors, and social problem solving ability were associated with symptom severity, and yielded significance levels for each variable. As with the logistic regression, the multiple regression used a hierarchical procedure, with an "enter" process within each functional set. The variables and set entry order was identical to that used in the logistic regression.

Phase II: Prospective study of healthcare utilization and lost time (Only phase I cases were followed in phase II)

Lost Time:

The lost time outcome was analyzed as an ordinal variable using multiple regression. The regression analysis determined whether, and how well, ergonomic and psycho-social stressors, and social problem solving ability predicted lost time, and yielded significance levels for each variable. The multiple regression used a hierarchical set procedure, with an "enter" procedure within each functional set. The sets and their entry order were: Set "D," (demographics) age, gender, education, rank, time in service, time in MOS, aerobic exercise, symptom severity, and lost time (T1), Set "E," (ergonomics) JRPDS back score, and Set "W," (WES) involvement, supervisor support, and work pressure, followed by Set "P," (SPSI) positive problem orientation, with the two way interaction terms (social problem solving X ergonomic exposure, social problem solving X work stress exposure) and three way interaction terms (social problem solving, ergonomic exposure, and work stress exposure) entered last.

Healthcare Utilization:

The healthcare utilization outcome was analyzed as a continuous variable (dollar value of healthcare provided for back and back-related symptoms), using multiple regression. The regression analysis determined whether, and how well, ergonomic and psycho-social stressors, and social problem solving ability predicted healthcare utilization, and yielded significance levels for each variable. The multiple regression

used a hierarchical set procedure, with an "enter" procedure within each functional set. The set entry order identical to that used for lost time.

Power Analysis

Phase I power analyses for multiple regression indicated that assuming type I error of .01, 13 demographic/Family/Fitness covariates with cumulative $R^2 = 0.1$, and 10 variables of interest, including interactions, yielding a cumulative $R^2 = 0.3$ (Total $R^2 = 0.4$), 240 cases were required for an incremental power between .80 and .99 for each variable set (SPSS, Sample Power, 1997). Using data from a recent prospective study on disability from low back pain, the twelve month prevalence of back-related symptoms with lost time was 25% (Symonds, Burton, Tillotson & Main, 1996). Using the 25% rate, in order to obtain 240 cases, 960 individuals would need to be screened for entry into the study. Power analysis for logistic regression for phase I indicates that with a probability of .1, an odds ratio of 2.0, a correlation of .25, and an Alpha of .05, a sample of 250 subjects will yield a Beta of .088 and power of .91 (Solo Power Analysis, 1995).

Table 3: Power Analysis

Phase I Power Analysis Table (n=240)	Variables in Set	Increment to R^2	Power for Increment
Set D - Demographics	13	0.10	0.96
Set P - Social problem solving	1	0.10	0.99
Set E - Ergonomic Exposure	1	0.05	0.95
Set W - Work Stress Exposure	3	0.10	0.99
Interaction (P X E X W)	5	0.05	0.80

Phase II power analyses for multiple regression indicated that assuming type I error of .01, 13 baseline covariates with cumulative $R^2 = 0.1$, and 11 variables of interest, including interactions, yielded a cumulative $R^2 = 0.35$ (Total $R^2 = 0.45$), 230 cases will result in power rating between .82 and .99 (SPSS, Sample Power, 1997).

Results

Sample Description

In Phase I, there were 431 subjects in the overall sample (248 cases, 57.5%, and 183 comparison subjects, 42.5%). Tables 4 and 5 present demographic data for all subjects and includes a breakdown by case and comparison group status. The mean age of the sample was 25.5 years (SD=6.1 years) and men were disproportionately represented at 91.6%. The average subject had spent 5.1 years in the service (SD=4.8) and 4.1 years in his/her MOS (SD=3.9 year). The largest group of subjects were single (48.3%) with a sample average of .75 children supported per subject (55.9% supported no children). The most frequently endorsed education level was H.S. Graduate or G.E.D. (48%) however, when this variable was collapsed into two levels, a majority, 51.9% of the sample, has "at least some college." Specialist/Corporal (paygrade E-4) was the rank of the largest group of subjects (33.1%) while slightly more than half the subjects were infantrymen (MOS =11B) (53%) by occupation. The largest group of subjects were from Ft. Myer, VA (37.6%) with the second largest group from Ft. Bragg, NC (31.1%). In Phase II, the sample consisted of all cases (n = 248) from Phase I.

Table 4: Sample Demographics (Categorical Variables)

	value		Com-parison	Case	Total
GENDER	Male	Count	176	219	395
		% within	44.6%	55.4%	100.0%
	Female	Count	7	29	36
		% within	19.4%	80.6%	100.0%
	Total	Count	183	248	431
		% within	42.5%	57.5%	100.0%
EDUCATION LEVEL	H. S. Grad / G.E.D.	Count	103	102	205
		% within	50.2%	49.8%	100.0%
	Some college	Count	57	108	165
		% within	34.5%	65.5%	100.0%
	2 year degree	Count	17	22	39
		% within	43.6%	56.4%	100.0%
	4 year degree	Count	5	10	15
		% within	33.3%	66.7%	100.0%
	Some graduate work	Count	0	3	3
		% within	0.0%	100.0%	100.0%
	Total	Count	182	245	427
		% within	42.6%	57.4%	100.0%
EDUCATION - 2 LEVELS	H.S Grad./GED	Count	103	102	205
		% within	50.2%	49.8%	100.0%
	At Least Some College	Count	79	143	222
		% within	35.6%	64.4%	100.0%
	Total	Count	182	245	427
		% within	42.6%	57.4%	100.0%
MARITAL STATUS	Single	Count	100	108	208
		% within	48.1%	51.9%	100.0%
	Married	Count	63	99	162
		% within	38.9%	61.1%	100.0%
	Separated	Count	7	12	19
		% within	36.8%	63.2%	100.0%
	Divorced	Count	5	17	22
		% within	22.7%	77.3%	100.0%
	Missing	Count	8	12	20
		% within	40.0%	60.0%	100.0%
	Total	Count	183	248	431
		% within	42.5%	57.5%	100.0%
# of CHILDREN SUPPORTED	0	Count	109	132	241
		% within	45.2%	54.8%	100.0%
	1	Count	30	46	76
		% within	39.5%	60.5%	100.0%
	2	Count	30	35	65
		% within	46.2%	53.8%	100.0%
	3	Count	7	18	25
		% within	28.0%	72.0%	100.0%
	4	Count	2	5	7
		% within	28.6%	71.4%	100.0%
	Missing	Count	5	12	17
		% within	29.4%	70.6%	100.0%
	Total	Count	183	248	431
		% within	42.5%	57.5%	100.0%

BASE	Ft. Bragg	Count	52	82	134
		% within	38.8%	61.2%	100.0%
	Walter Reed	Count	21	27	48
		% within	43.8%	56.3%	100.0%
	Ft. Meade	Count	1	3	4
		% within	25.0%	75.0%	100.0%
	Ft. Myer	Count	73	89	162
		% within	45.1%	54.9%	100.0%
	Ft. Belvoir	Count	6	11	17
		% within	35.3%	64.7%	100.0%
	Ft. Eustis	Count	23	35	58
		% within	39.7%	60.3%	100.0%
	Ft. Story	Count	7	1	8
		% within	87.5%	12.5%	100.0%
	Total	Count	183	248	431
		% within	42.5%	57.5%	100.0%
RANK	Private/E-1	Count	10	6	16
		% within	62.5%	37.5%	100.0%
	Private/E-2	Count	40	28	68
		% within	58.8%	41.2%	100.0%
	Private First Class/E-3	Count	34	38	72
		% within	47.2%	52.8%	100.0%
	Specialist/Corporal/E-4	Count	44	98	142
		% within	31.0%	69.0%	100.0%
	Sergeant/E-5	Count	27	37	64
		% within	42.2%	57.8%	100.0%
	Staff Sergeant/E-6	Count	22	29	51
		% within	43.1%	56.9%	100.0%
	Sergeant Fist Class/E-7	Count	4	8	12
		% within	33.3%	66.7%	100.0%
	Master Sergeant/E-8	Count	0	2	2
		% within	0.0%	100.0%	100.0%
	Other	Count	1	1	2
		% within	50.0%	50.0%	100.0%
	Total	Count	182	247	429
		% within	42.4%	57.6%	100.0%
Rank - 3 Groups	Private to Private First Class/E-1-3	Count	84	72	156
		% within	53.8%	46.2%	100.0%
	Specialist/Corporal/E-4	Count	44	98	142
		% within	31.0%	69.0%	100.0%
	Sergeant - Master Sergeant/E-5-8	Count	53	76	129
		% within	41.1%	58.9%	100.0%
	Total	Count	181	246	427
		% within	42.4%	57.6%	100.0%
Military Occupational Specialty	Infantryman - 11B	Count	82	145	227
		% within	36.1%	63.9%	100.0%
	Construction Equip Repairer - 62B	Count	9	3	12
		% within	75.0%	25.0%	100.0%
	Heavy Construction Equip Op - 62E	Count	8	7	15
		% within	53.3%	46.7%	100.0%
	Wheeled Vehicle Mechanic - 63B	Count	15	9	24
		% within	62.5%	37.5%	100.0%
	Wheeled Vehicle Driver - 88m	Count	29	38	67
		% within	43.3%	56.7%	100.0%
	Practical Nurse - 91C	Count	24	34	58
		% within	41.4%	58.6%	100.0%
	Other	Count	14	11	25
		% within	56.0%	44.0%	100.0%
	Missing	Count	2	1	3
		% within	66.7%	33.3%	100.0%
	Total	Count	183	248	431
		% within	42.5%	57.5%	100.0%

Table 5: Sample Demographics (Continuous Variables)

	Comparison			Case			Total		
	N	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
AGE	181	24.73	5.51	246	26.13	6.52	427	25.53	6.14
TIME IN SERVICE	181	4.44	4.28	244	5.61	5.02	425	5.11	4.75
TIME IN MOS	179	3.40	3.74	238	4.61	3.92	417	4.09	3.89

On lifestyle factors, a large majority (70.6%) of subjects reported engaging in aerobic exercise three or more times per week, with the remainder (29.4%) exercising aerobically two or fewer times per week. "Never smoked" was endorsed by 49.8% of the

Table 6: Descriptive Statistics, Categorical Independent Variables

	value		**Com-pariso**	**Case**	**Total**
Lifestyle Factors					
Smoking Status	*Current Smoker*	Count	59	91	150
		% within	39.3%	60.7%	100.0%
	Former Smoker	Count	23	36	59
		% within	39.0%	61.0%	100.0%
	Never Smoked	Count	95	112	207
		% within	45.9%	54.1%	100.0%
	Missing	Count	6	9	15
		% within	40.0%	60.0%	100.0%
	Total	Count	183	248	431
		% within	42.5%	57.5%	100.0%
Frequency of Aerobic Exercise	*rare/never*	Count	13	35	48
		% within	27.1%	72.9%	100.0%
	1-2X/wk	Count	30	48	78
		% within	38.5%	61.5%	100.0%
	3+/wk	Count	139	164	303
		% within	45.9%	54.1%	100.0%
	Total	Count	182	247	429
		% within	42.4%	57.6%	100.0%
Freq of Aerobic Exercise - 2 levels	*<3X/wk*	Count	43	83	126
		% within	34.1%	65.9%	100.0%
	3+/wk	Count	139	164	303
		% within	45.9%	54.1%	100.0%
	Total	Count	182	247	429
		% within	42.4%	57.6%	100.0%

sample, with current smokers (36.1%) and former smokers (14.2%) representing smaller subject groups. Tables 6 and 7 summarizes descriptive statistics for categorical and continuous independent variables.

Table 7: Descriptive Statistics, Continuous Independent Variables

	Comparison			Case			Total		
	N	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
Ergonomic Exposure									
JRPD - BACK SCORE	183	28.00	9.10	248	33.03	9.62	431	30.90	9.71
Work Psychosocial Factors									
WES-Involvement	183	4.73	2.46	248	3.46	2.13	431	4.00	2.36
WES-Peer Cohesion	183	5.09	2.17	248	4.30	1.98	431	4.64	2.10
WES-Supervisor Support	183	5.19	2.26	248	3.68	2.41	431	4.32	2.46
WES-Autonomy	183	5.43	1.84	248	4.54	2.00	431	4.92	1.98
WES-Task Orientation	183	5.82	2.04	248	5.31	1.98	431	5.52	2.02
WES-Work Pressure	183	5.32	2.15	248	6.80	2.05	431	6.17	2.22
WES-Clarity	183	4.73	2.13	248	3.87	2.09	431	4.24	2.14
WES-Control	183	6.82	1.77	248	6.87	1.73	431	6.85	1.75
WES-Innovation	183	3.67	2.12	248	2.63	1.99	431	3.07	2.11
WES-Physical Comfort	183	3.65	1.83	248	2.90	1.82	431	3.22	1.86
Problem Solving Factors									
SPSI- Avoidance Style	183	14.79	5.35	248	14.80	5.38	431	14.79	5.36
SPSI - Impulse/Careless Style	183	21.86	8.09	248	21.14	7.09	431	21.44	7.53
SPSI- Negative Orientation	183	20.41	8.03	248	21.19	8.39	431	20.86	8.24
SPSI- Positive Orientation	183	17.93	4.15	248	17.36	4.10	431	17.60	4.13
SPSI- Rational Problem Solving	183	65.32	16.52	248	63.94	15.28	431	64.53	15.82
SPSI Total Score	183	12.51	3.04	248	12.32	2.82	431	12.40	2.91
Family Psychosocial Factors									
FES - Cohesiveness Scale	183	6.62	2.26	244	6.62	2.24	427	6.62	2.25
FES - Expressiveness Scale	183	5.90	1.89	244	5.69	1.94	427	5.78	1.92
FES - Conflict Scale	183	3.20	2.11	244	3.11	2.22	427	3.15	2.17
Perceived Exertion									
BORG - Perceived Exertion	181	3.83	2.25	246	5.77	2.27	427	4.95	2.46
T1 - Symptom Severity & Lost Time									
Symptom Severity				248	55.24	48.88	248	55.24	48.88
Lost Time - Value				248	6.31	6.32	248	6.31	6.32
T2 - Healthcare Utilization & Lost Time									
HEALTHCARE COST				248	$ 84.05	$ 302.88	248	$84.05	$302.88
LOST TIME - Value				248	0.42	2.58	248	0.42	2.58

Phase I Results (Cross-Sectional):

Classifying Cases (Soldiers with Back Symptoms and Lost Time)

Univariate Analyses

Table 8 shows the univariate logistic regressions that were performed for each of the variables of interest. The univariate analyses revealed a number of demographic variables where cases and comparison subjects differed significantly. Soldiers of different ranks were unequally represented (Wald = 15.7, p <.001). When contrasted to comparison subjects, there were significantly more Specialist/Corporal (E-4) cases (Wald = 15.5, p <.001), and significantly more cases among Sergeants and above (E-5 to E-8) (Wald = 4.6, p <.05). Females were also over-represented among cases (Wald = 7.7, p <.001). Age discriminated cases from comparison subjects (Case Mean = 26.1, Comparison group Mean = 24.7, t = -2.3, p <.05), as did frequency of aerobic exercise (Wald = 4.9, p <.05), time in service (Case Mean = 5.6, SD = 5.0, Comparison group Mean = 4.4, SD = 4.3, t = -2.5, p <.05), and time in MOS (Case Mean = 4.6, SD = 3.9, Comparison group Mean = 3.4, SD = 3.7, t = -3.2, p <.01). Soldiers with at least some college were more likely to be cases as well, (Wald = 9.3, p <.01).There were no significant differences between cases and comparison subjects on the following variables: Number of Children Supported, Smoking Status, and Marital Status (although there was a trend for Marital Status, Wald = 7.0, p=.07, with divorcees being more prevalent among cases).

Table 8: Univariate Tests of Independent Variables

Variable	B	S.E.	Wald	df	Sig		R	Exp(B)	95% CI for Exp(B) Lower	Upper
Demographics										
Age	0.04	0.02	5.36	1	0.02	*	0.08	1.04	1.01	1.07
Gender (Categorical) "Female"	1.20	0.43	7.71	1	0.01	**	0.10	3.33	1.42	7.78
Education (Categorical)			9.90	4	0.04	*	0.06			
"Some College"	0.65	0.22	9.09	1	0.00		0.11	1.91	1.25	2.92
"2 yr. Degree"	0.27	0.35	0.58	1	0.45		0.00	1.31	0.66	2.60
"4 yr. Degree"	0.70	0.57	1.55	1	0.21		0.00	2.02	0.67	6.12
"Some Grad Wrk"	6.21	12.84	0.23	1	0.63		0.00	497.42	0.00	4.23E+13
Education 2 levels, (Categorical) "College"	0.60	0.20	9.29	1	0.00	**	0.11	1.83	1.24	2.69
Marital Status (Categorical)			7.07	4	0.13		0.00			
"Married"	0.38	0.21	3.11	1	0.08		0.04	1.46	0.96	2.21
"Separated"	0.46	0.50	0.87	1	0.35		0.00	1.59	0.60	4.19
"Divorced"	1.15	0.53	4.73	1	0.03		0.07	3.15	1.12	8.85
"Other"	0.33	0.48	0.47	1	0.49		0.00	1.39	0.55	3.54
No. of Children Supported	0.00	0.00	1.21	1	0.27		0.00	1.00	1.00	1.00
Rank (Categorical)			18.54	8	0.02	*	0.07			
"PVT/E-2"	0.15	0.57	0.07	1	0.79		0.00	1.17	0.38	3.58
"PFC/E-3"	0.62	0.57	1.20	1	0.27		0.00	1.86	0.61	5.67
"SPC/CPL/E-4"	1.31	0.55	5.74	1	0.02		0.08	3.71	1.27	10.85
"SGT/E-5"	0.83	0.58	2.06	1	0.15		0.01	2.28	0.74	7.05
"SSG/E-6"	0.79	0.59	1.79	1	0.18		0.00	2.20	0.69	6.97
"SFC/E-7"	1.20	0.80	2.26	1	0.13		0.02	3.33	0.69	16.02
"MSG/1SG/E-8"	5.71	9.56	0.36	1	0.55		0.00	300.35	0.00	4.12E+10
"Other"	0.51	1.51	0.12	1	0.73		0.00	1.67	0.09	31.87
Rank (Collapsed), (Categorical)			15.71	2	0.00	***	0.14			
"SPC/CPL/E-4"	0.95	0.24	15.52	1	0.00		0.15	2.60	1.62	4.18
"E-5 and above"	0.51	0.24	4.58	1	0.03		0.07	1.67	1.04	2.68
Time in Service	0.05	0.02	6.23	1	0.01	**	0.09	1.06	1.01	1.10
Time in MOS	0.09	0.03	9.62	1	0.00	***	0.12	1.09	1.03	1.15
Lifestyle Factors										
Smoking Status (Categorical)			1.93	3	0.59		0.00			
"Current Smoker"	0.03	0.55	0.00	1	0.96		0.00	1.03	0.35	3.04
"Former Smoker"	0.04	0.59	0.01	1	0.94		0.00	1.04	0.33	3.32
"Never Smoked"	-0.24	0.55	0.20	1	0.66		0.00	0.79	0.27	2.29
Frequency of Aerobic Exercise			6.40	2	0.04	*	0.06			
"Rare/Never"	0.82	0.34	5.72	1	0.02		0.08	2.28	1.16	4.48
"1-2x / wk"	0.30	0.26	1.38	1	0.24		0.00	1.36	0.82	2.26
Freq of Aerobic Exer (Categorical) "<3X/wk"	0.49	0.22	4.98	1	0.03	*	0.07	1.64	1.06	2.52
Ergonomic Exposure										
JRPD Back Score	0.06	0.01	26.66	1	0.00	***	0.20	1.06	1.04	1.08
Work Environment Factors										
Involvement	-0.24	0.04	28.82	1	0.00	***	-0.21	0.79	0.72	0.86
Peer Cohesion	-0.19	0.05	14.71	1	0.00	***	-0.15	0.83	0.76	0.91
Supvervisor Support	-0.27	0.04	36.99	1	0.00	***	-0.24	0.77	0.70	0.83
Autonomy	-0.24	0.05	20.25	1	0.00	***	-0.18	0.79	0.71	0.87
Task Orientation	-0.13	0.05	6.59	1	0.01	*	-0.09	0.88	0.80	0.97
Work Pressure	0.32	0.05	42.45	1	0.00	***	0.26	1.38	1.25	1.52
Clarity	-0.19	0.05	16.18	1	0.00	***	-0.16	0.83	0.75	0.91
Control	0.01	0.06	0.07	1	0.80		0.00	1.01	0.91	1.13
Innovation	-0.24	0.05	24.59	1	0.00	***	-0.20	0.78	0.71	0.86
Physical Comfort	-0.23	0.06	16.89	1	0.00	***	-0.16	0.80	0.72	0.89
Problem Solving Factors										
Avoidant Style	0.00	0.02	0.00	1	0.99		0.00	1.00	0.97	1.04
Impulsive/Carelessness Style	-0.01	0.01	0.96	1	0.33		0.00	0.99	0.96	1.01
Negative Problem Orientation	0.01	0.01	0.94	1	0.33		0.00	1.01	0.99	1.04
Positive Problem Orientation	-0.03	0.02	1.98	1	0.16		0.00	0.97	0.92	1.01
Rational Problem Solvng	-0.01	0.01	0.80	1	0.37		0.00	0.99	0.98	1.01
SPSI Total	-0.02	0.03	0.45	1	0.50		0.00	0.98	0.92	1.04
Family Environment Factors										
Cohesion	0.00	0.04	0.00	1	1.00		0.00	1.00	0.92	1.09
Expressiveness	-0.06	0.05	1.26	1	0.26		0.00	0.94	0.85	1.04
Conflict	-0.02	0.05	0.18	1	0.67		0.00	0.98	0.90	1.07
Perceived Physical Exertion										
Borg Scale	0.38	0.05	56.88	1	0.00	***	0.31	1.47	1.33	1.62

Primary variable p levels = * p<0.05, ** p<.01, *** p<.001

The JRPDS back subscale score was positively associated with case classification (Wald = 26.66, p <.001). Of the ten subscales of the WES, nine were significantly associated with case classification, in the directions expected. Lower levels of Involvement (Wald = 28.82, p <.001), Peer Cohesion (Wald = 14.70, p <.001), Supervisor Support (Wald = 36.99, p <.001), Autonomy (Wald = 20.25, p <.001), Task Orientation (Wald = 6.59, p <.05), Clarity (Wald = 16.18, p <.001), Innovation (Wald = 24.59, p <.001), and Physical Comfort (Wald = 16.89, p <.001) were all associated with case classification, whereas higher levels of Work Pressure was associated with case status. The only WES subscale that was not a significant correlate was Control.

Neither the Social Problem Solving Inventory (SPSI) aggregate score, nor any of the SPSI subscales were significantly associated with the case/comparison group outcome. The association between case/comparison group outcome and the SPSI positive problem orientation subscale showed a slight trend (p=.15). None of the FES subscales had any significant association with outcomes therefore these variables were not included in the multivariate logistic regression equations.

Interactions were tested entering the principle independent variables as one set, and then entering the interaction terms as a separate set. The effects of two-way and three-way interactions among ergonomic stressor exposure, work pressure, and social problem solving ability did not contribute significantly to the classification of case/comparison group status beyond the main effects of the individual variables.

Multivariate Analyses

For a variable to be considered for inclusion in the subsequent multivariate regression computations, the significance level for the univariate regression must have been $p < .1$. As the relative contribution of independent variables could change in a multivariate model, the decision to use $p < .1$ was made to avoid excluding potentially significant multivariate factors. Variables that qualified for inclusion in the initial multivariate logistic regression were; age, gender, education, marital status, rank, time in service, time in MOS, ergonomic exposure, nine of the WES subscales, and perceived exertion. Variables that were not significantly associated with the case/comparison group outcome included: number of children supported, smoking status, WES control subscale, SPSI aggregate and SPSI subscales, and the FES subscales (cohesion, expressiveness, and conflict).

Demographic and lifestyle factors were entered into the final regression equation in step one in order to partial out their contribution prior to entry of the variables of interest. Among the demographic factors, female gender (Wald = 9.83, $p < .01$, Relative Risk = 5.01) accounted for the largest percentage of variance ($R^2 = 1.55\%$). Having at least some college education (compared to having High School/GED)(Wald = 6.61, $p < .01$, Relative Risk = 1.97) was the next strongest correlate ($R^2 = 0.91\%$). Rank was a significant correlate overall, with the rank of Specialist/Corporal (E-4) at greatest risk (when compared to E-1 through E-3's) (Wald = 5.28, $p < .05$, Relative Risk = 1.9, $R^2 = 0.65\%$). There was a trend for Sergeants through Master Sergeants to be at risk

(compared to E-1 through E-3's) (Wald = 2.83, p <.1, Relative Risk = 1.74, R^2 = 0.16%). The final factor which was controlled for through first stage entry was a lifestyle factor, frequency of aerobic exercise. Soldiers who reported that they exercised aerobically less than three times per week (compared to those who exercised three or more times per week) were at increased risk of being classified as cases. (Wald = 5.00, p <.05, Relative Risk = 1.80, R^2 = 0.59%).

Among the hypothesized variables influencing case/comparison group classification, all of which were continuous measures, the ergonomic stressor exposure variable (JRPDS-back subscale) was the most potent correlate (Wald = 13.456, p <.001, [1]Relative Risk = 1.05, R^2 = 2.27%). Among the occupational psychosocial factors, Work Pressure (Wald = 11.87, p <.001, [1]Relative Risk = 1.23, R^2 = 1.95%), Supervisor Support (Wald = 7.34, p <.01, [1]Relative Risk = 0.84, R^2 = 1.05%), and Involvement (Wald = 5.54, p <.05, [1]Relative Risk = 0.87, R^2 = 0.70%) were all significant correlates of case status.

The variable representing perceived exertion (the Borg Scale) was added in the last stage. The final multiple regression model used all of the primary variables of interest, plus the Borg scale of perceived exertion. Tables 9 and 10 show the variables in the regression model prior to (Table 9) and subsequent to (Table 10) the inclusion of the Borg Scale. The inclusion of both tables permits an examination of the effects the

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[1] For continuous variables, the relative risk rating reflects the increase (or decrease) in risk for each one unit increase (or decrease) in the value of that variable above or below the mean.

Table 9: Regression Model without Perceived Exertion

									95% Confidence Interval	
Variable	**B**	**S.E.**	**Wald**	**df**	**Sig**	**R**	**R^2**	**Exp(B)**	**Lower**	**Upper**
Gender - female	1.61	0.51	9.83	1	0.002	0.12	0.02	5.01	1.83	13.70
Education - College	0.68	0.26	6.61	1	0.010	0.10	0.01	1.97	1.17	3.29
Rank			6.07	2	0.048	0.06	0.00			
SPC/CPL	0.64	0.28	5.28	1	0.022	0.08	0.01	1.90	1.10	3.29
SGT-MSG	0.56	0.33	2.83	1	0.092	0.04	0.00	1.74	0.91	3.33
Aerobic Exercise <2x / wk	0.59	0.26	5.00	1	0.025	0.08	0.01	1.80	1.08	3.02
JRPD Back Score	0.05	0.01	13.46	1	0.000	0.15	0.02	1.05	1.02	1.08
WES Involvement	-0.14	0.06	5.54	1	0.019	-0.08	0.01	0.87	0.77	0.98
WES Supervisor Support	-0.18	0.07	7.34	1	0.007	-0.10	0.01	0.84	0.74	0.95
WES Work Pressure	0.21	0.06	11.87	1	0.001	0.14	0.02	1.23	1.09	1.38
Constant	-0.31	0.61	0.26	1	0.613		0.00			

Table 10: Regression Model with Perceived Exertion

									95% Confidence Interval	
Variable	**B**	**S.E.**	**Wald**	**df**	**Sig**	**R**	**R^2**	**Exp(B)**	**Lower**	**Upper**
Gender - female	2.01	0.53	14.23	1	0.000	0.17	0.03	7.49	2.63	21.31
Education - College	0.75	0.28	6.98	1	0.008	0.11	0.01	2.11	1.21	3.66
Rank			5.01	2	0.082	0.05	0.00			
SPC/CPL	0.61	0.30	4.17	1	0.041	0.07	0.00	1.84	1.03	3.31
SGT-MSG	0.57	0.35	2.63	1	0.105	0.04	0.00	1.76	0.89	3.50
Aerobic Exercise <2x / wk	0.03	0.01	3.07	1	0.080	0.05	0.00	1.03	1.00	1.06
JRPD Back Score	0.69	0.28	6.03	1	0.014	0.10	0.01	1.99	1.15	3.45
WES Involvement	-0.21	0.06	10.06	1	0.002	-0.13	0.02	0.81	0.72	0.92
WES Supervisor Support	-0.14	0.07	4.23	1	0.040	-0.07	0.00	0.87	0.76	0.99
WES Work Pressure	0.12	0.06	3.55	1	0.060	0.06	0.00	1.13	1.00	1.28
Borg Scale	0.38	0.06	35.39	1	0.000	0.27	0.07	1.46	1.29	1.66
Constant	-0.55	0.66	0.70	1	0.402					

variance shared between the Borg Scale and the other variables in the model. Table 11 is the classification table associated with the final regression model ($\chi^2 = 164.99, p < .001$) which shows that the model classifies 76.8% of cases and comparison subjects correctly. The chance classification based upon distribution of cases and comparison subjects would have been 57.5%.

Table 11: Classification Table (Regression Model with Perceived Exertion)

		Predicted			
		Comparison	*Cases*	n	*Correct*
Observed	Value	0	1		
Comparison	0	125	52	177	70.62%
Cases	1	45	196	241	81.33%
				418	76.79%
		Comparison	*42.52%*		
		Cases	*57.48%*		
			of sample		

Effects of Perceived Exertion

Adding perceived exertion (Borg Scale) to the final model changed the relative influence of previously significant factors. With the Borg Scale in the model, female gender accounted for 2.7% of the variance, up from 1.6% without perceived exertion. Having "some college", increased from .9% of variance accounted for to 1.1% with the Borg Scale included. Rank, which was previously significant without perceived exertion, becomes only a trend ($p < .1$), with Specialist/Corporal accounting for .4% of variance. Frequency of aerobic exercise became a slightly more powerful correlate, increasing from .6% to .9% of variance. When perceived exertion is added, both ergonomic stressor exposure and work pressure became trends (JRPDS, $R^2 = .2\%$, Work Pressure, $R^2 = .4\%$) from their previously significant contributions. Supervisor support remained consistent with about the same contribution and Involvement became slightly more powerful (Supervisor Support, $R^2 = .5\%$, Involvement, $R^2 = 1.8\%$). The perceived exertion variable (Wald = 35.39, $p < .001$, [1]Relative Risk = 1.46) became the most significant contributor

to the classification equation, accounting for 7.5% of the variance.

Correlates of Perceived Exertion

The minimum perceived exertion score was 0, and the maximum was 10. The mean was 4.95 with a standard deviation of 2.5. The skewness statistic was .31, with kurtosis equal to -.54. The variables that had been univariately correlated with case status were entered into a hierarchical multiple regression to determine their association with perceived exertion. Table 12 shows the factors from the final regression equation. The significant factors in the final regression equation were higher levels of ergonomic exposure ($t = 5.85$, $p < .001$), higher levels of work pressure ($t = 5.69$, $p < .001$), lower levels of supervisor support ($t = -2.84$, $p < .01$), and higher levels of involvement ($t = 2.38$, $p < .05$). The model with these four variables accounted for 24% of the variance in perceived exertion ($F = 34.31$, $p < .001$).

Correlates of Symptom Severity

An index of symptom severity was calculated for cases only (n=248), by multiplying back pain episode frequency by intensity by duration. The minimum symptom severity score was 2, and the maximum was 300. The mean was 55.2 with a standard deviation of 48.9. The skewness statistic was 1.9, with kurtosis at 4.9. The variables that had been univariately correlated with case status were entered into a hierarchical multiple regression to determine their association with symptom severity.

Table 12: Correlates of Perceived Effort

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.494(a)	0.24	0.24	2.14	0.24	34.31	4	426	0.000

a Correlates: (Constant), Work Pressure, Involvement, JRPD - Back score, Supervisor Support

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	626.53	4	156.63	34.31	.000(a)
	Residual	1945.04	426	4.57		
	Total	2571.56	430			

a Correlates: (Constant), Work Pressure, Involvement, JRPD - Back score, Supervisor Support
b Dependent Variable: Perceived effort - BORG

Coefficients(a)

Model		Unstandardized Coefficients: B	Unstandardized Coefficients: Std. Error	Standardized Coefficients: Beta	t	Sig.
1	(Constant)	1.19	0.54		2.22	0.027
	JRPD Back Score	6.66E-02	0.01	0.26	5.85	0.000
	Involvement	0.13	0.05	0.12	2.38	0.018
	Supervisor Support	-0.16	0.05	-0.16	-2.84	0.005
	Work Pressure	0.30	0.05	0.27	5.69	0.000

a Dependent Variable: Perceived effort - BORG

Table 13: Correlates of Symptom Severity

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Change Statistics R^2 Change	F Change	df1	df2	Sig. F Change
1	.126(a)	0.02	0.01	48.59	0.02	4.00	1	246	0.047
2	.252(b)	0.06	0.06	47.49	0.05	12.50	1	245	0.000

a Correlates: (Constant), Perceived exertion - BORG

b Correlates: (Constant), Perceived exertion - BORG, WES-Involvement

ANOVA(c,d)

Model		Sum of Squares	df	Mean²	F	Sig.
1	Regression	9437.17	1	9437.17	4.00	.047(a)
	Residual	580809.79	246	2361.02		
	Total	590246.96	247			
2	Regression	37625.16	2	18812.58	8.34	.000(b)
	Residual	552621.80	245	2255.60		
	Total	590246.96	247			

a Correlates: (Constant), Perceived exertion - BORG

b Correlates: (Constant), Perceived exertion - BORG, WES-Involvement

c Dependent Variable: Symptom Severity

d Selecting only cases for which Case/Control Status = Case

Coefficients(a,b)

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations 0-order	Partial	Part
1	(Constant)	39.46	8.47		4.66	0.000			
	Perceived exertion	2.73	1.37	0.13	2.00	0.047	0.13	0.13	0.13
2	(Constant)	56.13	9.53		5.89	0.000			
	Perceived exertion	2.86	1.34	0.13	2.14	0.034	0.13	0.14	0.13
	WES-Involvement	-5.02	1.42	-0.22	-3.54	0.000	-0.22	-0.22	-0.22

a Dependent Variable: Symptom Severity

Table 13 shows the final regression equation of the variables associated with symptom severity. Significant correlates were: the work involvement subscale ($t = -3.4$, $p < .001$) and perceived exertion ($t = 2.14$, $p < .05$). The model with these two variables accounted for 6% of the variance in symptom severity ($F = 8.34$, $p < .001$).

Phase II Results (Prospective):

Predicting Lost Time

In an effort to predict lost work time at three months post survey, a hierarchical multiple regression equation was computed based on the regression models from the cross-sectional study. Any variables that were not significant at the level of $p < .1$ were removed from the final regression equation. This procedure left only four variables, Symptom Severity ($t = 2.07$, $p < .05$), Time in Service ($t = -2.93$, $p < .01$), Time in MOS ($t = 3.36$, $p < .01$), and Frequency of Aerobic Exercise ($t = -2.19$, $p < .05$) which were modestly predictive of lost time ($F = 5.03$, $R^2 = 7.6\%$). (Table 14). The analysis was based on all 248 cases, however, only 22 had periods of lost time associated with healthcare episodes.

Predicting Healthcare Utilization

To predict healthcare cost three months after initial survey, a hierarchical regression equation was computed, again based on the models from the cross-sectional study. A minimum significance level of $p < .1$ was used as the removal criteria for the regression procedure. This process left only three variables, symptom severity ($t = 2.89$, $p < .01$), time in MOS ($t = 2.39$, $p < .05$), and Frequency of Aerobic Exercise ($t = -2.03$, $p < .05$) which were modestly predictive of healthcare cost, ($F = 6.72$, $R^2 = 7.6\%$). (Table 15). The analysis was based on all 248 cases, however, only 37 had qualifying healthcare episodes.

Table 14: Predicting Lost Time

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.195(a)	0.038	0.030	2.54	0.038	4.87	2	245	0.01
2	.241(b)	0.058	0.047	2.52	0.020	5.17	1	244	0.02
3	.276(c)	0.076	0.061	2.50	0.018	4.82	1	243	0.03

a Predictors: (Constant), Time in MOS, Time in Service
b Predictors: (Constant), Time in MOS, Time in Service, Symptom Severity
c Predictors: (Constant), Time in MOS, Time in Service, Symptom Severity, Freq of Aerobic Exercise

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	62.68	2	31.34	4.87	.008(a)
	Residual	1577.86	245	6.44		
	Total	1640.54	247			
2	Regression	95.39	3	31.80	5.02	.002(b)
	Residual	1545.15	244	6.33		
	Total	1640.54	247			
3	Regression	125.42	4	31.35	5.03	.001(c)
	Residual	1515.13	243	6.24		
	Total	1640.54	247			

a Predictors: (Constant), Time in MOS, Time in Service
b Predictors: (Constant), Time in MOS, Time in Service, Symptom Severity
c Predictors: (Constant), Time in MOS, Time in Service, Symptom Severity, Freq of Aerobic Exercise
d Dependent Variable: Lost Time

Coefficients(a)

Model		Unstandardized B	Unstandardized Std. Error	Standardized Beta	t	Sig.
1	(Constant)	0.17	0.26		0.66	0.51
	Time in Service	-0.15	0.06	-0.29	-2.56	0.01
	Time in MOS	0.24	0.08	0.36	3.12	0.00
2	(Constant)	-0.24	0.31		-0.76	0.45
	Time in Service	-0.14	0.06	-0.27	-2.40	0.02
	Time in MOS	0.22	0.08	0.33	2.94	0.00
	Symptom Severity	0.01	0.00	0.14	2.27	0.02
3	(Constant)	1.10	0.68		1.62	0.11
	Time in Service	-0.18	0.06	-0.34	-2.93	0.00
	Time in MOS	0.26	0.08	0.39	3.36	0.00
	Symptom Severity	0.01	0.00	0.13	2.07	0.04
	Freq of Aerobic Ex	-0.50	0.23	-0.14	-2.19	0.03

a Dependent Variable: Lost Time

Table 15: Predicting Health Care Cost

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.160(a)	0.026	0.022	299.59	0.026	6.47	1	246	0.01
2	.246(b)	0.061	0.053	294.75	0.035	9.15	1	245	0.00
3	.276(c)	0.076	0.065	292.88	0.016	4.14	1	244	0.04

a Predictors: (Constant), Time in MOS
b Predictors: (Constant), Time in MOS, Symptom Severity
c Predictors: (Constant), Time in MOS, Symptom Severity, Freq of Aerobic Exercise

ANOVA(b)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	580327.61	1	580327.61	6.47	.012(a)
	Residual	22079220.71	246	89752.93		
	Total	22659548.32	247			
2	Regression	1374828.44	2	687414.22	7.91	.000(b)
	Residual	21284719.88	245	86876.41		
	Total	22659548.32	247			
3	Regression	1729863.29	3	576621.10	6.72	.000(c)
	Residual	20929685.03	244	85777.40		
	Total	22659548.32	247			

a Predictors: (Constant), Time in MOS
b Predictors: (Constant), Time in MOS, Symptom Severity
c Predictors: (Constant), Time in MOS, Symptom Severity, Freq of Aerobic Exercise
d Dependent Variable: Healthcare cost

Coefficients(a)

Model		Unstandardized Coefficients: B	Unstandardized Coefficients: Std. Error	Standardized Coefficients: Beta	t	Sig.
1	(Constant)	25.79	29.78		0.87	0.39
	Time in MOS	12.63	4.97	0.16	2.54	0.01
2	(Constant)	-35.87	35.70		-1.01	0.32
	Time in MOS	12.09	4.89	0.15	2.47	0.01
	Symptom Severity	1.16	0.38	0.19	3.02	0.00
3	(Constant)	100.80	75.97		1.33	0.19
	Time in MOS	11.64	4.86	0.15	2.39	0.02
	Symptom Severity	1.11	0.38	0.18	2.89	0.00
	Freq of Aerobic Ex	-52.13	25.62	-0.13	-2.03	0.04

a Dependent Variable: Healthcare Cost

Results: Internal Consistency of the Survey

Table 16 shows the correlations among the various components of the study survey. A review of the significant correlations support the internal consistency of the baseline survey. Symptom severity is positively correlated with time in MOS, JRPDS back score, work pressure, and the Borg scale, and negatively with work involvement, supervisor support, and frequency of aerobic exercise. Back related ergonomic exposure is positively correlated with symptom severity, work pressure, negative problem orientation, frequency of aerobic exercise, and perceived exertion, while negatively associated with age, rank, time in service, time in MOS, work involvement, supervisor support, and overall social problem solving. Work pressure is directly related to symptom severity, the JRPDS back score, and perceived exertion, while inversely related to work involvement and supervisor support. The Borg scale of perceived exertion is positively correlated with symptom severity, the JRPDS back score, and work pressure, and negatively correlated with gender (female), and supervisor support. Table 17 shows similar correlations for cases only and includes healthcare cost, and lost time.

Table 16: Inter-Item Correlations (Self Scored)

		Age	Gender	Education	Rank	Time in Service	Time in MOS	Symptom Severity	JRPD Back Score	WES Involvement	WES Superv Support	W Pre
Age	Pearson R	1.000										
	Sig. (2-tailed)	.										
	N	427										
Gender	Pearson R	.233(**)	1.000									
	Sig. (2-tailed)	0.000	.									
	N	427	431									
Education	Pearson R	.602(**)	.150(**)	1.000								
	Sig. (2-tailed)	0.000	0.002	.								
	N	423	427	427								
Rank	Pearson R	.733(**)	.167(**)	.509(**)	1.000							
	Sig. (2-tailed)	0.000	0.001	0.000	.							
	N	425	429	425	429							
Time in Service	Pearson R	.858(**)	.218(**)	.518(**)	.814(**)	1.000						
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	.						
	N	421	425	422	423	425						
Time in MOS	Pearson R	.760(**)	.160(**)	.411(**)	.775(**)	.870(**)	1.000					
	Sig. (2-tailed)	0.000	0.001	0.000	0.000	0.000	.					
	N	413	417	414	415	412	417					
Symptom Severity	Pearson R	0.088	0.045	0.081	0.062	0.077	.133(**)	1.000				
	Sig. (2-tailed)	0.071	0.348	0.096	0.199	0.113	0.006	.				
	N	427	431	427	429	425	417	431				
JRPD Back Score	Pearson R	-.132(**)	-0.075	-0.089	-.156(**)	-.148(**)	-.111(*)	.207(**)	1.000			
	Sig. (2-tailed)	0.006	0.122	0.066	0.001	0.002	0.024	0.000	.			
	N	427	431	427	429	425	417	431	431			
WES Involve	Pearson R	.139(**)	0.047	.116(*)	0.062	.122(*)	0.032	-.276(**)	-.146(**)	1.000		
	Sig. (2-tailed)	0.004	0.326	0.017	0.200	0.012	0.513	0.000	0.002	.		
	N	427	431	427	429	425	417	431	431	431		
WES Supv Spt	Pearson R	.235(**)	0.087	.183(**)	.222(**)	.232(**)	.143(**)	-.300(**)	-.245(**)	.561(**)	1.000	
	Sig. (2-tailed)	0.000	0.072	0.000	0.000	0.000	0.003	0.000	0.000	0.000	.	
	N	427	431	427	429	425	417	431	431	431	431	
WES Work Press	Pearson R	0.015	-0.086	0.038	0.025	0.064	0.089	.251(**)	.343(**)	-.212(**)	-.410(**)	
	Sig. (2-tailed)	0.762	0.073	0.436	0.613	0.189	0.068	0.000	0.000	0.000	0.000	
	N	427	431	427	429	425	417	431	431	431	431	
SPSI Avoidance	Pearson R	-.195(**)	-0.041	-.123(*)	-.274(**)	-.228(**)	-.243(**)	-0.040	0.083	-0.027	-.132(**)	
	Sig. (2-tailed)	0.000	0.396	0.011	0.000	0.000	0.000	0.411	0.084	0.574	0.006	
	N	427	431	427	429	425	417	431	431	431	431	
SPSI Impulsive	Pearson R	-.278(**)	-0.089	-.229(**)	-.335(**)	-.294(**)	-.303(**)	-0.093	0.084	-0.085	-.141(**)	
	Sig. (2-tailed)	0.000	0.064	0.000	0.000	0.000	0.000	0.053	0.082	0.076	0.003	
	N	427	431	427	429	425	417	431	431	431	431	
SPSI-NegProbOr	Pearson R	-.219(**)	-0.011	-.193(**)	-.302(**)	-.260(**)	-.278(**)	-0.061	.127(**)	-.126(**)	-.222(**)	
	Sig. (2-tailed)	0.000	0.820	0.000	0.000	0.000	0.000	0.204	0.009	0.009	0.000	
	N	427	431	427	429	425	417	431	431	431	431	
SPSI-PosProbOr	Pearson R	.185(**)	0.011	0.093	.164(**)	.158(**)	.150(**)	-0.003	-0.018	.174(**)	.157(**)	
	Sig. (2-tailed)	0.000	0.821	0.054	0.001	0.001	0.002	0.958	0.705	0.000	0.001	
	N	427	431	427	429	425	417	431	431	431	431	
SPSI-RatProbSolv	Pearson R	.246(**)	0.033	195(**)	.216(**)	.207(**)	.174(**)	0.038	-0.056	.170(**)	.100(*)	
	Sig. (2-tailed)	0.000	0.489	0.000	0.000	0.000	0.000	0.429	0.243	0.000	0.038	
	N	427	431	427	429	425	417	431	431	431	431	
SPSI	Pearson R	.305(**)	0.049	.226(**)	.349(**)	.311(**)	.306(**)	0.062	-.100(*)	.161(**)	.206(**)	
	Sig. (2-tailed)	0.000	0.309	0.000	0.000	0.000	0.000	0.202	0.038	0.001	0.000	
	N	427	431	427	429	425	417	431	431	431	431	
FES Cohesive	Pearson R	.175(**)	0.020	.121(*)	.208(**)	.201(**)	.197(**)	0.017	0.009	.123(*)	.195(**)	
	Sig. (2-tailed)	0.000	0.684	0.013	0.000	0.000	0.000	0.729	0.859	0.011	0.000	
	N	423	427	423	425	421	415	427	427	427	427	
FES Expressive	Pearson R	0.057	-0.037	0.021	0.065	0.057	0.054	0.020	-0.006	.210(**)	.175(**)	
	Sig. (2-tailed)	0.244	0.442	0.666	0.178	0.247	0.270	0.678	0.898	0.000	0.000	
	N	423	427	423	425	421	415	427	427	427	427	
FES Conflict	Pearson R	-.229(**)	0.000	-.200(**)	-.252(**)	-.238(**)	-.231(**)	-0.032	0.039	-0.075	-.130(**)	
	Sig. (2-tailed)	0.000	0.992	0.000	0.000	0.000	0.000	0.515	0.416	0.120	0.007	
	N	423	427	423	425	421	415	427	427	427	427	
HRA Aerobic Exer	Pearson R	-.136(**)	-.097(*)	-0.080	-.116(*)	-.153(**)	-0.071	-.118(*)	0.083	-0.008	0.031	
	Sig. (2-tailed)	0.005	0.044	0.099	0.016	0.002	0.151	0.014	0.086	0.863	0.522	
	N	425	429	425	427	423	415	429	429	429	429	
HRA Aerobic Ex2	Pearson R	-.167(**)	-.144(**)	-.119(*)	-.133(**)	-.188(**)	-.105(*)	-.100(*)	.104(*)	-0.051	0.000	
	Sig. (2-tailed)	0.001	0.003	0.014	0.006	0.000	0.033	0.039	0.031	0.290	0.992	
	N	425	429	425	427	423	415	429	429	429	429	
Borg Scale	Pearson R	-0.063	-.110(*)	-0.040	-0.043	-0.045	-0.013	.285(**)	.380(**)	-0.063	-.265(**)	
	Sig. (2-tailed)	0.194	0.023	0.416	0.372	0.358	0.790	0.000	0.000	0.195	0.000	
	N	423	427	424	425	421	413	427	427	427	427	

**R is significant at the 0.01 level (2-tailed).
*R is significant at the 0.05 level (2-tailed).

000 431													
(**) 000 431	1.000 431												
(**) 006 431	-0.043 0.374 431	1.000 431											
(**) 003 431	-0.011 0.820 431	.700(**) 0.000 431	1.000 431										
(**) 000 431	0.075 0.122 431	.755(**) 0.000 431	.709(**) 0.000 431	1.000 431									
(**) 001 431	0.000 0.995 431	-.261(**) 0.000 431	-.238(**) 0.000 431	-.281(**) 0.000 431	1.000 431								
0(*) 038 431	-0.023 0.633 431	-.150(**) 0.002 431	-.299(**) 0.000 431	-.150(**) 0.002 431	.734(**) 0.000 431	1.000 431							
(**) 000 431	-0.013 0.785 431	-.772(**) 0.000 431	-.792(**) 0.000 431	-.785(**) 0.000 431	.692(**) 0.000 431	.639(**) 0.000 431	1.000 431						
(**) 000 427	0.008 0.876 427	-.329(**) 0.000 427	-.289(**) 0.000 427	-.305(**) 0.000 427	.285(**) 0.000 427	.215(**) 0.000 427	.386(**) 0.000 427	1.000 427					
(**) 000 427	0.002 0.966 427	-.206(**) 0.000 427	-.133(**) 0.006 427	-.155(**) 0.001 427	.183(**) 0.000 427	.114(*) 0.019 427	.214(**) 0.000 427	.511(**) 0.000 427	1.000 427				
0(**) 007 427	0.027 0.573 427	.325(**) 0.000 427	.295(**) 0.000 427	.299(**) 0.000 427	-.234(**) 0.000 427	-.210(**) 0.000 427	-.368(**) 0.000 427	-.590(**) 0.000 427	-.338(**) 0.000 427	1.000 427			
.031 .522 429	0.018 0.711 429	0.005 0.915 429	-0.001 0.978 429	-0.004 0.927 429	0.049 0.308 429	0.010 0.840 429	0.017 0.729 429	0.005 0.912 425	.098(*) 0.043 425	0.019 0.703 425	1.000 429		
.000 .992 429	0.056 0.245 429	-0.015 0.754 429	-0.001 0.991 429	0.003 0.947 429	0.072 0.135 429	0.022 0.649 429	0.030 0.542 429	-0.015 0.762 425	.109(*) 0.024 425	0.004 0.929 425	.922(**) 0.000 429	1.000 429	
5(**) .000 427	.403(**) 0.000 427	-0.023 0.632 427	-0.024 0.620 427	0.042 0.383 427	-0.011 0.824 427	0.001 0.984 427	-0.002 0.961 427	0.011 0.829 423	-0.023 0.644 423	-0.061 0.214 423	0.058 0.233 425	0.071 0.142 425	1.000 427
S erv ort	WES Work Pressure	SPSI Avoidant Style	SPSI- Impulse/ Careless	SPSI- Neg Prob Orient	SPSI-Pos Prob Orient	SPSI-Rat Prob Solve	SPSI	FES Cohesive ness	FES Express- iveness	FES Conflict	HRA- Aerobic Exercise	HRA- Aerobic Exer 2lvl	Borg Scale

Table 17: Inter-Item Correlations - (Cases Only)

		Age	Gender	Education 2 gps	Rank - 3 gps	Time In Service	Time In MOS
Age	Pearson R	1.000					
	Sig. (2-tailed)	.					
	N	246					
Gender	Pearson R	.226(**)	1.000				
	Sig. (2-tailed)	0.000	.				
	N	246	248				
Education - 2 Gps	Pearson R	.462(**)	.181(**)	1.000			
	Sig. (2-tailed)	0.000	0.004	.			
	N	243	245	245			
Rank - 3 Gps	Pearson R	.704(**)	.187(**)	.383(**)	1.000		
	Sig. (2-tailed)	0.000	0.003	0.000	.		
	N	244	246	243	246		
Time in Service	Pearson R	.858(**)	.252(**)	.416(**)	.745(**)	1.000	
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	.	
	N	242	244	242	242	244	
Time in MOS	Pearson R	.788(**)	.159(*)	.361(**)	.715(**)	.879(**)	1.000
	Sig. (2-tailed)	0.000	0.014	0.000	0.000	0.000	.
	N	236	238	236	236	235	238
Back Sx Sev	Pearson R	0.021	-0.044	0.009	0.008	-0.012	0.037
	Sig. (2-tailed)	0.748	0.488	0.894	0.906	0.848	0.575
	N	246	248	245	246	244	238
JRPD Back Score	Pearson R	-.175(**)	-0.103	-0.069	-.133(*)	-.197(**)	-.184(**)
	Sig. (2-tailed)	0.006	0.105	0.283	0.037	0.002	0.004
	N	246	248	245	246	244	238
WES-Involvement	Pearson R	.238(**)	.129(*)	.182(**)	.190(**)	.230(**)	.141(*)
	Sig. (2-tailed)	0.000	0.042	0.004	0.003	0.000	0.030
	N	246	248	245	246	244	238
WES-Superv Spt	Pearson R	.326(**)	.168(**)	.236(**)	.407(**)	.355(**)	.294(**)
	Sig. (2-tailed)	0.000	0.008	0.000	0.000	0.000	0.000
	N	246	248	245	246	244	238
WES-WorkPressure	Pearson R	0.003	-.182(**)	0.057	-0.033	0.042	0.063
	Sig. (2-tailed)	0.961	0.004	0.375	0.610	0.517	0.331
	N	246	248	245	246	244	238
SPSI- Pos Prob Solv	Pearson R	.191(**)	-0.007	.136(*)	.171(**)	.127(*)	0.120
	Sig. (2-tailed)	0.003	0.907	0.033	0.007	0.048	0.065
	N	246	248	245	246	244	238
HRA - AeroEx - 2 Gps	Pearson R	-.218(**)	-.178(**)	-0.093	-.156(*)	-.255(**)	-0.110
	Sig. (2-tailed)	0.001	0.005	0.148	0.015	0.000	0.090
	N	245	247	244	245	243	237
Borg	Pearson R	-0.113	-.201(**)	-0.106	-0.108	-0.123	-0.093
	Sig. (2-tailed)	0.079	0.002	0.100	0.092	0.056	0.155
	N	244	246	244	244	242	236
Healthcare Cost	Pearson R	.134(*)	.134(*)	0.082	0.124	.127(*)	.160(*)
	Sig. (2-tailed)	0.036	0.035	0.201	0.053	0.048	0.013
	N	246	248	245	246	244	238
Lost Time	Pearson R	0.027	-0.001	-0.001	0.070	0.009	0.112
	Sig. (2-tailed)	0.675	0.983	0.989	0.277	0.892	0.085
	N	246	248	245	246	244	238

****R is significant at the 0.01 level (2-tailed).**
***R is significant at the 0.05 level (2-tailed).**

1.000 . 238										
0.037 0.575 238	1.000 . 248									
84(**) 0.004 238	0.113 0.077 248	1.000 . 248								
141(*) 0.030 238	-.215(**) 0.001 248	-0.084 0.187 248	1.000 . 248							
94(**) 0.000 238	-.206(**) 0.001 248	-.220(**) 0.000 248	.494(**) 0.000 248	1.000 . 248						
0.063 0.331 238	0.111 0.080 248	.242(**) 0.000 248	-.174(**) 0.006 248	-.418(**) 0.000 248	1.000 . 248					
0.120 0.065 238	0.049 0.445 248	0.057 0.369 248	0.112 0.078 248	0.103 0.106 248	0.088 0.168 248	1.000 . 248				
-0.110 0.090 237	-0.059 0.357 247	.161(*) 0.011 247	-0.067 0.297 247	-0.036 0.569 247	0.083 0.194 247	0.003 0.959 247	1.000 . 247			
-0.093 0.155 236	.127(*) 0.046 246	.270(**) 0.000 246	0.026 0.679 246	-.245(**) 0.000 246	.316(**) 0.000 246	0.118 0.064 246	.156(*) 0.015 245	1.000 . 246		
160(*) 0.013 238	.193(**) 0.002 248	0.001 0.985 248	-0.061 0.340 248	-0.076 0.234 248	0.000 0.995 248	-0.008 0.905 248	-.132(*) 0.039 247	-0.053 0.405 246	1 . 248	
0.112 0.085 238	.157(*) 0.013 248	0.081 0.204 248	-0.078 0.221 248	-0.077 0.229 248	0.008 0.902 248	-0.007 0.910 248	-0.069 0.281 247	0.025 0.697 246	.786(**) 0 248	1 . 248
ne In OS	**Symptom Severity**	**JRPD Bk Score**	**WES Involve-ment**	**WES Superv Spt**	**WES Work-Pressure**	**SPSI Pos Prob Solv**	**HRA Aer Ex - 2 Gps**	**BORG Scale**	**Health-care Cost**	**Lost Time**

Back Specific Diagnoses

Table 18 shows the back specific diagnoses as indicated in ADS records, used in Phase II of the study, along with their International Classification of Disease (9th Ed.) (ICD-9) coding.

Table 18: Back Specific Diagnoses

Diagnosis Description	*ICD-9 Code*	*Frequency*
Sacroiliitis, NEC	720.2	1
Cervical Spondylosis, w/ Myelopathy	721.1	2
Lumbosacral Spondylosis w/o Myelopathy	721.3	1
Degeneration of Thoracic/Thoracolumbar Intervertebra	722.51	1
Cervicalgia	723.1	2
Spinal Stenosis of Unspecified Region	724.00	6
Pain in Thoracic Spine	724.1	1
Lumbago	724.2	10
Thoracic/Lumbosacral Neuritis or Radiculitis, Unspec	724.4	3
Bachache, Unspecified	724.5	7
Other Symptoms referable to Back	724.8	1
Nonallopathic Lesions of Cervical Region, NEC	739.1	1
Nonallopathic Lesions of Lumbar Region, NEC	739.3	1
Nonallopathic Lesions of Sacral Region, NEC	739.4	1
Lumbosacral (Joint)(Ligament) Sprain	846.0	2
Thoracic Sprain	847.1	1
Lumbar Sprain	847.2	13

Discussion

The results of the present study confirm the general hypothesis that: ergonomic stressor exposure, occupational psychosocial factors (involvement, supervisor support, and work pressure), perceived work exertion, and demographic and lifestyle factors (gender, education, rank, and aerobic exercise) discriminate individuals with back problems and work disability from individuals with no back problem or lost work time. There was limited support for several other hypotheses. Symptom severity was significantly associated with only two factors, work involvement and perceived exertion. Three variables, symptom severity, time in MOS, and frequency of aerobic exercise, contributed significantly to the prediction of healthcare utilization, and symptom severity, time in service, time in MOS, and frequency of aerobic exercise, contributed significantly to predicting lost work time. The hypothesis that social problem solving (or the interaction of social problem solving with other factors) was associated with back problems, lost work time, or healthcare utilization due to back problems was not supported.

Many studies have examined relationships between ergonomic stressors, workplace psychosocial factors, or demographic/lifestyle factors with back pain symptoms, injuries or disability (Bigos, et al., 1991; Greenwood, et al., 1990; Lanier & Stockton, 1988; Karasek, et al., 1981; Habeck, et al., 1991; Vlaeyen et al, 1995; Feuerstein & Thebarge 1991) however, few (Lancourt & Kettlehut, 1992; Marras et al, 1995; Feuerstein, Berkowitz, & Huang, in press) have investigated these relationships

simultaneously, or with outcomes defined by both symptoms and disability. The present study investigated the complex nature of the multiple factors associated with symptoms and disability. Additionally, the present study used these multiple factors to predict subsequent disability and healthcare utilization. The results from the present study were based on symptoms and temporary disability in working employees who are relatively healthy and physically fit, not on a population of chronically disabled individuals.

Study hypotheses posited that ergonomic stressor exposure, workplace psychosocial environment/stressors, social problem solving, and perceived exertion would be associated with case classification and symptom severity. For cross-sectional case classification, demographic and lifestyle factors, ergonomic stressor exposure, occupational psychosocial environment/stressor exposure, and perceived exertion were all significantly associated in the multivariate regression model, providing support for several of the hypotheses. There was less support for hypotheses on factors associated with symptom severity. In addition to perceived exertion, the only factor that remained significantly associated with symptom severity, was the WES Involvement subscale, a measure of employee concern for and commitment to their job.

Workplace Ergonomic Exposure

Existing studies (Magora, 1972, 1973; Herrin et al 1986; Marras et al., 1995; Rohrer et al., 1994) have found ergonomic stressor exposure to be related to an increased incidence and/or risk of back disorders, or disability. Most ergonomic studies of low back

problems have only looked at symptoms, not lost time.

Consistent with previous findings, the present study found that individuals who report higher levels of back-related ergonomic exposure are significantly more likely to be classified as cases. Although back ergonomic exposure was associated with back pain and lost time, it was not directly related to exacerbation of symptoms. This indicates that back ergonomic stressors may contribute to the inability or unwillingness to work with pain independent of the severity of pain. However, increased level of back ergonomic exposure was directly associated with increased perceived exertion, which then has an impact on symptom severity. While the back ergonomic exposure measure used in the present study was a self report, the results are nevertheless consistent with those of a previous study that utilized a quantitative measure of force and posture during actual work tasks (Marras et al, 1995).

The present study examined a variety of different occupations, some of which are exposed to more back-intensive and/or ergonomically stressful tasks than others. Differences in symptoms and lost time have been demonstrated and therefore would be expected across diverse occupations. As the occupational specialties selected for inclusion were previously identified as high risk for permanent back-related disability (Berkowitz et al, in press), and as the present study's hypotheses focused on work demand rather than job-type, MOS was not covaried from the main effects of the regression equation.

In theory, it has been argued that the various physical exposures can be abated through a combination of engineering controls, administrative controls, and personal protective equipment (Cohen, Gjessing, Fine, Bernard & McGlothlin, 1997). Although work station and/or equipment re-design may optimally be effective, this type of ergonomic intervention may also be costly and time-consuming, and therefore potentially less attractive to management. A less resource intensive alternative may be teaching supervisors and employees to modify ergonomic exposure through changes in behavior. These behavioral strategies might include: allowing employees to take frequent breaks (reducing general fatigue), encouraging them to change position frequently (reducing strain and muscle fatigue), use of appropriate tools and postures (reducing strain), and reducing periods of extended vibration exposure. These workplace accommodations may also be useful in facilitating return to work or reducing the incidence or severity of low back pain and lost time.

Workplace Psychosocial Environment

Psychosocial factors in the workplace have been implicated generally in the development of musculoskeletal symptoms and more specifically, in back related symptoms and disability. A review of studies to 1992 (Bongers, et al., 1993) concluded that low levels of job control and social support from colleagues was associated with the increased prevalence of work-related musculoskeletal disorders. High psychological workload and poor supervisor climate (Johansson & Rubenowitz, 1994) were two of the significant factors in occupational back disability among assemblers, truck drivers,

packers, and machinery operators in eight large Swedish companies. While Feuerstein, Berkowitz & Huang (in press) found that higher levels of work stress and worries, and lower levels of social support were associated with permanent work disability due to back pain in the Army.

The multivariate model used in the present study identified significant associations among job involvement, supervisor support, and work pressure, with case/comparison group classification. Individuals who reported higher levels of involvement and supervisor support were less likely to be cases, while subjects reporting higher levels of work pressure were more likely to be cases. This suggests that there may be a protective effect operating for those individuals who perceive themselves as more involved in their workplace and as having more supportive supervisors. Interestingly, higher levels of perceived exertion were associated with higher levels of work pressure, lower levels of supervisor support, and higher levels of involvement. This finding indicates that the direct and indirect effects of job involvement operate differently. Directly, subjects with higher involvement are less likely to be cases. Indirectly, subjects with higher involvement perceive higher levels of exertion, subjects who, in turn, are more likely to be cases. It may be that those employees who rate themselves as being more involved in their workplace also perceive that they work somewhat harder than those who are less involved, but that being more involved directly reduces the likelihood of meeting case criteria. In contrast, those employees who perceived greater exertion and lower work involvement are more likely to be cases. The current study provides

additional support for the role that work psychosocial factors play in these back disorders and in resulting temporary work disability and illustrates the complex roles of such factors.

Of work psychosocial factors, only Involvement was associated with symptom severity (i.e. higher involvement was associated with lower symptom severity). The WES Involvement subscale includes questions assessing how committed the individual is to their job. Recent studies (Elloy, Everett, & Flynn, 1995; Brown & Leigh, 1996) suggest that the psychological work climate contributes positively to job involvement. Brown & Leigh found that job involvement was related to effort which was, in turn, related to job performance. Habeck and colleagues (1991) found that participation in workplace problem solving and decision making, two dimension of job involvement, differentiated companies with high and low worker's compensation claims. It appears that being involved in or having the benefit of a supportive supervisory work environment may provide a protective level of social support. This support may not only enhance an individual's stress coping ability, but also help the employee better deal with physical health problems when they occur.

As with ergonomic exposure, the Army and it's leaders may be able to improve the psychosocial work environment (i.e. involvement, supervisor support, and work pressure) for its soldiers. While the need to accomplish a unit's military mission is ever present, how those missions are executed may play an important role in keeping soldiers

back-healthy. Even after controlling for the effects of rank, soldiers who were more involved in their workplace, who felt more supported by their supervisors, and who perceived less work pressure, were more likely to be asymptomatic thus enhancing readiness. While the types and quantity of workload to be accomplished may be fixed, the significant inverse correlation between supervisor support and work pressure suggests that, how missions are presented to soldiers, how well their leadership is organized, and how efficiently their time is used, may have a substantial impact on how soldiers perceive work pressure and/or work stress. Hollenbeck (1992) notes the positive relationship between organizational culture and supervisor support with employee satisfaction, which has in turn, been inversely associated with the development of back disorders. While the specific psychosocial mechanisms may be as yet unknown, it is apparent that soldiers who have supportive leaders, and who are encouraged to be involved in their workplace, are less likely to be back pain casualties, temporarily unable to perform their jobs.

Perceived Exertion in the Workplace

In addition to the specific contributions of back specific ergonomic exposure, work involvement, supervisor support, and work pressure, perceived exertion is a dimension of work demand that influences back pain and disability. Along with work involvement, perceived exertion was the only other significant correlate of symptom severity. Data indicates that the Borg scale has been shown to be an accurate predictor of actual physiological exertion (Eston & Williams, 1988; Ceci & Hassman, 1991). Borg (1972) used cycle ergometry to provide reliability data for the Borg scale with

correlations exceeding .90. Most reliability studies of the Borg scale were accomplished with healthy subjects. When patient samples were added (Borg & Linderholm, 1970), correlations between perceived exertion and other physiological indices of exertion dropped from .85 to between .50 and .70. As suggested by Borg (1998) this drop may reflect the contribution of factors other than physiological (i.e., psychological) cues and would be expected to influence the report of perceived exertion.

The findings regarding perceived exertion are interesting in that the strength of its association with case classification appears to result from the apportioning of shared variance with several other variables. Examination of the effect of adding the Borg scale to the multivariate model (after all other factors had been calculated) indicates that some of the effects of both back ergonomic exposure and work pressure variables are apportioned to perceived exertion. Back ergonomic exposure had previously accounted for 2.27% of the variance and work pressure accounted for another 1.95%. When the perceived exertion measure is added, these two factors drop to .24% and .35%, respectively. While the perceived exertion measure accounts for 7.47% of the variance, approximately 3.63% of that amount was from a reduction in the percent variance accounted for by the ergonomic exposure and work pressure.

Perceived exertion and work involvement were the two factors that were significant correlates of symptom severity. Although it was hypothesized that ergonomic stressors and work pressure would be related to symptom severity, it may be that with

decrease in statistical power from using cases alone, the effects of perceived exertion have captured the contributions of some of these other factors. The concept that perceived exertion would be related to both ergonomic exposure and work pressure has face validity, however there also appears to be an independent dimension added by perceived exertion, which enhances the classification power of the multivariate model. It may be that the Borg scale is truly capturing how hard a person perceives that they are exerting themselves. That perception of exertion is not a perfect measure of actual physical demand suggests that this perception is influenced by a number psychological factors (Borg, 1998). From a practical epidemiological perspective, it is appears logical to use the Borg scale as a measure of perceived physical and psychological work demand. The results of the present study support the concept that work demand is associated with lost time due to back pain. Using the Borg scale (perceived exertion) to assess overall perceived work demand may permit its use as a brief screening tool to identify soldiers at risk of temporary disability from back pain. If an individual provides an elevated Borg rating, then the JRPDS back, and WES work pressure, involvement, and supervisor support subscales could be used to determine if targeting a particular workplace stressor would be advisable for intervention.

Social Problem Solving

The present study hypothesized that social problem solving would mediate (or moderate) the effects of ergonomic and work psychosocial factors, and that the interaction of these factors with social problem solving would be significant. The results

do not support this hypothesis. Although examination of the correlation table (Table 16) suggests expected associations among factors such as age, rank, and education, with more positive problem solving factors and fewer negative problem solving factors, there was no apparent effect of social problem solving on back pain or disability. The SPSI scores were not associated with back disorders, disability, healthcare cost or lost time. It is possible that the dimensions of problem solving as assessed by the SPSI are not crucial to the successful moderation of ergonomic or psychosocial stressors. It is also possible however, that other problem solving dimensions (not measured by this scale) may be involved in moderating these stressors and should be investigated in future studies.

Lifestyle Factors

Two lifestyle factors, smoking (Bigos, et al., 1991, Lancourt & Kettlehut, 1992) and aerobic fitness (Cady et al., 1979; Frymoyer & Cats-Baril, 1987; Feuerstein, Berkowitz, & Huang, in press), were included in the study as they have been shown in previous studies to be associated with back pain and/or prolonged disability. Smoking was not a significant factor in either phase of the present study. Providing some support to previous research, lower self-reported frequency of aerobic exercise was a significant but minimal ($R^2 = .49\%$) correlate of case status, and also was a modest predictor of future healthcare utilization and lost time. The impact of aerobic exercise on back disorders may affect chronic disability, as opposed to acute conditions. It is possible that as pain continues to persist, the individual becomes gradually deconditioned. It may be at the chronological point where deconditioning sets in that frequency of aerobic exercise

becomes a more important factor. As some soldiers may choose to remain relatively inactive aerobically between Army semi-annual physical fitness tests, it may be that they become deconditioned during that interim period, and have increased risk of back disorders during a period of intensive reconditioning, preparing to take the physical fitness test. Overcoming the deficits that result from deconditioning is one of the goals of functional restoration programs in chronic low back pain patients. (Kohles, Barnes, Gatchel & Mayer, 1990).

Demographic factors

In the univariate tests, a number of demographic variables differentiated cases from the comparison group. Cases were more likely to be older, have completed some college, and have longer time in service and in their MOS than did comparison subjects. Additionally, soldiers in the junior rank of Specialist/Corporal (E-4) were more likely to be cases, as were women. However, when these differences were considered in the multivariate regression model, only gender, education, and rank were significant correlates of case/comparison group status.

Higher levels of formal education have been associated with lower incidence of back pain and disability (Rohrer, et al., 1994; Frymoyer & Cats-Baril, 1987). In the present study, individuals with at least some college were more likely to be cases than those with either a high school diploma or a G.E.D. These findings contrast with those of a two year prospective study (Dionne et al, 1995) which found that subjects with thirteen

or more years of formal education cross-sectionally experienced less disability and longitudinally experienced a greater decline in existing disability than subjects with less education on an modified Roland-Morris Scale. One difference in the present study is that symptomatic cases were compared to asymptomatic subjects, whereas Dionne and colleagues (1995) used only symptomatic individuals. Additionally, the amended Roland-Morris scale used in the Dionne study assessed functional limitations in activities of daily living, not work disability. In the present study however, education was not associated with symptom severity, or predictive of healthcare utilization or lost time. Education and rank were positively correlated ($r=.509$, $p<.001$) and as all subjects in this study were enlisted personnel, those with increased education would likely be senior enlisted personnel. As senior enlisted personnel are normally only small group supervisors, increasing formal education may not necessarily lead to positions of significantly greater decision latitude, as it may in the civilian community. Increased decision latitude, which is a factor which may help reduce the job stress (Karasek, et al., 1981) associated with back disorders, may not be conferred upon enlisted small group supervisors.

In the prospective phase of the study, time in MOS contributed slightly but significantly to predicting both the cost of healthcare utilization for back related problems and lost time. In contrast to these results, a study by Habeck and colleagues (1991) found that workers with less than two years experience on the job had significantly higher disability claims, perhaps due to increased accidents on the job from inexperience. Generally, the longer a soldier is in their MOS, the more senior rank they attain, and the

more supervisory in nature their job becomes, with lower acute ergonomic exposure. It may be however, that longer time in MOS is related to chronic exposure to ergonomically stressful tasks (a factor not assessed in this study), thus exerting a cumulative effect which might lead to increased symptoms, and potentially to increased healthcare cost (Frymoyer & Cats-Baril, 1987). Interestingly, there was an inverse relationship between total time in service and future lost time, again suggesting that it is the cumulative exposure to back intensive MOS tasks that increases risk, and not Army service overall (which would be more highly associated with increasing rank).

Rank was found to be a significant correlate both in univariate and multivariate models. Specialist/Corporals (E-4) were at significantly greater risk of being cases than comparison subjects, and there was a trend for more senior non-commissioned officers (Sergeants to Master Sergeants) to be cases as well. On possible explanation could be Karasek's (1981) demand and control model of job stress, where Specialists and Corporals are becoming slightly more senior, but have minimal supervisory authority, exercising very little control over their work environment.

Previous studies U.S. Army soldiers (Berkowitz et al, in press) have found that women are at greater risk than men for permanent disability from back problems. The present study supports previous findings of female gender as a risk factor however, the MOSs that were studied were selected due to their having a higher incidence of soldier's with back disability. It is possible that women in MOSs with lower risk of back disability

do not experience back disability at a greater rate than men in those similar MOSs. Investigation of that theory was beyond the scope of this study.

Marital status and number of children supported were investigated as potential indicators of social support and/or family stressors, however neither was significant in univariate tests and were therefore not included in multivariate models.

Strengths and Limitations of the Present Study

Difficulties encountered:

It was anticipated that approximately 25% of soldiers surveyed would meet case criteria, and that at least an equal number would meet criteria for inclusion in the asymptomatic comparison group. It turned out that estimates for cases were accurate, but that a large majority of soldiers had back symptoms without any lost work time, i.e. not eligible for the comparison group. This led to having fewer comparison subjects than intended (183 comparison subjects to 248 cases) which may have reduced statistical power slightly. Another factor that may have had an impact on the prospective portion of the study was lack of sufficient power. Although the sample size of 248 cases would most likely have provided adequate statistical power to detect significant factors in healthcare utilization and lost time (250 cases, 10 variables, estimated R^2=.16, Alpha = .01, Power = .99), the expected prevalence of back disorders was not considered in estimating how many cases would seek healthcare for back disorders during the 3 month follow-up period. For the phase II analyses, only 37 cases had follow-up healthcare utilization data

(or potential lost time), which may have been insufficient to detect potential predictors (40 cases, 3 variables, estimated R^2 =.08 Alpha = .05 Power = .29).

The variable planned to measure fitness was the individual's run score on the Army Physical Fitness Test. These scores proved difficult to obtain for all subjects, hence the use of the response to Frequency of Aerobic Exercise. The variable planned to measure lost time was to be a calculation involving the number of days of limited duty and no duty. Difficulty in obtaining records that indicated the exact number of days of lost time necessitated using an alternative measure. The ADS provides a record of the "return to full/limited/no duty" disposition of each episode of care, which was then converted into to a gross measure of lost time based on the number of episodes with each type of disposition (e.g. 0 x # of full duty episodes + 1 x # of limited duty episodes + 2 x # of no duty episodes).

The ADS database is primarily administrative in function, and hence does not provide a level of detail that might prove valuable in answering the highly complex question of the predictors of back-related disability. For example, it was not possible to determine how long a period of limited duty or no duty was prescribed for a particular incident of care. As this study used subjects with existing back symptoms it is impossible to determine whether the results of the present cross-sectional study are secondary to back symptoms, or whether these results may also predict those symptoms.

Most of the measures used in this study were based on self-report with such inherent limitations as: constrained question/response range in structured questionnaires, questionnaire developer bias, semantic differential in the meaning of questions/responses, response sets, and respondent misrepresentation (Cozby, 1981; Rosenthal & Rosnow, 1991). Additionally, basic to a self-report questionnaire is the fact that the data recorded is the respondent's "report" of the queried item, which ideally should be cross-validated with additional measures. However, consistent differences in self-report on various dimensions may provide a meaningful and potentially cost effective tool to predict back-related disability. Additionally, the self-report measure used in the present study was shown to be internally consistent.

There are several features of this study which may affect the generalizability of this study. While there were a variety of occupations represented, most of which have civilian analogs, however slightly more than half were young infantrymen, which may not generalize easily to the civilian community. The study subjects were generally healthy and physically fit individuals who were employed full time by a single employer and were provided a full spectrum of healthcare services at no cost to the individual.

Implications for future research

The present study is part of a larger study which includes a twelve month prospective follow-up period. A longer follow-up is needed to permit improved testing of the hypotheses set forth in the present study. Once the specific factors affecting back

disorders and disability are determined, additional studies using those factors as the basis for secondary prevention interventions need to be conducted. Figure 4 provides a model of occupational back pain and disability that incorporates the findings from the present study. Additionally, future controlled intervention studies could confirm the hypothesis that a supportive work environment can have a beneficial effect on employee back health and work readiness. Such evidence could provide incentive for leaders to be conspicuously more supportive.

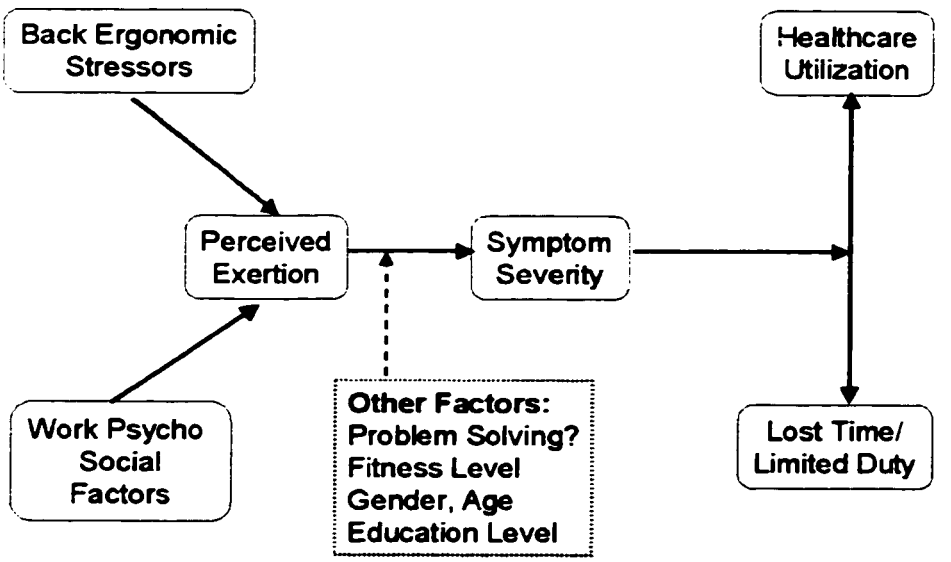

Figure 4: Revised Model for Occupational Back Pain and Disability

Note: While direct effects of ergo/psychosocial factors do exist, they are not shown in this model so as to highlight the moderating role of perceived exertion.

Clinical and/or Organizational Implications

The hazard chain of back disability can be divided into three phases 1) acute (less than 3-4 weeks of disability), 2) subacute (from 3-4 weeks to 12 weeks of disability), and chronic (greater than 12 weeks). Where Feuerstein, Berkowitz & Huang (in press) investigated chronic disability, the present study has moved forward in the hazard chain to identify factors associated with lost time in individuals who have returned to work following either acute or subacute disability.

The findings as a whole indicate that individuals who are in the rank of Specialists and Corporals, report less aerobic exercise, experience more work pressure, are less involved in their workplace, and have lower levels of supervisor support, and report higher levels of perceived exertion are at more likely to resemble soldiers with low back pain and lost time than asymptomatic soldiers. Further among soldiers with back symptoms and lost work time, those who report higher perceived exertion and lower levels of involvement will tend to report a higher degree of symptom severity. As symptom severity was implicated as a predictive factor in both subsequent healthcare utilization and lost time, the factors that influence symptom severity should also be of future interest. The findings that relate increased symptom severity with increased healthcare cost and/or utilization are consistent with the findings from a study of clinical back pain patients in a primary care health maintenance organization setting (Engel, Von Korff, & Katon, 1996). The authors found that increases in a variety of symptom indicators predicted high back pain costs. Increased depression (the only psychosocial

dimension assessed), on the other hand, predicted higher total healthcare cost, but not increased utilization for back problems, suggesting that depression is not directly related to back-related healthcare. From the present study, both perceived exertion and workplace involvement were correlates of symptom severity, whereas Engel and colleagues (1996), found only disability compensation predictive of symptom severity. These findings have important clinical implications.

First, there is the potential to use these data in the development of assessment tools that could be applied to screen patients at risk for disability, who may require more extensive attention than is currently provided in conventional care. Such a screening tool can be a cost effective method of assessing patients for triage to interventions that address directly, identified risk factors. Such an approach should enhance clinical outcomes. Secondly, the findings suggest the potential of addressing workplace psychosocial factors and increasing the frequency of aerobic conditioning within existing sub-acute rehabilitation interventions. They also suggest the importance of training supervisors in methods to more effectively manage employees with back pain (Linton, 1991) which may improve the rate at which employees return to full duty.

Finally, integrating treatments that target the risk factors identified in this study may have the potential to reduce back disorder symptoms and symptom severity, reduce the healthcare costs associated with the management of back disorders, and reduce periods of lost work time, ultimately improving combat readiness.

REFERENCES

Andersson, G.B.J. & Pope, M.H. (1991). The patient. In M.Pope, G.Andersson, J.Frymoyer, & D.Chatlin (Eds.). Occupational Low Back Pain: Assessment, Treatment, and Prevention. St.Louis: Mosby Year Book.

Armstrong, T.J., Buckle, P., Fine, L.J., Hagberg, M., Jonsson, B., Kilbom, A., Kuorinka, I.A., Silverstein, B.A., Sjogaard, G., & Viikari-Juntura, E.R.A. (1993). A conceptual model for work-related neck and upper-limb musculoskeletal disorders. Scandinavian Journal of Work Environment and Health,19, 73-84.

Ashby, D. (1998). Third Party Reimbursement Rates for FY - 1998. Clinical Operations Directorate, U.S. Army Medical Command, Ft. Sam Houston, TX.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall

Battie, M. C. & Bigos, S. J. (1991). Industrial back pain complaints: a broader perspective. Orthop Clin North America, 22, 273-282.

Berkowitz, S. M, Feuerstein, M., Lopez, M.S., & Peck, C.A. Jr. (In press). Occupational back disability in U.S. Army personnel. Military Medicine,

Bigos, S.J., Spengler, D.M., Martin, N.A., Zehn, J., Fisher, L., Nachemson, A. & Wang, M.H., (1986). Back injuries in industry: A retrospective study. II. Injury factors. Spine, 11, 246-251.

Bigos, S.J., Battie, M.C., Spengler, D.M., Fisher, L.D., Fordyce, W.E., Hansson, T.H., Nachemson, A.L., & Wortley, M.D. (1991). A prospective study of work perceptions and psychosocial factors affecting the report of back injury. Spine, 16(1), 1-6.

Bigos, S. J., Battie, M. C., Spengler, D. M., Fisher, L. D., Fordyce, W. E., Hansson, T. H., Nachemson, A. L., & Zeh, J. (1992). A longitudinal, prospective study of industrial back injury reporting. Clin Orthop Rel Res, 279, 21-32.

Bombardier, C., Kerr, M. S., Shannon, H. S. & Frank, J. W. (1994). A guide to interpreting epidemiologic studies on the etiology of back pain. Spine, 19, 20475 - 20565.

Bongers, P.M., De Winter, C.R., Kompier, M.A.J., & Hildebrandt, V.H. (1993). Psychosocial factors at work and musculoskeletal disease. Scandinavian Journal of Work

Environment and Health, 19, 297-312.

Borg, G.A.V. (1972). A ratio scaling method of inter-individual comparisons. Reports from the Institute of Applied Psychology, 27. Stockholm: University of Stockholm.

Borg, G.A.V. (1982). Psychological bases of perceived exertion. Medicine and Science in Sports and Exercise, 377-381.

Borg, G.A.V. (1990). Psychological scaling with application in physical work and the perception of exertion. Scandinavian Journal of Work Environment & Health, 16 (Suppl 1), 55-58.

Borg, G.A.V. (1970). Perceived exertion as an indicator of somatic stress. Scandinavian Journal of Rehabilitation Medicine, 2, 92-98.

Borg, G. (1998). Borg's Perceived Exertion and Pain Scales. Champagne, IL: Human Kinetics.

Borg, G.A.V. & Linderholm, H., Exercise performance and perceived exertion in patients with coronary insufficiency, arterial hypertension, and vasoregulatory asthenia. Acta Medica Scandinavica, 187, 17-26.

Brennan, A. J. J. (1985). Health and fitness boom moves into corporate America. Occupational Health & Safety, July, 38-45.

Brown, S. P. & Leigh, T. W. (1996). A new look a psychological climate and its relationship to job involvement, effort, and performance. Journal of Applied Psychology, 81, 358-368.

Bureau of National Affairs, Inc. (1988). Back Injuries: costs, causes, cases & prevention. Washington, DC:Author.

Bureau of Labor Statistics, (1991). Occupational injuries and illnesses in the U.S. by industry, 1989, U.S. Dept of Labor, Bulletin 2379. Washington, DC: U.S.G.P.O.

Cady, L.D., Bischoff, D.P., O'Connell, E.R., Thomas, P.C., & Allan, J.H. (1979). Strength and fitness and subsequent back injuries in fire-fighting. Journal of Occupational Medicine, 21, 269.

Cailliet, R. (1988). Low Back Pain Syndrome, 4th ed. Philadelphia, PA: FA Davis Co.

Ceci, R. & Hassmen, P. (1991). Self-monitored exercise at three different RPE intensities in treadmill vs field running. Medicine Science Sports & Exercise, 23, 732-738.

Chaffin, D. B. & Park, K. S. (1973). A longitudinal study of low-back pain as associated with occupational weight lifting factors. American Industrial Hygiene Association Journal, 34, 513-525.

Cheadle, A., Franklin, G., Wolfhagen, C., Savarino, J., Liu, P.Y., Salley, C., & Weaver, M. (1994). Factors influencing the duration of work-related disability: a population based study of Washington state workers' compensation. American Journal of Public Health, 84,(2), 190-196.

Chesson, C.V. & Hilton, S.M. (1988). The epidemiology of back-related hospitalizations among U.S. Navy personnel. Naval Health Research Center Report No. 88-18.

Cohen, A.L., Gjessing, C.C., Fine, L.J., Bernard, B.P., & McGlothlin, J.P. (1997). Elements of ergonomic programs. Cincinnati, OH: DHHS, (NIOSH): Pub 97-117.

Cyriax, J. (1981). Textbook of Orthopaedic Medicine, 7th Ed. London, England: Baillière Tindall.

D'Zurilla, T. J. (1990). Problem-solving training for effective stress-management and prevention. Journal of Cognitive Psychotherapy: An International Quarterly, 4, 327-355.

D'Zurilla, T. J. & Chang, E. C. (1995). The relations between social problem solving and coping. Cognitive Therapy and Research, 19, 547-562.

D'Zurilla, T. J. & Sheedy, C. F. (1991). The relation between social problem-solving ability and subsequent level of psychological stress in college students. Journal of Personality and Social Psychology, 61, 841-846.

Dehlin, O., Berg, S., Hedenrud, B., Andersson, G.B.J., & Grimly, G. (1981). Effect of physical training and ergonomic counseling on the psychological perception of work and on the subjective assessment of low-back insufficiency. Scandinavian Journal of Rehab Medicine, 13, 1-9.

Department of the Army, Office of the Deputy Chief of Staff for Personnel. (1994). U.S. Army Regulation 611-201, Enlisted Career Management Fields and Military Occupational Specialty. Washington, DC: Author.

Deyo, R.A. & Tsui-Wu, Y-J. (1987). Functional disability due to back pain: A populations based study including the importance of socioeconomic factors. Arth Rheum, 30, 1247-1253.

Dolce, J.J., Crocker, M.F., & Doleys, D.M. (1986). Prediction of outcomes among chronic pain patients. Behaviour Research and Therapy, 14, 313-319.

Donchin, M., Woolf, O., Kaplan, L., & Floman, Y. (1990). Secondary prevention of low back pain. Spine, 15, 1317-1320.

EDS D/SIDDOMS (1996). Ambulatory Data System (ADS) User Interface Technical Design Specifications for Release 1.1. Falls Church, Virginia

Elliott, T. R. & Marmarosh, C. L. (1994). Problem-solving appraisal, health complaints, and health-related expectancies. Journal of Counseling & Development, 72, 531-537.

Elliott, T. R., Sherwin, E., Harkins, S. W., Marmarosh, C. (1995). Self-appraised problem-solving ability, affective states, and psychological distress. Journal of Counseling Psychology, 42, 105-115.

Elloy, D. F., Everett, J. E., & Flynn, W. R. (1995). Multidimensional mapping of the correlates of job involvement. Canadian Journal of Behavioural Science, 27, 79-91.

Eston, R. G. & Williams, J. G. (1988). Reliability of ratings of perceived effort regulation of exercise intensity. British Journal of Sports Medicine, 22, 153-155.

Feldman, J.B. (1995). The workers' compensation patient: a cognitive-behavioral approach to rehabilitation. Presented at the APA-NIOSH Work, Stress, and Health Conference, Washington, DC, March.

Feuerstein, M. & Zastowny, T. R., (1996). Occupational rehabilitation: Multidisciplinary management of work-related musculoskeletal pain and disability. In (R.J. Gatchel & D.C. Turk, eds.). Psychological approaches to pain management: A practitioner's handbook. Guilford Press: New York.

Feuerstein, M., Berkowitz, S.M., & Peck, C. (1997). Occupational musculoskeletal disorders in U.S. Army personnel: Prevalence, gender and military occupational specialties. Journal of Occupational and Environmental Medicine, 1, 1-10.

Feuerstein, M., Berkowitz, S. M, Huang, G.A. (In press). Correlates of occupational low back disability: Implications for secondary prevention. Journal of Occupational and

Environmental Medicine.

Feuerstein, M., Callan-Harris, S., Hickey, P., Dyer, D., Armbruster, W. & Carosella, A. M. (1993). Multidisciplinary rehabilitation of chronic work-related upper extremity disorders: long term effects. Journal of Occupational Medicine, 35, 396-403.

Feuerstein, M., Carter, R. L. & Papciak, A. S. (1987). A prospective analysis of stress and fatigue in recurrent low back pain. Pain, 31, 333-344.

Feuerstein,M. (1996). Workstyle: Definition, empirical support, and implications for prevention, evaluation, and rehabilitation of occupational upper-extremity disorders. In S. Moon & S. Sauter (Eds.) Beyond Biomechanics: Psychosocial Influences on Cumulative Trauma Disorders in Office Workers. London:Taylor/Francis

Feuerstein, M. (1993). Workers' compensation reform in New York state: a proposal to address medical ergonomic and psychological factors associate with work disability. Journal of Occupational Rehabilitation, 3, 3, 125-133.

Feuerstein, M. & Thebarge, R. W. (1991). Perceptions of disability and occupational stress as discriminators of work disability in patients with chronic pain. Journal of Occupational Rehabilitation, 1, 3, 185-195.

Feuerstein, M. & Beattie, P. (1995). Biobehavioral factors affecting pain and disability in low back pain: mechanisms and assessment. Physical Therapy, 75(4), 267-280.

Feuerstein, M. (1991). A multidisciplinary approach to the prevention,evaluation and management of work disability. Journal of Occupational Rehabilitation, 1, 1, 5-11.

Feuerstein, M., Sult, S. & Houle, M. (1985). Environmental stressors and chronic low back pain: life events, family, and work environment. Pain, 22, 295-307.

Fiske, M. & Owens, S.H. (1994). Prevention of work disability using a health information model. AAOHN Journal, 42(9), 435-441.

Fitzgerald, T.E. & Feuerstein,M. (1992, March). Self-efficacy,physical performance, and pain behaviors following musculoskeletal injury. Paper presented at the meeting of the Society of Behavioral Medicine, New York.

Fitzgerald, T.E., (1992). Psychosocial aspects of work-related musculoskeletal disability. In J.Quick, L.Murphy, J.Hurrell,Jr. (Eds.). Stress & Well-Being at Work. Washington, DC: American Psychological Association.

Fitzgerald, T.E. & Prochaska, J.O. (1990). Nonprogressing profiles in smoking

cessation: What keeps people refractory to self-change? Journal of Substance Abuse, 2, 87-105.

Fordyce, W.E. (1994). Pain and suffering: What is the unit? Quality of Life Research: An International Journal of Quality of Life Aspects of Treatement, Care & Rehabilitation, 3(Suppl 1), S51-S56.

Frank, J. W., Pulcins, I. R., Kerr, M. S., Shannon, H. S., & Stansfeld, S. A., (1995). Occupational back pain - an unhelpful polemic. Scandinavian Journal of Work, Environment, & Health, 21, 3-14.

Frymoyer, J.W., Haldeman, S., & Andersson, G.B.J., (1991) Impairment rating - the United States perspective. In M.Pope, G.Andersson, J.Frymoyer, & D.Chatlin (Eds.). Occupational Low Back Pain: Assessment, Treatment, and Prevention. St.Louis: Mosby Year Book.

Frymoyer, J.W., Pope, M.H., Clements, J., Wilder, D., MacPherson, B., & Ashikaga, T. (1983). Risk factors in low-back pain. Journal of Bone Joint Surg, 65A, 213.

Frymoyer, J.W. & Cats-Baril, W. (1987). Correlates of low back pain disability. Clin Orthop Rel Res, 22, 89-98.

Garg, A. & Moore, J. D. (1992). Epidemiology of low-back pain in industry. Journal of Occupational Medicine, 7, 593-608.

Gattuso, S.M., Litt, M.D., & Fitzgerald, T.E. (1992). Coping with gastrointestinal endoscopy: Self-efficacy enhancement and coping style. Journal of Consulting and Clinical Psychology, 60, 133-139.

Gervais, S., Dupuis, G., Véronneau, F., Bergeron, Y., Millette, D., & Avard, J. (1991). Predictive model to determine cost/benefit of early detection and intervention in occupational low back pain. Journal of Occupational Rehabilitation, 1(2), 113-131.

Goodman, C.G. & Snyder, T.E. (1990). Systemic origins of musculoskeletal pain: associated signs and symptoms. In C.Goodman (Ed.) Differential Diagnosis in Physical Therapy. Philadelphia, PA: WB Saunders Co.

Greenwood, J.G., Wolf, H.J., Person, J.C., Woon, C.L., Posey, P., & Main, C.F. (1990). Early intervention in low back disability among coal miners in West Virginia: Negative findings. Journal of Occupational Medicine, 32, 1047-1052.

Habeck, R.V., Leahy, M.J., Hunt. H.A., Chan, F., & Welch, E.M. (1991). Employer factors related to workers' compensations claims and disability management. Rehabil

Counsel Bull, 34, 210-226.

Haldeman, S. (1990). Presidential Address: North American Spine Society: Failure of the pathology model to predict back pain. Spine, 15, 718-724.

Hales, T.R., Sauter, S.L., Peterson, M.R., Fine, L.J., Putz-Anderson, V., Schleifer, L.R., Ochs, T.T., & Bernard, B.P. (1994). Musculoskeletal disorders among visual display terminal users in a telecommunications company. Ergonomics, 37, 1603-21.

Herrin, G. D., Jaraiedi, M. & Anderson, C. K. (1986). Prediction of overexertion injuries using biomechanical and psychophysical models. American Industrial Hygiene Association Journal, 47, 322-330.

Hollenbeck, J.R., Ilgen, D.R. & Crampton, S.M. (1992). Lower back disability in occupational settings: A review of the literature from a human resource management view. Personnel Psychology, 45(2), 247-278.

Huang, G.A., Feuerstein, M., Berkowitz, S.M.. & Peck, C.A. Jr. (1998). Predicting Occupational upper extremity disability: A study of demographic, physical, and psychosocial factors. Military Medicine, 163(8), 552-558.

Jacob, M.C., Kerns, R.D., Rosenberg, R. & Haythornwaite, J. (1993). Chronic pain: intrusion and accommodation. Behaviour Research and Therapy, 31, 519-527.

Jamison, R.N., Stetson, B.A., & Parris, W.C. (1991). The relationship between cigarette smoking and chronic low back pain. Addictive Behaviors, 16, 103-110.

Jensen, M.C., Brant-Zawadzki, M.N., Obuchowski, N., Modic, M.R., Malkasian, D., & Ross, J.S., (1994). Magnetic resonance imaging of the lumbar spine in people without back pain. The New England Journal of Medicine, 331(2), 69-73.

Jensen, M.C., Kelly, A.P., Brant-Zawadzki, M.N. (1994). MRI of degenerative disease of the lumbar spine. Magnetic Resonance Quarterly, 10(3), p173-90

Jensen, M.P., Turner, J.A., Romano, J.M., & Karoly, P. (1991) Self-efficacy and outcome expectancies: relationship to chronic pain coping strategies. Pain, 44, 263-269.

Johansson, J.A. & Rubenowitz, S. (1994). Risk indicators in the psychosocial and physical work environment for work-related neck, shoulder, and low back symptoms: a study among blue- and white-collar workers in eight companies. Scandinavian Journal of Rehabilitation Medicine, 26, 131-142.

Jones, B.H, Bovee, M.W., Harris, J.M & Cowan, D.N. (1993). Intrinsic risk factors

for exercise-related injuries among male and female army trainees. The American Journal of Sports Medicine, 21, 705-710.

Kanner, A.D. (1981). Comparison of two modes of stress measurement, daily hassles and uplifts versus major life events. Journal of Behavioral Medicine, 4(1), 1.

Karasek, R., Baker, D., Marxer, F. Ahlbom, A. & Theorell, T. (1981). Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. American Journal of Public Health, 71, 694-705.

Knapik, J., Ang, P., Reynolds, K., & Jones, B. (1993). Physical fitness, age, and injury incidence in infantry soldiers. JOM, 35, 6, 598-603.

Kohles, S., Barnes, D. Gatchel, R.J. & Mayer, T.G. (1990). Improved physical performance outcomes after functional restoration treatment in patients with chronic low back pain. Early versus recent training results. Spine, 15(12), 1321-1324.

Lackner, J. M., Carosella, A. M. & Feuerstein, M. (1996). Pain expectancies, pain, and functional self-efficacy expectancies as determinants of disability in patients with chronic low back disorders. Journal of Consulting and Clinical Psychology, 64, 212-220.

Lahad, A., Malter, A. D., Berg, A. O., & Deyo, R. A. (1994). The effectiveness of four interventions for the prevention of low back pain. Journal of the American Medical Association, 272, 1286-1291.

Lancourt, J. & Kettelhut, M. (1992). Predicting return to work for lower back pain patients receiving worker's compensation. Spine, 17, 629-640.

Lanier, D.C. & Stockton, P. (1988). Clinical correlates of outcome of acute episodes of low back pain. Journal of Family Practice, 27, 478-479

LaPlante, M. P. (1988). Data on disability from the National Health Interview Survey, 1983-1985: An info use report. Washington, DC: National Institute on Disability and Rehabilitation Research.

Linenger, J. M. & West, L. A. (1994). Epidemiology of soft-tissue/musculoskeletal injury among U.S. Marine recruits undergoing basic training. Military Medicine, 157, 491-493.

Linton, S. J. (1990). Risk factors for neck and back pain in a working population in Sweden. Work and Stress, 4 (1), 41-49.

Linton, S. J. (1991). A behavioral workshop for training immediate supervisors: the

key to neck and back injuries? Perceptual Motor Skills, 73, 1159-1170.

Magora, A. (1972). Investigation of the relation between low back pain and occupation: III. Physical requirements: Sitting, standing, and weight lifting. Internal Medicine,41, 5-9.

Magora, A. (1973). Investigation of the relation between low back pain and occupation: Physical requirements: Bending, rotation, reaching, and sudden maximal effort. Scandinavian Journal of Rehabilitation Medicine, 5, 191-196.

Marcotte, A., Barker, R., Joyce, M., Miller, N., Klinenberg, E. J., Cogburn, C. D. & Goddard, D. E. (1997). Preventing Work-Related Musculoskeletal Illnesses Through Ergonomics: The Air Force PREMIER Program Volume 2: Job Requirements and Physical Demands Survey Methodology Guide. (AL/OE-TR-1996-0158 V.2) U.S. Air Force Armstrong Laboratory, Brooks AFB, TX

Marras, W.S., Lavender, S.A., Leurgans, S.E., Fathallah, F.A., Ferguson, S.A., Allread, W.G., & Rajuie, S.L. (1995). Biomechanical risk factors for occupationally related low back disorders. Ergonomics, 38, 377-410.

Marx, M. B., Somes, Garrity, Reeb, & Maffeo . (1984). The influence of a supportive, problem-solving, group intervention on the health status of students with recent life change. Journal of Psychosomatic Research, 28, 275-278.

Moffett, J.A.K., Chase, S.M., Portek, I., & Ennis, J.R. (1986). A controlled, prospective study to evaluate the effectiveness of a back school in the relief of chronic low back pain. Spine, 11, 120-122.

Moos, R.H. & Moos, B.S. (1981). Family Environment Scale manual. Palo Alto, CA: Consulting Psychologists Press

Moos, R.H. (1981). Work environment scale manual. Palo Alto, CA: Consulting Psychologists Press

Nachemson, A. L. (1992). Newest knowledge of low back pain: a critical look. Clin Orthop Rel Res, 279, 8-20.

National Institutes of Health, (1993). Research Plan for the National Center for Medical Rehabilitation Research. Publication No. 93-3509: Washington, DC

Nezu, A. M. (1986a). Negative life stress and anxiety: Problem solving as a moderator variable. Psychological Reports, 58, 279-283.

Nezu, A. M. (1986b). Cognitive appraisal of problem-solving effectiveness: Relation to depression and depressive symptoms. Journal of Clinical Psychology, 42, 847-852.

Nezu, A. M. & Ronan, G. F. (1988). Stressful life events, problem solving, and depressive symptoms among college students: A prospective analysis. Journal of Counseling Psychology, 35, 134-138.

Nezu, A. M., Nezu, C. M., Saraydarian, L., Kalmar, K., Ronan, G. F. (1986). Social problem solving as a moderator variable between negative life stress and depressive symptoms. Cognitive Research and Therapy, 10, 489-498.

Papciak, A.S. & Feuerstein, M. (1991). Fear of pain in work rehabilitation. Presented at the 25th Annual Meeting of the Association of the Advancement of Behavior Therapy, Nov 91, New York, NY.

Peck, C. (1995). Disability cost estimate for 1994. U.S. Army Physical Disability Agency. Personal Communication.

Pope, M.H., Andersson, G.B.J., & Chaffin, D.B. (1991). The workplace. In M.Pope, G.Andersson, J.Frymoyer, & D.Chaffin (Eds.) Occupational Low Back Pain: Assessment, Treatment, and Prevention. St. Louis, MO:Mosby Year Book

Putz-Anderson, V., Waters, T. Baron, S. & Hanley, K. (1993). HETA 91-405-2340, August 1993, Big Bear Grocery Warehouse, Columbus Ohio. Health Hazard Evaluation Report No. 91-405. NIOSH: Cincinnati, OH

Reilly, P. A., Travers, R. & Littlejohn, G. O. (1991). Epidemiology of soft tissue rheumatism: the influence of the law. Journal of Rheumatology, 18, 1448-1449.

Reisbord, L.S. & Greenland, S. (1985). Factors associated with self-reported back pain prevalence: a population based study. Journal of Chronic Disease, 38, 691-702.

Rohrer, M.H., Santos-Eggimann, B., Raccaud, F., & Haller-Maslov, E. (1994). Epidemiologic study of low back pain in 1398 Swiss conscripts between 1985 and 1992. European Spin Journal, 3, 2-7.

Ross, J. & Woodward, A. (1994). Risk factors for injury during basic military training: Is there a social element to injury pathogenesis? Journal of Occupational Medicine, 36, 11201126.

Rossignol, M., Lortie, M. & Ledoux, F. (1993). Comparison of spinal health indicators in predicting spinal status in 1 year longitudinal study. Spine, 18, 54-60.

Singer, J. Gilbert, J.R. Hutton, T. & Taylor, D.W. (1987). Predicting outcome in acute low back pain. Can Fam Phys, 33, 655-659.

Spitzer, W.O., et al. (1987). Scientific appraisal to the assessment and management of activity-related spinal disorders. Spine, 12, (75), 51-59.

Sternbach, R.A. (1986). Pain and "hassles" in the United States: findings of the Nuprin pain report. Pain, 27, 69-80.

Symonds, T. L., Burton, A. K., Tillotson, K. M. & Main, C. J. (1996). Do attitudes and beliefs influence work loss due to low back trouble? Occupational Medicine, 46, 25-32..

U.S. Department of Labor 1994, Work Injuries and illnesses by selected characteristics, News, April, Washington, DC.

Vlaeyen, J.W.S., Kole-Snijders, A.M.J., Rotteveel, A., Ruesink, R. & Heuts, P.H.T.G., (1995). The role of fear of movement/(re)injury in pain disability. Journal of Occupational Rehabilitation, 5, 235-252.

Waddell, G., Morris, E.W., DiPaola, M.P., Bircher, M., & Finlayson, D. (1986). A concept of illness tested as an improved basis for surgical decision in low-back disorders. Spine, 11, 712-719.

Waddell, G. (1987). A new clinical model for the treatment of low-back pain. Pine, 12, 632-644.

Waddell, G., Somerville, D., Henderson, I. & Newton, M. (1992). Objective clinical evaluation of physical impairment in chronic low back pain. Spine, 17, 617-628.

Waddell, G., Newton, M., Henderson, I., Somerville, D. & Main, C. (1993). A fear-avoidance beliefs questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. Pain, 52, 148-156.

Waters, T. R., Putz-Anderson, V., Garg, A. & Fine, L. J. (1993). Revised NIOSH equation for the design and evaluation of manual lifting tasks. Ergonomics, 36, 749-776.

Weighill, V.E. (1983). "Compensation neurosis": A review of the literature. Journal of Psychosomatic Research, 27, 97-104.

Westman, M. (1992). Moderating effect of decision latitude on stress-strain relationship: Does organizational level matter? Journal of Organizational Behavior, 13, 713-722.

Whaley, M. H., Woodall, T., Kaminsky, L. A., & Emmett, J. D. (1997). Reliability of perceived exertion during graded exercise testing in apparently healthy adults. Journal of Cardiopulmonary Rehabilitation, 17, 37-42.

Wilkinson, P. & Mynors-Wallis, L. (1994). Problem-solving therapy in the treatment of unexplained physical symptoms in primary care: a preliminary study. Journal of Psychosomatic Research, 38, 591-598.

Zigmond, D. (1976). The medical model: its limitations and alternatives. Hospital Update, 2, 424-427.

APPENDIX A: Occupational Pain and Work Survey

1750

Occupational Pain and Work Survey

- *Use a No. 2 pencil only.*
- *Do not use ink, ballpoint, or felt tip pens.*
- *Make solid marks that fill the response completely.*
- *Erase cleanly any marks you wish to change.*
- *Make no stray marks on this form.*

Shade circles like this: ●
Not like this: ⊗ ✓

For optimum accuracy, please print in capital letters and avoid contact with the edge of the box. The following will serve as an example:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

1. BIRTHDATE

	MM		DD		YY	
	☐	☐ /	☐	☐ /	☐	☐
1	①	①	①	①	①	①
2	②	②	②	②	②	②
3	③	③	③	③	③	③
4	④	④	④	④	④	④
5	⑤	⑤	⑤	⑤	⑤	⑤
6	⑥	⑥	⑥	⑥	⑥	⑥
7	⑦	⑦	⑦	⑦	⑦	⑦
8	⑧	⑧	⑧	⑧	⑧	⑧
9	⑨	⑨	⑨	⑨	⑨	⑨
0	⓪	⓪	⓪	⓪	⓪	⓪

2. Name: Omit spaces, hypens, apostrophes, and jr., III, etc.

LAST (family) NAME 15 letters

3. FIRST (given) NAME 12 letters

4. MI

5. YOUR MAILING ADDRESS: P.O. BOX or STREET ADDRESS

6. CITY

7. STATE

8. ZIP

9. EDUCATION LEVEL
- ○ H. S. Grad / G.E.D.
- ○ Some College or other Post High School
- ○ 2 year degree
- ○ 4 year degree
- ○ Some graduate work

10. GENDER
- ○ Male
- ○ Female

11. # OF CHILDREN YOU SUPPORT

0	1	2	3	4	5	6+
○	○	○	○	○	○	○

12. LENGTH OF SERVICE (ARMY)

Yrs. Mo.

13. MOS
- ○ 11B - Infantryman
- ○ 31R - Multi-channel Trans. Systems Operator
- ○ 62B - Construction Equipment Repairer
- ○ 62E - Heavy Construction Equipment Operator
- ○ 63B - Unit-level Wheeled Vehicle Mechanic
- ○ 88M - Wheeled Vehicle Driver
- ○ 91C - Practical Nurse
- ○ Other _____

14. SMOKING STATUS
- ○ Current smoker
- ○ Former smoker
- ○ Never smoked

15. MARITAL STATUS
- ○ Single
- ○ Married
- ○ Separated
- ○ Divorced
- ○ Widowed

16. LENGTH OF TIME IN MOS

Yrs. Mo.

17. TODAY'S DATE

MM / DD / YY

18. WORK PHONE NUMBER

( ) -

19. Base/Installation
- ○ Aberdeen Proving Ground / Edgewood
- ○ Walter Reed Army Medical Center
- ○ Ft. Meade
- ○ Ft. Myer
- ○ Ft. Belvoir
- ○ Other _____

20. Rank
- ○ E-1
- ○ E-2
- ○ E-3
- ○ E-4
- ○ E-5
- ○ E-6
- ○ E-7
- ○ E-8
- ○ E-9
- ○ Other

21. SOCIAL SECURITY NUMBER

	☐	☐	☐ -	☐	☐ -	☐	☐	☐	☐
1	①	①	①	①	①	①	①	①	①
2	②	②	②	②	②	②	②	②	②
3	③	③	③	③	③	③	③	③	③
4	④	④	④	④	④	④	④	④	④
5	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤	⑤
6	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥	⑥
7	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦	⑦
8	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧	⑧
9	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨	⑨
0	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪	⓪

1750

Section A: WQ

1. ***Please read and respond to all questions.***
2. ***Please mark the bubble that best describes you.***
3. ***Your responses are confidential.***

Thank you in advance for completing the survey.

	Rarely	Occasionally	Sometimes	Often	Very often
1. How often does your job require you to work **very fast**?	O	O	O	O	O
2. How often does your job require you to work **very hard**?	O	O	O	O	O
3. How often does your job leave you with **little time** to get things done?	O	O	O	O	O
4. How often is there a **great deal** to get done?	O	O	O	O	O
5. How often is there a **marked increase** in your workload?	O	O	O	O	O
6. How often is there a marked increase in the **amount of concentration** required on your job?	O	O	O	O	O
7. How often is there a marked increase in how **fast you have to think**?	O	O	O	O	O
8. How often are you **physically** exhausted at the end of the work day?	O	O	O	O	O
9. How often are you **mentally** exhausted at the end of the work day?	O	O	O	O	O

10. How would you describe the physical effort required of your job on a particular day?

O	O	O	O	O	O	O	O	O	O	O	O
0	.5	1	2	3	4	5	6	7	8	9	10
nothing at all	Very very easy	Very easy	Easy	Moderately hard	Somewhat hard	Hard		Very hard			Very very hard

Section B: Symptoms

	Yes	No
1. **Have you had any pain or physical discomfort during the past year, that you believe to be related to your assignment in your current MOS?**	O	O
2. **Have you had any periods of "limited duty" ("profile") or "no duty" ("quarters") during the past year due to pain or physical discomfort in your back?**	O	O

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Do you experience physical problems with any of the following areas of your body?

For each area that you answer "Yes," please complete the column below that area. If you answer "No" for that area, do not complete the column for that body area, but go on to the next column.

	Lower Back (incl. buttocks)	Upper Back	Neck
	O Yes O No (Go to next column)	O Yes O No (Go to next column)	O Yes O No (Go to next page)
1. When did you first notice the problem?	O Within past 12 mos. O 13 to 24 mos. ago O 25 to 36 mos. ago O more than 36 mos.	O Within past 12 mos. O 13 to 24 mos. ago O 25 to 36 mos. ago O more than 36 mos.	O Within past 12 mos. O 13 to 24 mos. ago O 25 to 36 mos. ago O more than 36 mos.
2. How often have you experienced the problem?	O Almost always (Daily) O Frequently (1X / wk) O Sometimes (1X / mo.) O Rarely (every 2-3 mos) O Almost never (ea. 6 mo.)	O Almost always (Daily) O Frequently (1X / wk) O Sometimes (1X / mo.) O Rarely (every 2-3 mos) O Almost never (ea. 6 mo.)	O Almost always (Daily) O Frequently (1X / wk) O Sometimes (1X / mo.) O Rarely (every 2-3 mos) O Almost never (ea. 6 mo.
3. On average, how long has each episode lasted?	O Less than 1 hr O 1 hr to 1 day O 1 day to 1 wk O 1 wk to 1 month O 1 to 6 months O More than 6 mos.	O Less than 1 hr O 1 hr to 1 day O 1 day to 1 wk O 1 wk to 1 month O 1 to 6 months O More than 6 mos.	O Less than 1 hr O 1 hr to 1 day O 1 day to 1 wk O 1 wk to 1 month O 1 to 6 months O More than 6 mos.
4. On average, how bad has this problem been over the past year?	O No discomfort O Mild O Moderate O Severe O Unbearable	O No discomfort O Mild O Moderate O Severe O Unbearable	O No discomfort O Mild O Moderate O Severe O Unbearable
5. What symptoms do you have with this problem? (mark all that apply)	O Pain O Ache O Stiffness O Weakness O Other_____	O Pain O Ache O Stiffness O Weakness O Other_____	O Pain O Ache O Stiffness O Weakness O Other_____
6. Is this problem interfering with your ability to do your job?	O Yes O No	O Yes O No	O Yes O No
7. How much work did you miss (i.e. "no duty or quarters") in the past 12 months due to this problem?	O No time lost O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No time lost O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No time lost O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days
8. How much "limited duty" or "profile" have you been assigned in the past 12 months due this problem?	O No limited duty O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No limited duty O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No limited duty O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days
9. What do you think caused the problem? (Fill in your best guess)	O Work tasks O Phys fitness training O Off-duty activities O Traffic accident O Other_____	O Work tasks O Phys fitness training O Off-duty activities O Traffic accident O Other_____	O Work tasks O Phys fitness training O Off-duty activities O Traffic accident O Other_____

1750

Do you experience physical problems with any of the following areas of your body?

For each area that you answer "Yes," please complete the column below that area. If you answer "No" for that area, do not complete the column for that body area, but go on to the next column.

	Shoulders	Elbows/Forearms	Wrists/Hands
	O Yes O No (Go to next column)	O Yes O No (Go to next column)	O Yes O No (Go to next page)
1. When did you first notice the problem?	O Within past 12 mos. O 13 to 24 mos. ago O 25 to 36 mos. ago O more than 36 mos.	O Within past 12 mos. O 13 to 24 mos. ago O 25 to 36 mos. ago O more than 36 mos.	O Within past 12 mos. O 13 to 24 mos. ago O 25 to 36 mos. ago O more than 36 mos.
2. How often have you experienced the problem?	O Almost always (Daily) O Frequently (1X / wk) O Sometimes (1X / mo.) O Rarely (every 2-3 mos) O Almost never (ea. 6 mo.)	O Almost always (Daily) O Frequently (1X / wk) O Sometimes (1X / mo.) O Rarely (every 2-3 mos) O Almost never (ea. 6 mo.)	O Almost always (Daily) O Frequently (1X / wk) O Sometimes (1X / mo.) O Rarely (every 2-3 mos) O Almost never (ea. 6 mo.
3. On average, how long has each episode lasted?	O Less than 1 hr O 1 hr to 1 day O 1 day to 1 wk O 1 wk to 1 month O 1 to 6 months O More than 6 mos.	O Less than 1 hr O 1 hr to 1 day O 1 day to 1 wk O 1 wk to 1 month O 1 to 6 months O More than 6 mos.	O Less than 1 hr O 1 hr to 1 day O 1 day to 1 wk O 1 wk to 1 month O 1 to 6 months O More than 6 mos.
4. On average, how bad has this problem been over the past year?	O No discomfort O Mild O Moderate O Severe O Unbearable	O No discomfort O Mild O Moderate O Severe O Unbearable	O No discomfort O Mild O Moderate O Severe O Unbearable
5. What symptoms do you have with this problem? (mark all that apply)	O Pain O Ache O Stiffness O Weakness O Other_____	O Pain O Ache O Stiffness O Weakness O Other_____	O Pain O Ache O Stiffness O Weakness O Other_____
6. Is this problem interfering with your ability to do your job?	O Yes O No	O Yes O No	O Yes O No
7. How much work did you miss (i.e. "no duty or no quarters") in the past 12 months due to this problem?	O No time lost O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No time lost O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No time lost O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days
8. How much "limited duty" or "profile" have you been assigned in the past 12 months due to this problem?	O No limited duty O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No limited duty O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days	O No limited duty O 1 to 10 days O 11 to 30 days O 31 to 90 days O More than 90 days
9. What do you think caused the problem? (Fill in your best guess)	O Work tasks O Phys fitness training O Off-duty activities O Traffic accident O Other_____	O Work tasks O Phys fitness training O Off-duty activities O Traffic accident O Other_____	O Work tasks O Phys fitness training O Off-duty activities O Traffic accident O Other_____

Section C: JRPDS (Job Factors Only)

Indicate on average, how long you do this work on a daily (every day or weekly) basis.

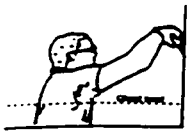

Figure A.

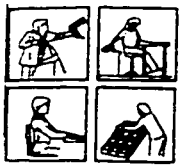

Figure B.

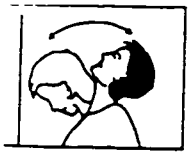

Figure C.

Figure D.

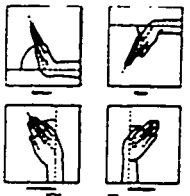

Figure E.

Figure F.

Task	More than 4 hrs / day	2 - 4 hrs / day	Less than 2 hrs / day	Less than 5 hrs / week	Never
1. I work with my hands at or above chest level. (Figure A)	O	O	O	O	O
2. To get to or do my work, I must lay on my back or side and work with my arms up.	O	O	O	O	O
3. I must hold or carry materials (or large stacks of files) during the course of my work.	O	O	O	O	O
4. I force or yank components of work objects in order to complete a task.	O	O	O	O	O
5. I reach/hold my arms in front of or behind my body (e.g., using keyboard, filing, handling parts, perform inspection tasks, pushing/pulling carts, etc). (Figure B)	O	O	O	O	O
6. My neck is tipped forward or backward when I work. (Figure C)	O	O	O	O	O
7. I cradle a phone or other device between my neck and shoulder. (Figure D)	O	O	O	O	O
8. My wrists are bent (up, down, to the thumb, or little finger side) while I work. (Figure E)	O	O	O	O	O
9. I apply pressure or hold an item/material/tool (e.g., screwdriver, spray gun, mouse, etc. in my hand for longer than 10 seconds at a time).	O	O	O	O	O
10. My work requires me to use my hands in a way that is similar to wringing out clothes. (Figure F).	O	O	O	O	O
11. I perform a series of repetitive tasks/movements during the normal course of my work (e.g. using keyboard, tightening fasteners, cutting meat, etc).	O	O	O	O	O
12. The work surface (e.g., desk, bench, etc.) or tool(s) that I use presses into my palm(s), wrist(s), or against the sides of my fingers leaving red marks on or beneath the skin.	O	O	O	O	O
13. I use my hand/palm like a hammer to do aspects of my work.	O	O	O	O	O
14. My hands and fingers are cold when I work.	O	O	O	O	O
15. I work at a fast pace to keep up with machine production quota or performance incentive.	O	O	O	O	O
16. The tool(s) that I use vibrates and/or jerks my hand(s)/arm(s).	O	O	O	O	O
17. My work requires that I repeatedly throw or toss items.	O	O	O	O	O
18. My work requires me to twist my forearms, such as turning a screwdriver.	O	O	O	O	O

Section C: JRPDS (cont.)

Indicate on average, how long you do this work on a daily (every day or weekly) basis.

Task	More than 4 hrs / day	2-4 hrs / day	Less than 2 hrs / day	Less than 5 hrs / week	Never
19. I wear gloves that are bulky, or reduce my ability to grip.	O	O	O	O	O
20. I squeeze or pinch work objects with a force similar to that which is required to open a lid on a new jar.	O	O	O	O	O
21. I grip work objects or tools as if I am gripping tightly onto a pencil.	O	O	O	O	O
22. When I lift, move components, or do other aspects of my work, my hands are lower than my knees. (Figure G)	O	O	O	O	O
23. I lean forward continually when I work (e.g., when sitting, when standing, when pushing carts, etc).	O	O	O	O	O
24. The personal protective equipment or clothing that I wear limits or restricts my movement.	O	O	O	O	O
25. I repeatedly bend my back (e.g., forward, backward, to the side, or twist) in the course of my work.	O	O	O	O	O
26. When I lift, my body is twisted and/or I lift quickly. (Figure H)	O	O	O	O	O
27. I can feel vibration through the surface that I stand on, or through my seat.	O	O	O	O	O
28. I lift and/or carry items with one hand (Figure I)	O	O	O	O	O
29. I lift or handle bulky items.	O	O	O	O	O
30. I lift materials that weigh more than 25 pounds.	O	O	O	O	O
31. My work requires that I kneel or squat. (Figure J)	O	O	O	O	O
32. I must constantly move or apply pressure with one or both feet (e.g. using foot pedals. driving, etc).	O	O	O	O	O
33. When I'm sitting, I cannot rest both feet flat on the floor. (Figure K)	O	O	O	O	O
34. I stand on hard surfaces.	O	O	O	O	O
35. I can see glare on my computer screen or work surface.	O	O	O	O	O
36. It is difficult to hear a person on the phone or to concentrate because of other activity, voices, or noise in/near my work area.	O	O	O	O	O
37. I must look at the monitor screen constantly so that I do not miss important information (e.g. radar scope).	O	O	O	O	O
38. It is difficult to see what I am working with (monitor, paper, parts, etc).	O	O	O	O	O

Figure G.

Figure H.

Figure I.

Figure J.

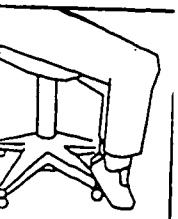

Figure K

Section D: WES

Indicate whether the statement is true or false in reference to your work environment.

	TRUE	FALSE
1. The work is really challenging.	O	O
2. People go out of their way to make a new soldier feel comfortable.	O	O
3. Supervisors (leaders) tend to talk down to soldiers.	O	O
4. Few soldiers have any important responsibilities.	O	O
5. People pay a lot of attention to getting work done.	O	O
6. There is constant pressure to keep working.	O	O
7. Things are sometimes pretty disorganized.	O	O
8. There's a strict emphasis on following policies and regulations.	O	O
9. Doing things in a different way is valued.	O	O
10. It sometimes gets too hot.	O	O
11. There's not much group spirit.	O	O
12. The atmosphere is somewhat impersonal.	O	O
13. Supervisors (leaders) usually compliment a soldier who does something well.	O	O
14. Soldiers have a great deal of freedom to do as they like.	O	O
15. There's a lot of time wasted because of inefficiencies.	O	O
16. There always seems to be an urgency about everything.	O	O
17. Activities are well-planned.	O	O
18. People can wear wild looking clothing on the job if they want.	O	O
19. New and different ideas are always being tried out.	O	O
20. The lighting is extremely good.	O	O
21. A lot of people seem to be just putting in time.	O	O
22. People take a personal interest in each other.	O	O
23. Supervisors (leaders) tend to discourage criticisms from soldiers.	O	O
24. Soldiers are encouraged to make their own decisions.	O	O
25. Things rarely get "put off 'till tomorrow."	O	O
26. People cannot afford to relax.	O	O
27. Rules and regulations are somewhat vague and ambiguous.	O	O
28. People are expected to follow set rules in doing their work.	O	O
29. This place would be one of the first to try out a new idea.	O	O
30. Work space is awfully crowded.	O	O

Section D: WES (cont.)

Indicate whether the statement is true or false in reference to your work environment

	TRUE	FALSE
31. People seem to take pride in the organization.	O	O
32. Soldiers rarely do things together after work.	O	O
33. Supervisors (leaders) usually give full credit to ideas contributed by soldiers.	O	O
34. People can use their own initiative to do things.	O	O
35. This is a highly efficient, work oriented place.	O	O
36. Nobody works too hard.	O	O
37. The responsibilities of supervisors (leaders) are clearly defined.	O	O
38. Supervisors (leaders) keep a rather close watch on soldiers.	O	O
39. Variety and change are not particularly important.	O	O
40. This place has a stylish and modern appearance.	O	O
41. People put quite a lot of effort into what they do.	O	O
42. People are generally frank about how they feel.	O	O
43. Supervisors (leaders) often criticize soldiers over minor things.	O	O
44. Supervisors (leaders) encourage their soldiers to rely on themselves when a problem arises.	O	O
45. Getting a lot of work done is important to people.	O	O
46. There is no time pressure.	O	O
47. The details of assigned jobs are generally explained to soldiers.	O	O
48. Rules and regulations are pretty well enforced.	O	O
49. The same methods have been used for quite a long time.	O	O
50. The place could stand some new interior decorations.	O	O
51. Few people ever volunteer.	O	O
52. Soldiers often eat lunch together.	O	O
53. Soldiers generally feel free to ask for a pass.	O	O
54. Soldiers generally do not try to be unique and different.	O	O
55. There's an emphasis on "work before play."	O	O
56. It is very hard to keep up with your work load.	O	O
57. Soldiers are often confused about exactly what they are supposed to do.	O	O
58. Supervisors (leaders) are always checking on soldiers and supervise them very closely.	O	O
59. New approaches to things are rarely tried.	O	O
60. The colors and decorations make the place warm and cheerful to work in.	O	O

Section D: WES (cont.)

Indicate whether the statement is true or false in reference to your work environment

	TRUE	FALSE
61. It is quite a lively place.	O	O
62. Soldiers who differ greatly from the others in the organization don't get on well.	O	O
63. Supervisors (leaders) expect far too much from solders.	O	O
64. Soldiers are encouraged to learn things even if they are not directly related to the job.	O	O
65. Soldiers work very hard.	O	O
66. You can take it easy and still get your work done.	O	O
67. Fringe benefits are fully explained to soldiers.	O	O
68. Supervisors (leaders) do not often give in to employee (soldier) pressure.	O	O
69. Things tend to stay just about the same.	O	O
70. It is rather drafty at times.	O	O
71. It's hard to get people to do any extra work.	O	O
72. Soldiers often talk to each other about their personal problems.	O	O
73. Soldiers discuss their personal problems with supervisors (leaders).	O	O
74. Soldiers function fairly independently of supervisors (leaders).	O	O
75. People seem to be quite inefficient.	O	O
76. There are always deadlines to be met.	O	O
77. Rules and policies are constantly changing.	O	O
78. Soldiers are expected to conform rather strictly to the rules and customs.	O	O
79. There is a fresh, novel atmosphere about the place.	O	O
80. The furniture is usually well-arranged.	O	O
81 Work is usually very interesting.	O	O
82. Often people make trouble by talking behind others' backs.	O	O
83. Supervisors (leaders) really stand up for their people.	O	O
84. Supervisors (leaders) meet with soldiers regularly to discuss their future work goals.	O	O
85. There's a tendency for people to come to work late.	O	O
86. People often have to work overtime to get their work done.	O	O
87 Supervisors (leaders) encourage soldiers to be neat and orderly.	O	O
88. If a soldier comes in late, he can make it up by staying late.	O	O
89. Things always seem to be changing.	O	O
90. The rooms are well ventilated.	O	O

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Section E: SPSI-R

Below are a series of statements that describe how some people might think, feel, and act when faced with important problems in everyday living. We are not talking about the ordinary hassles and pressures that you deal with successfully everyday. In this questionnaire, a problem is something important in your life that bothers you a lot but you don't immediately know how to make it better or stop it from bothering you so much. Read each statement carefully and select one of the choices below that indicates how true the statement is of you. Consider yourself as you typically think, feel, and act when you are faced with important problems these days. Mark your choice in the bubbles to the right of each question.

	Not at all true of me	Slightly true of me	Moderately true of me	Very true of me	Extremely true of me
1. I spend too much time worrying about my problems instead of trying to solve them.	O	O	O	O	O
2. I feel threatened and afraid when I have an important problem to solve.	O	O	O	O	O
3. When making decisions, I do not evaluate all my options carefully enough.	O	O	O	O	O
4. When I have a decision to make, I fail to consider the effects that each option is likely to have on the well-being of other people.	O	O	O	O	O
5. When I am trying to solve a problem, I often think of different solutions and then try to combine some of them to make a better solution.	O	O	O	O	O
6. I feel nervous and unsure of myself when I have an important decision to make.	O	O	O	O	O
7. When my first efforts to solve a problem fail, I know if I persist and do not give up too easily, I will be able to eventually find a good solution.	O	O	O	O	O
8. When I am attempting to solve a problem, I act on the first idea that occurs to me.	O	O	O	O	O
9. Whenever I have a problem, I believe that it can be solved.	O	O	O	O	O
10. I wait to see if a problem will resolve itself first, before trying to solve it myself.	O	O	O	O	O
11. When I have a problem to solve, one of the things I do is analyze the situation and try to identify what obstacles are keeping me from getting what I want.	O	O	O	O	O
12. When my first efforts to solve a problem fail, I get very frustrated.	O	O	O	O	O
13. When I am faced with a difficult problem, I doubt that I will be able to solve it on my own no matter how hard I try.	O	O	O	O	O
14. When a problem occurs in my life, I put off trying to solve it for as long as possible.	O	O	O	O	O
15. After carrying out a solution to a problem, I do not take the time to evaluate all of the results carefully.	O	O	O	O	O
16. I go out of my way to avoid having to deal with problems in my life.	O	O	O	O	O
17. Difficult problems make me very upset.	O	O	O	O	O
18. When I have a decision to make, I try to predict the positive and negative consequences of each option.	O	O	O	O	O
19. When problems occur in my life, I like to deal with them as soon as possible.	O	O	O	O	O
20. When I am attempting to solve a problem, I try to be creative and think of new or original solutions.	O	O	O	O	O

Section E: SPSI-R (cont.)

	Not at all true of me	Slightly true of me	Moderately true of me	Very true of me	Extremely true of me
21. When I am trying to solve a problem, I go with the first good idea that comes to mind.	O	O	O	O	O
22. When I try to think of different possible solutions to a problem, I cannot come up with many ideas.	O	O	O	O	O
23. I prefer to avoid thinking about the problems in my life instead of trying to solve them.	O	O	O	O	O
24. When making decisions, I consider both the immediate consequences and the long-term consequences of each option.	O	O	O	O	O
25. After carrying out my solution to a problem, I analyze what went right and what went wrong.	O	O	O	O	O
26. After carrying out my solution to a problem, I examine my feelings and evaluate how much they have changed for the better.	O	O	O	O	O
27. Before carrying out my solution to a problem, I practice the solution in order to increase my chances of success.	O	O	O	O	O
28. When I am faced with a difficult problem, I believe I will be able to solve it on my own if I try hard enough.	O	O	O	O	O
29. When I have a problem to solve, one of the first things I do is get as many facts about the problem as possible.	O	O	O	O	O
30. I put off solving problems until it is too late to do anything about them.	O	O	O	O	O
31. I spend more time avoiding my problems than solving them.	O	O	O	O	O
32. When I am trying to solve a problem, I get so upset that I cannot think clearly.	O	O	O	O	O
33. Before I try to solve a problem, I set a specific goal so that I know exactly what I want to accomplish.	O	O	O	O	O
34. When I have a decision to make, I do not take the time to consider the pros and cons of each option.	O	O	O	O	O
35. When the outcome of my solution to a problem is not satisfactory, I try to find out what went wrong and then I try again.	O	O	O	O	O
36. I hate having to solve the problems that occur in my life.	O	O	O	O	O
37. After carrying out a solution to a problem, I try to evaluate as carefully as possible how much the situation has changed for the better.	O	O	O	O	O
38. When I have a problem, I try to see it as a challenge, or opportunity to benefit in some positive way from having the problem.	O	O	O	O	O
39. When I am trying to solve a problem, I think of as many options as possible until I cannot come up with any more ideas.	O	O	O	O	O
40. When I have a decision to make, I weigh the consequences of each option and compare them against each other.	O	O	O	O	O

Section E: SPSI-R (cont.)

	Not at all true of me	Slightly true of me	Moderately true of me	Very true of me	Extremely true of me
41. I become depressed and immobilized when I have an important problem to solve.	O	O	O	O	O
42. When I am faced with a difficult problem, I go to someone else for help in solving it.	O	O	O	O	O
43 When I have a decision to make, I consider the effect that each option is likely to have on my personal feelings.	O	O	O	O	O
44. When I have a problem to solve, I examine what factors or circumstances in my environment might be contributing to the problem.	O	O	O	O	O
45 When making decisions, I go with my "gut feeling" without thinking too much about the consequences of each option.	O	O	O	O	O
46. When making decisions, I use a systematic method for judging and comparing alternatives.	O	O	O	O	O
47. When I am trying to solve a problem, I keep in mind what my goal is at all times.	O	O	O	O	O
48 When I am attempting to solve a problem, I approach it from as many different angles as possible.	O	O	O	O	O
49 When I am having trouble understanding a problem, I try to get more specific and concrete information about the problem to help clarify it.	O	O	O	O	O
50. When my first efforts to solve a problem fail, I get discouraged and depressed.	O	O	O	O	O
51. When a solution that I have carried out does not solve my problem satisfactorily, I do not take the time to examine carefully why it did not work.	O	O	O	O	O
52. I am too impulsive when it comes to making decisions.	O	O	O	O	O

Section F: FES

Indicate whether the statement is true or false in reference to your family environment.

	TRUE	FALSE
1. Family members really help and support one another.	O	O
2. Family members often keep their feelings to themselves.	O	O
3. We fight a lot in our family.	O	O
4. We often seem to be killing time at home.	O	O
5. We say anything we want to around home.	O	O
6. Family members rarely become openly angry.	O	O
7. We put a lot of energy into what we do at home.	O	O
8. It's hard to "blow off steam" at home without upsetting somebody.	O	O
9. Family members sometimes get so angry they throw things.	O	O
10. There is a feeling of togetherness in our family.	O	O
11. We tell each other about our personal problems.	O	O
12. Family members hardly ever lose their tempers.	O	O
13. We rarely volunteer when something has to be done at home.	O	O
14. If we feel like doing something on the spur of the moment we often just pick up and go.	O	O
15. Family members often criticize each other.	O	O
16. Family members really back each other up.	O	O
17. Someone usually gets upset if you complain in our family.	O	O
18. Family members sometimes hit each other.	O	O
19. There is very little group spirit in our family.	O	O
20. Money and paying bills is openly talked about in our family.	O	O
21. If there's a disagreement in our family, we try hard to smooth things over and keep the peace.	O	O
22. We really get along well with each other.	O	O
23 We are usually careful about what we say to each other.	O	O
24. Family members often try to one-up or out-do each other.	O	O
25. There is plenty of time and attention for everyone in our family.	O	O
26. There are a lot of spontaneous discussions in our family.	O	O
27. In our family, we believe you don't ever get anywhere by raising your voice.	O	O

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APPENDIX B: Consent Form

UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES
4301 JONES BRIDGE ROAD
BETHESDA, MARYLAND 20814-4799

INFORMED CONSENT

Research Study Title: **Predictors of occupational back pain and readiness status: ergonomic and psychosocial factors in high risk military occupations**

Principal Investigator: Michael Feuerstein, Ph. D. (with Amy Haufler, Ph.D., S. M. Berkowitz, M.S., and Grant D. Huang. B.A.)

1. Purpose of the Study:

You are invited to participate in a research study that will examine back pain and work. Currently, the factors contributing to occupational back disorders are not well understood. You were selected as a possible participant because we are trying to better understand how various work factors in certain military jobs may have an impact on back pain and ability to work.

2. Procedures involved in the Study:

If you decide to participate, you will be administered a survey to complete which will take approximately 60-70 minutes. The survey will ask you to select responses to questions related to your health, sources of stress, and job characteristics. We will also measure your approach to problem solving. A subset of soldiers will be selected to participate in subsequent phases of the study. If selected, you will be requested to participate in the following: 1) work site ergonomic assessment (i.e., 30-60 minute videotaping while performing your job), and 2) a three and 12 month follow-up consisting of brief 12 item questionnaire that will be mailed to you and sent back to us. In addition, information regarding lost work time, limited duty status and use of health care in relation to back pain will be obtained from military administrative/medical records at the three and 12 month periods.

When you enter the study, you will be assigned a personal study ID number. Although your social security number (SSN) will be used to link your initial questionnaire to follow-up medical and administrative data, only the Principal Investigator (Dr. Feuerstein) and his research team will have access to your SSN. Additionally, only the Principal Investigator (Dr. Feuerstein) and his research team will be able to link your SSNs to names in the event that this is necessary for any unforseen reason. Your name and personal information will not be released to anyone.

3. Possible Discomfort and Risks Involved:

To the best of our knowledge, you will not be exposed to any risks, discomforts, or inconveniences as a result of your participation in this study. You have the right to refuse or discontinue participation at any time.

4. Privacy

The results of this study will be maintained in a locked cabinet at the Uniformed Services University of the Health Sciences, Bethesda, Maryland. The results of this study will be provided to CHPPM in the form of group data. In addition, data from the ergonomic assessment in the form of videotapes will be analyzed by research staff only and individual results will not be available.

The Institutional Review Board at the Uniformed Services University of the Health Sciences may see records from the study. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission. Confidentiality will be protected to the full extent of the law.

5. Recourse in the Event of Injury:

DOD will provide medical care at government facilities, if DOD eligible (active duty, dependents, and retired military), for injury or illness resulting from participation in this research. Such care may not be available to other research participants. Compensation may be available through judicial avenues for non-active duty research participants if they are injured through negligence (fault) of the Government.

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APPENDIX C: Diagnosis Inclusion Criteria

APPENDIX C: Diagnosis Inclusion Criteria Decision Matrix

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
008.8	INTEST. INF. DUE TO OTH ORGANISM, NOT ELSEWHERE CL				X
034.0	STREPTOCOCCAL SORE THROAT				X
042	HUMAN IMMUNODEFICIENCY VIRUS (HIV) DISEASE				X
053.9	HERPES ZOSTER W/O MENTION OF COMPLICATION				X
070.30	VIRAL HEPATITIS B W/OUT MENTION OF HEPATIC COMA, A				X
070.41	ACUTE OR UNSPEC HEPATITIS C W/ HEPATIC COMA				X
070.54	CHRONIC HEPATITIS C W/O MENTION OF HEPATIC COMA				X
078.0	MOLLUSCUM CONTAGIOSUM				X
078.10	VIRAL WARTS, UNSPEC				X
078.11	CONDYLOMA ACUMINATUM				X
078.19	OTH SPEC VIRAL WARTS				X
079.99	UNSPEC VIRAL INFECTION				X
098.2	GONOCOCCAL INFECTION, CHRONIC, OF LOWER GENITOURIN				X
099.9	VENEREAL DISEASE, UNSPEC				X
110.1	DERMATOPHYTOSIS OF NAIL				X
110.3	DERMATOPHYTOSIS OF GROIN & PERIANAL AREA				X
110.4	DERMATOPHYTOSIS OF FOOT				X
110.9	DERMATOPHYTOSIS OF UNSPEC SITE				X
112.9	CANDIDIASIS OF UNSPEC SITE				X
133.8	OTH ACARIASIS				X
136.9	UNSPEC INFECTIOUS & PARASITIC DISEASES				X
174.9	MALIG NEOPLASM OF BREAST (FEMALE), UNSPEC				X
199.1	OTH MALIG NEOPLASM OF UNSPEC SITE				X
202.80	OTH MALIG LYMPHOMAS, UNSPEC SITE				X
214.9	LIPOMA, UNSPEC SITE				X
216.9	BENIGN NEOPLASM OF SKIN, SITE UNSPEC				X
238.2	NEOPLASM OF UNCERTAIN BEHAVIOR OF SKIN				X
240.9	GOITER, UNSPEC				X
241.0	NONTOXIC UNINODULAR GOITER				X
241.9	UNSPEC NONTOXIC NODULAR GOITER				X
244.9	UNSPEC ACQUIRED HYPOTHYROIDISM				X
252.1	HYPOPARATHYROIDISM				X
257.2	OTH TESTICULAR HYPOFUNCTION				X
258.9	POLYGLANDULAR DYSFUNCTION, UNSPEC				X
272.0	PURE HYPERCHOLESTEROLEMIA				X
276.5	VOLUME DEPLETION DISORDER				X
278.00	OBESITY, UNSPEC				X
285.9	ANEMIA, UNSPEC				X
291.9	UNSPEC ALCOHOLIC PSYCHOSIS			X	
292.9	UNSPEC DRUG-INDUCED MENTAL DISORDER			X	
296.10	MANIC AFFECT DIS, RECUR EPISODE, UNSPEC DEGREE			X	
296.20	MAJ DEPRESS AFFECT DIS, SINGLE EPISODE, UNSPEC DEG			X	
296.22	MAJ DEPRESS AFFECT DIS, SINGLE EPISODE, MODERATE D			X	
296.30	MAJ DEPRESS AFFECT DIS, RECUR EPISODE, UNSPEC DEGR			X	
296.50	BIPOLAR AFFECT DIS, DEPRESSED, UNSPEC DEGREE			X	
300.00	ANXIETY STATE, UNSPEC			X	
300.01	PANIC DISORDER			X	
300.4	NEUROTIC DEPRESSION			X	
300.81	SOMATIZATION DISORDER			X	
302.9	UNSPEC PSYCHOSEXUAL DISORDER			X	
303.00	ACUTE ALCOHOLIC INTOXICATION IN ALCOHOLISM, UNSPEC			X	
303.01	ACUTE ALCOHOLIC INTOXICATION IN ALCOHOLISM, CONTIN			X	
303.03	ACUTE ALCOHOLIC INTOXICATION IN ALCOHOLISM, IN REM			X	
303.90	OTH & UNSPEC ALCOHOL DEPENDENCE, UNSPEC DRINKING B			X	
303.91	OTH & UNSPEC ALCOHOL DEPENDENCE, CONTINUOUS DRINKI			X	
303.93	OTH & UNSPEC ALCOHOL DEPENDENCE, IN REMISSION			X	
304.31	CANNABIS DEPENDENCE, CONTINUOUS USE			X	
305.00	ALCOHOL ABUSE, UNSPEC DRINKING BEHAVIOR			X	
305.02	ALCOHOL ABUSE, EPISODIC DRINKING BEHAVIOR			X	
305.1	TOBACCO USE DISORDER			X	
305.22	CANNABIS ABUSE, EPISODIC USE			X	
305.60	COCAINE ABUSE, UNSPEC USE			X	
305.62	COCAINE ABUSE, EPISODIC USE			X	
305.92	OTH, MIXED, OR UNSPEC DRUG ABUSE, EPISODIC USE			X	
307.51	BULIMIA			X	
307.80	PSYCHOGENIC PAIN, SITE UNSPEC			X	
307.81	TENSION HEADACHE			X	

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
307.89	OTH PSYCHALGIA			X	
308.3	OTH ACUTE REACTIONS TO STRESS			X	
309.0	ADJUSTMENT REACTION W/ BRIEF DEPRESSIVE REACTION			X	
309.28	ADJUSTMENT REACTION W/ MIXED EMOTIONAL FEATURES			X	
309.29	OTH ADJUSTMENT REACTIONS W/ PREDOMINANT DISTURBANC			X	
309.81	PROLONGED POSTTRAUMATIC STRESS DISORDER			X	
311	DEPRESSIVE DISORDER, NOT ELSEWHERE CLASSIFIED			X	
316	PSYCHIC FACTORS ASSOCIATED W/ DISEASES CLASSIFIED			X	
340	MULTIPLE SCLEROSIS				X
345.10	GENERALIZED CONVULSIVE EPILEPSY, W/O MENTION OF IN				X
346.00	CLASSICAL MIGRAINE W/O MENTION OF INTRACTABLE MIGR				X
346.90	MIGRAINE, UNSPEC W/O MENTION OF INTRACTABLE MIGRAI				X
351.0	BELLS PALSY				X
353.6	PHANTOM LIMB (SYNDROME)				X
354.0	CARPAL TUNNEL SYNDROME				X
355.6	LESION OF PLANTAR NERVE				X
355.8	MONONEURITIS OF LOWER LIMB, UNSPEC				XX
357.9	UNSPEC INFLAMMATORY & TOXIC NEUROPATHIES		X		
361.30	RETINAL DEFECT, UNSPEC				X
362.70	HEREDITARY RETINAL DYSTROPHY, UNSPEC				X
367.0	HYPERMETROPIA				X
367.1	MYOPIA				X
367.20	ASTIGMATISM, UNSPEC				X
367.4	PRESBYOPIA				X
367.9	UNSPEC DISORDER OF REFRACTION & ACCOMMODATION				X
368.03	REFRACTIVE AMBLYOPIA				X
368.8	OTH SPEC VISUAL DISTURBANCES				X
372.00	ACUTE CONJUNCTIVITIS, UNSPEC				X
372.30	CONJUNCTIVITIS, UNSPEC				X
374.05	TRICHIASIS OF EYELID W/O ENTROPION				X
378.10	EXOTROPIA, UNSPEC				X
379.21	VITREOUS DEGENERATION				X
380.4	IMPACTED CERUMEN				X
381.81	DYSFUNCTION OF EUSTACHIAN TUBE				X
382.9	UNSPEC OTITIS MEDIA				X
384.20	PERFORATION OF TYMPANIC MEMBRANE, UNSPEC				X
388.30	TINNITUS, UNSPEC				X
388.70	OTALGIA, UNSPEC				X
389.10	SENSORINEURAL HEARING LOSS, UNSPEC				X
401.1	BENIGN ESSENTIAL HYPERTENSION				X
401.9	UNSPEC ESSENTIAL HYPERTENSION				X
424.0	MITRAL VALVE DISORDERS				X
435.9	UNSPEC TRANSIENT CEREBRAL ISCHEMIA				X
448.9	OTH & UNSPEC CAPILLARY DISEASES				X
456.4	SCROTAL VARICES				X
459.9	UNSPEC CIRCULATORY SYSTEM DISORDER				X
461.9	ACUTE SINUSITIS, UNSPEC				X
462	ACUTE PHARYNGITIS				X
463	ACUTE TONSILLITIS				X
465.8	ACUTE UPPER RESPIRATORY INFECTIONS OF OTH MULTIPLE				X
465.9	ACUTE UPPER RESPIRATORY INFECTIONS OF UNSPEC SITE				X
466.0	ACUTE BRONCHITIS				X
470	DEVIATED NASAL SEPTUM				X
473.9	UNSPEC SINUSITIS (CHRON)				X
474.10	HYPERTROPHY OF TONSIL W/ ADENOIDS				X
477.0	ALLERGIC RHINITIS DUE TO POLLEN				X
477.9	ALLERGIC RHINITIS, CAUSE UNSPEC				X
478.29	OTH DISEASES OF PHARYNX OR NASOPHARYNX				X
490	BRONCHITIS, N/SPEC AS ACUTE OR CHRON				X
493.90	ASTHMA, UNSPEC TYPE, W/O MENT OF STATUS ASTHMATICU				X
496	CHRON AIRWAY OBSTRUCT, N/ELSEWHERE CLASSIFIED				X
520.1	SUPERNUMERARY TEETH				X
520.6	DISTURBANCES IN TOOTH ERUPTION				X
526.81	EXOSTOSIS OF JAW				X
529.9	UNSPEC CONDITION OF THE TONGUE				X
530.81	ESOPHAGEAL REFLUX				X
533.90	PEP ULC OF UNSP SITE, UNSP AS ACUTE OR CHRON, W/O				X
535.00	ACUTE GASTRITIS (W/O MENT OF HEMOR)				X
536.8	DYSPEPSIA & OTH SPEC DISORDERS OF FUNCTION OF STOM				X

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
550.00	UNILATERAL OR UNSPEC INGUINAL HERNIA, W/ GANGRENE				X
550.90	UNILATERAL OR UNSPEC INGUINAL HERNIA, W/O MENT OF				X
558.9	OTH & UNSPEC NONINFECTIOUS GASTROENTERITIS & COLIT				X
564.0	CONSTIPATION				X
564.1	IRRITABLE COLON				X
565.0	ANAL FISSURE				X
569.3	HEMOR OF RECTUM & ANUS				X
573.8	OTH SPEC DISORDERS OF LIVER				X
579.0	CELIAC DISEASE				X
588.9	UNSPEC DISORDER RESULTING FROM IMPAIRED RENAL FUNC				X
590.80	PYELONEPHRITIS, UNSPEC				X
592.0	CALCULUS OF KIDNEY				X
592.9	URINARY CALCULUS, UNSPEC				X
595.0	ACUTE CYSTITIS				X
599.0	URINARY TRACT INFECTION, SITE N/SPEC				X
599.7	HEMATURIA				X
604.90	ORCHITIS & EPIDIDYMITIS, UNSPEC				X
606.1	OLIGOSPERMIA				X
606.8	INFERTILITY DUE TO EXTRATESTICULAR CAUSES				X
606.9	MALE INFERTILITY, UNSPEC				X
608.9	UNSPEC DISORDER OF MALE GENITAL ORGANS				X
611.71	MASTODYNIA				X
616.10	VAGINITIS & VULVOVAGINITIS, UNSPEC				X
622.1	DYSPLASIA OF CERVIX (UTERI)				X
625.3	DYSMENORRHEA				X
625.6	STRESS INCONTINENCE, FEMALE				X
625.9	UNSPEC SYMPTOM ASSOCIATED W/ FEMALE GENITAL ORGANS				X
626.8	OTH DISORDERS OF MENSTRUATION & OTH ABNORMAL BLEED				X
626.9	UNSPEC DISORDERS OF MENSTRUATION & OTH ABNORMAL BL				X
628.9	INFERTILITY, FEMALE, OF UNSPEC ORIGIN				X
629.9	UNSPEC DISORDER OF FEMALE GENITAL ORGANS				X
681.11	ONYCHIA & PARONYCHIA OF TOE				X
682.6	CELLULITIS & ABSCESS OF LEG, EXCEPT FOOT				X
682.9	CELLULITIS & ABSCESS OF UNSPEC SITES				X
685.1	PILONIDAL CYST W/O MENT OF ABSCESS				X
686.9	UNSPEC LOCAL INFECTION OF SKIN & SUBCUTANEOUS TISS				X
692.9	CONTACT DERMATITIS & OTH ECZEMA, UNSPEC CAUSE				X
700	CORNS & CALLOSITIES				X
701.1	KERATODERMA, ACQUIRED				X
701.4	KELOID SCAR				X
702.19	OTH SEBORRHEIC KERATOSIS				X
703.0	INGROWING NAIL				X
704.01	ALOPECIA AREATA				X
704.1	HIRSUTISM				X
704.8	OTH SPEC DISEASES OF HAIR & HAIR FOLLICLES				X
706.0	ACNE VARIOLIFORMIS				X
706.1	OTH ACNE				X
706.2	SEBACEOUS CYST				X
706.8	OTH SPEC DISEASES OF SEBACEOUS GLANDS				X
709.2	SCAR CONDITIONS & FIBROSIS OF SKIN				X
709.9	UNSPEC DISORDER OF SKIN & SUBCUTANEOUS TISSUE				X
715.00	OSTEOARTHROSIS, GENERALIZED, INVOLVING UNSPEC SITE		X		
715.90	OSTEOARTHROSIS, UNSPEC WHETHER GENERALIZED OR LOCA		X		
715.91	OSTEOARTHROSIS, UNSPEC WHETHER GENERALIZED OR LOCA		X		
715.96	OSTEOARTHROSIS, UNSPEC WHETHER GENERALIZED OR LOCA		X		
715.97	OSTEOARTHROSIS, UNSPEC WHETHER GENERALIZED OR LOCA		X		
715.98	OSTEOARTHROSIS, UNSPEC WHETHER GENERALIZED OR LOCA		X		
716.90	UNSPEC ARTHROPATHY, SITE UNSPEC		X		
717.5	DERANGEMENT OF MENISCUS, N/ELSEWHERE CLASSIFIED				X
717.7	CHONDROMALACIA OF PATELLA				X
717.82	OLD DISRUPTION OF MEDIAL COLLATERAL LIGAMENT				X
717.9	UNSPEC INTERNAL DERANGEMENT OF KNEE				X
718.30	RECURRENT DISLOCATION OF JOINT, SITE UNSPEC				X
718.31	RECURRENT DISLOCATION OF JOINT OF SHOULDER REGION				X
718.48	CONTRACTURE OF JOINT OF OTH SPEC SITES				X
718.81	OTH JOINT DERANGEMENT, N/ELSEWHERE CLASSIFIED, INV				X
718.87	OTH JOINT DERANGEMENT, N/ELSEWHERE CLASSIFIED, INV				X
719.20	VILLONODULAR SYNOVITIS, SITE UNSPEC				XX
719.28	VILLONODULAR SYNOVITIS INVOLVING OTH SPEC SITES				XX

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
719.40	PAIN IN JOINT, SITE UNSPEC		X		
719.41	PAIN IN JOINT INVOLVING SHOULDER REGION				X
719.45	PAIN IN JOINT INVOLVING PELVIC REGION & THIGH		X		
719.46	PAIN IN JOINT INVOLVING LOWER LEG				X
719.47	PAIN IN JOINT INVOLVING ANKLE & FOOT				X
719.49	PAIN IN JOINT INVOLVING MULTIPLE SITES		X		
719.68	OTH SYMPTOMS REFERABLE TO JOINT OF OTH SPEC SITES		X		
719.70	DIFFICULTY IN WALKING INVOLVING JOINT, SITE UNSPEC		X		
719.86	OTH SPEC DISORDERS OF LOWER LEG JOINT				X
719.96	UNSPEC DISORDER OF LOWER LEG JOINT				X
720.2	SACROILIITIS, N/ELSEWHERE CLASSIFIED	X			
721.1	CERVICAL SPONDYLOSIS W/ MYELOPATHY	X			
721.3	LUMBOSACRAL SPONDYLOSIS W/O MYELOPATHY	X			
722.2	DISPLACEMENT OF INTERVERTEBRAL DISC, SITE UNSPEC,	X			
722.51	DEGENERATION OF THORACIC OR THORACOLUMBAR INTERVER	X			
722.83	POSTLAMINECTOMY SYNDROME OF LUMBAR REGION	X			
722.90	OTH & UNSPEC DISC DISORDER OF UNSPEC REGION	X			
723.0	SPINAL STENOSIS IN CERVICAL REGION	X			
723.1	CERVICALGIA	X			
723.4	BRACHIAL NEURITIS OR RADICULITIS NOS	X			
724.00	SPINAL STENOSIS OF UNSPEC REGION	X			
724.1	PAIN IN THORACIC SPINE	X			
724.2	LUMBAGO	X			
724.3	SCIATICA	X			
724.4	THORACIC OR LUMBOSACRAL NEURITIS OR RADICULITIS, U	X			
724.5	BACKACHE, UNSPEC	X			
724.6	DISORDERS OF SACRUM	X			
724.8	OTH SYMPTOMS REFERABLE TO BACK	X			
726.10	DISORDERS OF BURSAE & TENDONS IN SHOULDER REGION,				X
726.2	OTH AFFECTIONS OF SHOULDER REGION, N/ELSEWHERE CLA				X
726.32	LATERAL EPICONDYLITIS				X
726.60	ENTHESOPATHY OF KNEE, UNSPEC				X
726.61	PES ANSERINUS TENDINITIS OR BURSITIS				X
726.64	PATELLAR TENDINITIS				X
726.69	OTH ENTHESOPATHY OF KNEE				X
726.70	ENTHESOPATHY OF ANKLE & TARSUS, UNSPEC				X
726.71	ACHILLES BURSITIS OR TENDINITIS				X
726.79	OTH ENTHESOPATHY OF ANKLE & TARSUS				X
726.90	ENTHESOPATHY OF UNSPEC SITE		X		
726.91	EXOSTOSIS OF UNSPEC SITE		X		
727.00	SYNOVITIS & TENOSYNOVITIS, UNSPEC				X
727.04	RADIAL STYLOID TENOSYNOVITIS				X
727.1	BUNION				X
727.3	OTH BURSITIS DISORDERS				X
727.43	GANGLION, UNSPEC				X
727.9	UNSPEC DISORDER OF SYNOVIUM, TENDON, & BURSA				X
728.3	OTH SPECIFIC MUSCLE DISORDERS		X		
728.71	PLANTAR FASCIAL FIBROMATOSIS				X
728.85	SPASM OF MUSCLE		X		
729.1	MYALGIA & MYOSITIS, UNSPEC		X		
729.2	NEURALGIA, NEURITIS, & RADICULITIS, UNSPEC		X		
729.5	PAIN IN LIMB				XX
732.7	OSTEOCHONDRITIS DISSECANS				XX
733.10	PATHOLOGIC FRACTURE, UNSPEC SITE				X
733.19	PATHOLOGIC FRACTURE OF OTH SPEC SITE				X
733.6	TIETZES DISEASE				X
733.99	OTH DISORDERS OF BONE & CARTILAGE		X		
734	FLAT FOOT				X
735.2	HALLUX RIGIDUS				X
735.4	OTH HAMMER TOE (ACQUIRED)				X
736.1	MALLET FINGER				X
738.0	ACQUIRED DEFORMITY OF NOSE				X
739.1	NONALLOPATHIC LESIONS OF CERVICAL REGION, N/ELSEWH	X			
739.2	NONALLOPATHIC LESIONS OF THORACIC REGION, N/ELSEWH	X			
739.3	NONALLOPATHIC LESIONS OF LUMBAR REGION, N/ELSEWHER	X			
739.4	NONALLOPATHIC LESIONS OF SACRAL REGION, N/ELSEWHER	X			
739.6	NONALLOPATHIC LESIONS OF LOWER EXTREMITIES, N/ELSE		X		
745.4	VENTRICULAR SEPTAL DEFECT				X
754.61	CONGENITAL PES PLANUS				X

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
754.71	TALIPES CAVUS				X
756.11	CONGENITAL SPONDYLOLYSIS, LUMBOSACRAL REGION	X			
780.2	SYNCOPE & COLLAPSE				X
780.31	780.31				X
780.39	780.39				X
780.4	DIZZINESS & GIDDINESS				X
780.6	FEVER				X
780.7	MALAISE & FATIGUE				X
782.0	DISTURBANCE OF SKIN SENSATION				X
782.1	RASH & OTH NONSPECIFIC SKIN ERUPTION				X
783.2	ABNORMAL LOSS OF WEIGHT				X
784.0	HEADACHE				X
785.1	PALPITATIONS				X
785.6	ENLARGEMENT OF LYMPH NODES				X
786.09	OTH DYSPNEA & RESPIRATORY ABNORMALITY				X
786.50	UNSPEC CHEST PAIN				X
786.52	PAINFUL RESPIRATION				X
786.59	OTH CHEST PAIN				X
787.01	NAUSEA W/ VOMITING				X
787.02	NAUSEA ALONE				X
787.2	DYSPHAGIA				X
787.91	DIARRHEA				X
788.41	URINARY FREQUENCY				X
789.00	ABDOMINAL PAIN, UNSPEC SITE				X
790.4	NONSPECIFIC ELEVATION OF LEVELS OF TRANSAMINASE OR				X
795.5	NONSPECIFIC REACTION TO TUBERCULIN SKIN TEST W/O A				X
796.2	ELEVATED BLOOD PRESSURE READING W/O DIAGNOSIS OF H				X
799.8	OTH ILL-DEFINED CONDITIONS				X
799.9	OTH UNKNOWN & UNSPEC CAUSE OF MORBIDITY OR MORTALI				X
805.8	CLSD FRACT OF UNSPEC PART OF VERT COL W/O MENT OF				X
810.00	CLSD FRACT OF CLAVICLE, UNSPEC PART				X
813.42	OTH CLSD FRACTURES OF DISTAL END OF RADIUS (ALONE)				X
813.80	CLSD FRACT OF UNSPEC PART OF FOREARM				X
813.81	FRACT OF UNSPEC PART OF RADIUS (ALONE), CLSD				X
813.82	FRACT OF UNSPEC PART OF ULNA (ALONE), CLSD				X
814.00	CLSD FRACT OF CARPAL BONE, UNSPEC				X
814.01	CLSD FRACT OF NAVICULAR (SCAPHOID) BONE OF WRIST				X
815.00	CLSD FRACT OF METACARPAL BONE(S), SITE UNSPEC				X
816.00	CLSD FRACT OF PHALANX OR PHALANGES OF HAND, UNSPEC				X
817.0	MULT CLSD FRACTURES OF HAND BONES				X
817.1	MULT OPEN FRACTURES OF HAND BONES				X
823.00	CLSD FRACT OF UPPER END OF TIBIA				X
823.20	CLSD FRACT OF SHAFT OF TIBIA				X
823.80	CLSD FRACT OF UNSPEC PART OF TIBIA				X
823.81	CLSD FRACT OF UNSPEC PART OF FIBULA				X
824.8	UNSPEC FRACT OF ANKLE, CLSD				X
825.20	FRACT OF UNSPEC BONE(S) OF FOOT (EXCEPT TOES), CLS				X
825.25	FRACT OF METATARSAL BONE(S), CLSD				X
829.0	FRACT OF UNSPEC BONE, CLSD				X
831.04	CLSD DISLOCATION OF ACROMIOCLAVICULAR (JOINT)				X
834.00	CLSD DISLOCATION OF FINGER, UNSPEC PART				X
834.01	CLSD DISLOCATION OF METACARPOPHALANGEAL (JOINT)				X
834.02	CLSD DISLOCATION OF INTERPHALANGEAL (JOINT), HAND				X
836.1	TEAR OF LATERAL CARTILAGE OR MENISCUS OF KNEE, CUR				X
839.8	CLSD DISLOCATION, MULT & ILL-DEFINED SITES				X
840.4	ROTATOR CUFF (CAPSULE) SPRAIN				X
840.9	SPRAIN OF UNSPEC SITE OF SHOULDER & UPPER ARM				X
841.0	RADIAL COLLATERAL LIGAMENT SPRAIN				X
841.1	ULNAR COLLATERAL LIGAMENT SPRAIN				X
842.00	SPRAIN OF UNSPEC SITE OF WRIST				X
842.01	SPRAIN OF CARPAL (JOINT) OF WRIST				X
842.13	SPRAIN OF INTERPHALANGEAL (JOINT) OF HAND				X
843.9	SPRAIN OF UNSPEC SITE OF HIP & THIGH				X
844.1	SPRAIN OF MEDIAL COLLATERAL LIGAMENT OF KNEE				X
844.2	SPRAIN OF CRUCIATE LIGAMENT OF KNEE				X
844.9	SPRAIN OF UNSPEC SITE OF KNEE & LEG				X
845.00	UNSPEC SITE OF ANKLE SPRAIN				X
845.03	TIBIOFIBULAR (LIGAMENT) SPRAIN, DISTAL				X
845.09	OTH ANKLE SPRAIN				X

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
846.0	LUMBOSACRAL (JOINT) (LIGAMENT) SPRAIN	X			
847.0	NECK SPRAIN		X		
847.1	THORACIC SPRAIN	X			
847.2	LUMBAR SPRAIN	X			
848.8	OTH SPECIFIED SITES OF SPRAINS & STRAINS		X		
848.9	UNSPEC SITE OF SPRAIN & STRAIN		X		
850.9	CNCUS, UNSPEC				XX
854.00	INTCRAN INJ OF OTH & UNSPEC NATURE, W/O MENT OF OP				XX
854.05	INTCRAN INJ OF OTH & UNSPEC NATURE, W/O MENT OF OP				XX
873.0	OPEN WOUND OF SCALP, W/O MENT OF COMPLIC				X
873.40	OPEN WOUND OF FACE, UNSPEC SITE, UNCOMPLICATED				X
879.8	OPEN WOUND(S) (MULT) OF UNSPEC SITE(S), W/O MENT O				X
880.00	OPEN WOUND OF SHOULDER REGION, W/O MENT OF COMPLIC				X
883.0	OPEN WOUND OF FINGERS, W/O MENT OF COMPLIC				X
883.2	OPEN WOUND OF FINGERS, W/ TENDON INVOLVEMENT				X
892.0	OPEN WOUND OF FOOT EXCEPT TOE(S) ALONE, W/O MENT O				X
916.4	INSECT BITE, NONVENOMOUS, OF HIP, THIGH, LEG, & AN				X
917.2	BLISTER OF FOOT & TOE(S), W/O MENT OF INFECTION				X
918.1	SUPERFIC INJ OF CORNEA				X
919.4	INSECT BITE, NONVENOMOUS, OF OTH, MULT, & UNSPEC S				X
922.1	CNTUS OF CHEST WALL				X
924.3	CNTUS OF TOE				X
924.8	CNTUS OF MULT SITES, NOT ELSEWHERE CLASSIFIED		XX		
924.9	CNTUS OF UNSPEC SITE		XX		
931	FORGN BODY IN EAR				X
945.14	ERYTHEMA DUE TO BURN (1ST DEG) OF LOWER LEG				X
958.3	POSTTRAUMATIC WOUND INFECTION NOT ELSEWHERE CLASSI				X
991.3	FROSTBITE OF OTH & UNSPEC SITES				X
992.0	HEAT STROKE & SUNSTROKE				X
992.5	HEAT EXHAUSTION, UNSPEC				X
995.2	UNSPEC ADVERSE EFFECT OF DRUG, MEDICINAL & BIOLOGI				X
995.3	ALLERGY, UNSPEC, NOT ELSEWHERE CLASSIFIED				X
995.50	995.50				X
995.59	995.59				X
995.81	ADULT MALTREATMENT SYNDROME				X
996.70	OTH COMPLICATIONS DUE TO UNSPEC DEVICE, IMPLANT, &				X
V01.1	CONTACT W/ OR EXPOSURE TO TUBERCULOSIS				X
V01.6	CONTACT W/ OR EXPOSURE TO VENEREAL DISEASES				X
V01.7	CONTACT W/ OR EXPOSURE TO OTH VIRAL DISEASES				X
V03.1	NEED FOR PROPHYLC VACC W/ TYPHOID-PARATYPHOID (TAB				X
V04.0	NEED FOR PROPHYLC VACC & INOCUL AGAINST POLIOMYELI				X
V04.4	NEED FOR PROPHYLC VACC & INOCUL AGAINST YELLOW FEV				X
V04.8	NEED FOR PROPHYLC VACC & INOCUL AGAINST INFLUENZA				X
V05.3	NEED FOR PROPHYLC VACC & INOCUL AGAINST VIRALHEPAT				X
V06.4	NEED FOR PROPHYLC VACC W/ MEASLES-MUMPS-RUBELLA (M				X
V06.5	NEED FOR PROPHYLC VACC & INOCUL AGAINST TETANUS-DI				X
V06.9	NEED FOR PROPHYLC VACC W/ UNSPEC COMBINED VACCINE				X
V07.4	POSTMENOPAUSAL HORMONE REPLACEMENT THERAPY				X
V12.72	PERSONAL HISTORY OF COLONIC POLYPS				X
V15.85	PERSONAL HISTORY OF EXPOSURE TO POTENTIALLY HAZ BO				X
V15.9	UNSPEC PERSONAL HISTORY PRESENTING HAZARDS TO HEAL				X
V22.0	SUPERVISION OF NORMAL FIRST PREGNANCY				X
V22.1	SUPERVISION OF OTH NORMAL PREGNANCY				X
V22.2	PREGNANT STATE, INCIDENTAL				X
V25.01	GENERAL COUNSELING ON PRESCRIPTION OF ORAL CONTRAC				X
V25.09	OTH GENERAL COUNSELING & ADVICE ON CONTRACEPTIVE M				X
V25.2	STERILIZATION				X
V25.49	SURVEILLANCE OF OTH CONTRACEPTIVE METHOD				X
V26.0	TUBOPLASTY OR VASOPLASTY AFTER PREVIOUS STERILIZAT				X
V28.4	ANTENATAL SCREENING FOR FETAL GROWTH RETARDN USING				X
V45.89	OTH POSTSURGICAL STATUS		X		
V53.1	FITTING & ADJUSTMENT OF SPECTACLES & CONTACT LENSE				X
V53.7	FITTING & ADJUSTMENT OF ORTHOPEDIC DEVICES		X		
V54.0	AFTERCARE INVOLV REMOV OF FRACT PLATE OR OTH INT F		X		
V54.8	OTH ORTHOPEDIC AFTERCARE		X		
V54.9	UNSPEC ORTHOPEDIC AFTERCARE		X		
V57.0	CARE INVOLV BREATHING EXERCISES				X
V57.1	CARE INVOLV OTH PHYSICAL THERAPY		X		
V58.3	ATTENTION TO SURGICAL DRESSINGS & SUTURES		X		

Dx Code	Diagnosis	Bk Dx	Incl-NS w/Bk Dx	Incl-MH w/Bk Dx	Excl
V58.49	OTH SPEC AFTERCARE FOLLOWING SURGERY		X		
V61.0	FAMILY DISRUPTION			X	
V61.10	PARTNER RELATIONAL PROBLEM			X	
V61.20	PARENT-CHILD PROBLEM, UNSPEC			X	
V61.21	CHILD ABUSE			X	
V61.49	OTH HEALTH PROBLEMS WITHIN THE FAMILY				X
V62.2	OTH OCCUPATIONAL CIRCUMSTANCES OR MALADJUSTMENT			X	
V62.81	INTERPERSONAL PROBLEMS, NOT ELSEWHERE CLASSIFIED			X	
V62.82	BEREAVEMENT, UNCOMPLICATED				X
V62.9	UNSPEC PSYCHOSOCIAL CIRCUMSTANCE			X	
V65.3	DIETARY SURVEILLANCE & COUNSELING		X		
V65.40	OTH SPEC COUNSELING		X		
V65.41	EXERCISE COUNSELING		X		
V65.44	HUMAN IMMUNODEFICIENCY VIRUS (HIV) COUNSELING				X
V65.45	COUNSELING ON OTH SEXUALLY TRANSMITTED DISEASES				X
V65.49	OTH SPEC COUNSELING		X		
V65.5	PERSON W/ FEARED COMPLAINT IN WHOM NO DIAGNOSIS WA		X		
V65.9	UNSPEC REASON FOR CONSULTATION		X		
V67.0	FOLLOW-UP EXAMINATION FOLLOWING SURGERY		X		
V67.4	FOLLOW-UP EXAMINATION FOLLOWING TREATMENT OF FRACT		X		
V67.59	OTH FOLLOW-UP EXAMINATION		X		
V67.9	UNSPEC FOLLOW-UP EXAMINATION		X		
V68.0	ISSUE OF MEDICAL CERTIFICATES				X
V68.1	ISSUE OF REPEAT PRESCRIPTIONS		X		
V68.81	REFERRAL OF PATIENT W/O EXAMINATION OR TREATMENT		X		
V68.89	ENCOUNTERS FOR OTH SPEC ADMINISTRATIVE PURPOSE				X
V70.0	ROUTINE GENERAL MEDICAL EXAMINATION AT A HEALTH CA				X
V70.2	GENERAL PSYCHIATRIC EXAMINATION, OTH & UNSPEC			X	
V70.3	OTH GENERAL MEDICAL EXAMINATION FOR ADMINISTRATIVE		X		
V70.4	EXAMINATION FOR MEDICOLEGAL REASONS		X		
V70.5	HEALTH EXAMINATION OF DEFINED SUBPOPULATIONS				X
V71.09	OBSERVATION OF OTH SUSPECTED MENTAL CONDITION		X		
V71.8	OBSERVATION FOR OTH SPEC SUSPECTED CONDITIONS		X		
V71.9	OBSERVATION FOR UNSPEC SUSPECTED CONDITION		X		
V72.0	EXAMINATION OF EYES & VISION				X
V72.1	EXAMINATION OF EARS & HEARING				X
V72.2	DENTAL EXAMINATION				X
V72.3	GYNECOLOGICAL EXAMINATION				X
V72.4	PREGNANCY EXAMINATION OR TEST, PREGNANCY UNCONFIRM				X
V72.83	OTH SPEC PRE-OPERATIVE EXAMINATION		X		
V72.84	PRE-OPERATIVE EXAMINATION, UNSPEC		X		
V74.1	SCREENING EXAMINATION FOR PULMONARY TUBERCULOSIS				X
V74.5	SCREENING EXAMINATION FOR VENEREAL DISEASE				X
V76.10	V76.10				XX
V76.2	SCREENING FOR MALIGNANT NEOPLASMS OF THE CERVIX				X
V76.49	SCREENING FOR MALIGNANT NEOPLASMS OF OTH SITES				X
V80.0	SCREENING FOR NEUROLOGICAL CONDITIONS		X		
V81.1	SCREENING FOR HYPERTENSION				X
V82.8	SCREENING FOR OTH SPEC CONDITIONS		X		
V82.9	SCREENING FOR UNSPEC CONDITION		X		

APPENDIX D: CPT Code Inclusion Criteria

APPENDIX D: CPT Inclusion Decision Matrix

CPT	Procedure	Incl-NS w/ Bk Dx	Incl-MH w/ Bk Dx	Excl
11010	UNKNOWN CPT CODE			X
11042	CLEANSING OF SKIN/TISSUE			X
11101	BIOPSY, EACH ADDED LESION			X
20550	INJ TENDON/LIGAMENT/CYST	X		
20605	DRAIN/INJECT JOINT/BURSA	X		
20670	REMOVAL OF SUPPORT IMPLANT	X		
23455	REPAIR SHOULDER CAPSULE			X
29065	APPLICATION OF LONG ARM CAST			X
29075	APPLICATION OF FOREARM CAST			X
29125	APPLY FOREARM SPLINT			X
29405	APPLY SHORT LEG CAST			X
31231	NASAL ENDOSCOPY, DX			X
36000	PLACE NEEDLE IN VEIN			X
36415	DRAWING BLOOD			X
52204	CYSTOSCOPY			X
55250	REMOVAL OF SPERM DUCT(S)			X
57452	EXAMINATION OF VAGINA			X
58999	GENITAL SURGERY PROCEDURE			X
64550	APPLY NEUROSTIMULATOR	X		
65222	REMOVE FOREIGN BODY FROM EYE			X
69210	REMOVE IMPACTED EAR WAX			X
73620	X-RAY EXAM OF FOOT			X
74000	X-RAY EXAM OF ABDOMEN			X
74400	CONTRAST X-RAY URINARY TRACT			X
80059	HEPATITIS PANEL			X
81000	URINALYSIS, NONAUTO, W/SCOPE			X
82270	TEST FECES FOR BLOOD			X
83718	BLOOD LIPOPROTEIN ASSAY			X
86311	HIV ANTIGEN TEST			X
86580	TB INTRADERMAL TEST			X
86592	BLOOD SEROLOGY, QUALITATIVE			X
86631	CHLAMYDIA, ANTIBODY			X
86735	MUMPS			X
86762	RUBELLA			X
86765	RUBEOLA			X
87070	CULTURE SPECIMEN, BACTERIA			X
87072	CULTURE OF SPECIMEN BY KIT			X
87075	CULTURE SPECIMEN, BACTERIA			X
87101	SKIN FUNGUS CULTURE			X
87210	SMEAR, STAIN & INTERPRET			X
90714	TYPHOID IMMUNIZATION			X
90718	TD IMMUNIZATION			X
90724	INFLUENZA IMMUNIZATION			X
90730	HEPATITIS A VACCINE			X
90780	IV INFUSION THERAPY, 1 HOUR			X
90781	IV INFUSION, ADDITIONAL HOUR			X
90784	INJECTION (IV)			X
90801	PSYCHIATRIC INTERVIEW		X	
90825	EVALUATION OF TESTS/RECORDS	X		
90889	PREPARATION OF REPORT	X		
92015	REFRACTION			X
92070	FITTING OF CONTACT LENS			X
92225	SPECIAL EYE EXAM, INITIAL			X
92230	EYE EXAM WITH PHOTOS			X
92283	COLOR VISION EXAMINATION			X
92310	CONTACT LENS FITTING			X
92340	FITTING OF SPECTACLES			X

CPT	Procedure	Incl-NS	Incl-MH	Excl
92552	PURE TONE AUDIOMETRY, AIR			X
92556	SPEECH AUDIOMETRY, COMPLETE			X
92557	COMPREHENSIVE HEARING TEST			X
92567	TYMPANOMETRY			X
92568	ACOUSTIC REFLEX TESTING			X
93278	ECG/SIGNAL-AVERAGED			X
93307	ECHO EXAM OF HEART			X
93320	DOPPLER ECHO EXAM, HEART			X
93770	MEASURE VENOUS PRESSURE			X
94010	BREATHING CAPACITY TEST			X
94060	EVALUATION OF WHEEZING			X
94200	LUNG FUNCTION TEST (MBC/MVV)			X
94375	RESPIRATORY FLOW VOLUME LOOP			X
94664	AEROSOL OR VAPOR INHALATIONS			X
95831	LIMB MUSCLE TESTING, MANUAL	X		
95832	HAND MUSCLE TESTING, MANUAL			X
95851	RANGE OF MOTION MEASUREMENTS	X		
95852	RANGE OF MOTION MEASUREMENTS	X		
95860	MUSCLE TEST, ONE LIMB	X		
95900	MOTOR NERVE CONDUCTION TEST	X		
95904	SENSE NERVE CONDUCTION TEST	X		
97001	UNKNOWN CPT CODE			?
97010	HOT OR COLD PACKS THERAPY	X		
97014	ELECTRIC STIMULATION THERAPY	X		
97016	VASOPNEUMATIC DEVICE THERAPY	X		
97018	PARAFFIN BATH THERAPY	X		
97022	WHIRLPOOL THERAPY	X		
97032	ELECTRICAL STIMULATION	X		
97033	ELECTRIC CURRENT THERAPY	X		
97035	ULTRASOUND THERAPY	X		
97039	PHYSICAL THERAPY TREATMENT	X		
97110	THERAPEUTIC EXERCISES	X		
97112	NEUROMUSCULAR REEDUCATION	X		
97116	GAIT TRAINING THERAPY	X		
97250	MYOFASCIAL RELEASE	X		
97260	REGIONAL MANIPULATION	X		
97265	JOINT MOBILIZATION	X		
97530	THERAPEUTIC ACTIVITIES	X		
97750	PHYSICAL PERFORMANCE TEST	X		
97799	PHYSICAL MEDICINE PROCEDURE	X		
99000	SPECIMEN HANDLING			X
99070	SPECIAL SUPPLIES	?		
99071	PATIENT EDUCATION MATERIALS	X		

APPENDIX E: Third Party Payer Reimbursement Rates

APPENDIX E: Third Party Payer Reimbursement Rates, FY-1998

MEDICAL AND DENTAL SERVICES
FISCAL YEAR 1998

The FY 1998 Department of Defense (DoD) reimbursement rates for inpatient, outpatient, and other services are provided in accordance with Section 1095 of title 10, United States Code. Due to size, the sections containing the Drug Reimbursement Rates (Section III.D) and the rates for Ancillary Services Requested by Outside Providers (Section III.E) are not included in this package. The Office of the Assistant Secretary of Defense (Health Affairs) will provide these rates upon request (see Tab N for the point of contact). The medical and dental service rates in this package (including the rates for ancillary services, prescription drugs or other procedures requested by outside providers) are effective October 1, 1997.

OUTPATIENT RATES AND CHARGES

II. OUTPATIENT RATES 1/ 2/

Per Visit

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
	A. Medical Care			
BAA	Internal Medicine	$105.00	$195.00	$208.00
BAB	Allergy	39.00	73.00	78.00
BAC	Cardiology	81.00	150.00	160.00
BAE	Diabetic	44.00	82.00	87.00
BAF	Endocrinology (Metabolism)	85.00	158.00	168.00
BAG	Gastroenterology	110.00	203.00	216.00
BAH	Hematology	145.00	269.00	287.00
BAI	Hypertension	81.00	149.00	159.00
BAJ	Nephrology	171.00	317.00	338.00
BAK	Neurology	109.00	202.00	215.00
BAL	Outpatient Nutrition	34.00	63.00	67.00
BAM	Oncology	114.00	211.00	225.00
BAN	Pulmonary Disease	141.00	260.00	278.00
BAO	Rheumatology	84.00	156.00	166.00
BAP	Dermatology	63.00	117.00	124.00
BAQ	Infectious Disease	141.00	260.00	278.00
BAR	Physical Medicine	78.00	145.00	155.00
BAS	Radiation Therapy	72.00	132.00	141.00

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
BAZ	Medical Care Not Elsewhere Classified (NEC)	84.00	156.00	166.00
	B. Surgical Care			
BBA	General Surgery	$119.00	$220.00	$235.00
BBB	Cardiovascular and Thoracic Surgery	110.00	203.00	216.00
BBC	Neurosurgery	137.00	253.00	270.00
BBD	Ophthalmology	84.00	155.00	166.00
BBE	Organ Transplant	191.00	353.00	376.00
BBF	Otolaryngology	88.00	162.00	173.00
BBG	Plastic Surgery	100.00	184.00	196.00
BBH	Proctology	67.00	124.00	132.00
BBI	Urology	101.00	187.00	199.00
BBJ	Pediatric Surgery	89.00	164.00	175.00
BBZ	Surgical Care NEC	65.00	120.00	127.00
	C. Obstetrical and Gynecological (OB-GYN) Care			
BCA	Family Planning	$45.00	$83.00	$89.00
BCB	Gynecology	74.00	136.00	146.00
BCC	Obstetrics	68.00	126.00	135.00
BCZ	OB-GYN Care NEC	112.00	207.00	221.00
	D. Pediatric Care			
BDA	Pediatric	$54.00	$100.00	$106.00
BDB	Adolescent	55.00	101.00	108.00
BDC	Well Baby	36.00	66.00	70.00
BDZ	Pediatric Care NEC	64.00	119.00	126.00
	E. Orthopaedic Care			
BEA	Orthopaedic	$83.00	$153.00	$164.00
BEB	Cast	45.00	82.00	88.00
BEC	Hand Surgery	38.00	70.00	75.00
BEE	Orthotic Laboratory	59.00	110.00	117.00

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
BEF	Podiatry	49.00	91.00	97.00
BEZ	Chiropractic	21.00	38.00	40.00
	F. Psychiatric and/or Mental Health Care			
BFA	Psychiatry	$97.00	$179.00	$191.00
BFB	Psychology	71.00	132.00	141.00
BFC	Child Guidance	59.00	109.00	117.00
BFD	Mental Health	80.00	147.00	157.00
BFE	Social Work	80.00	149.00	159.00
BFF	Substance Abuse	62.00	115.00	123.00
	G. Family Practice/Primary Medical Care			
BGA	Family Practice	$67.00	$124.00	$132.00
BHA	Primary Care	64.00	118.00	126.00
BHB	Medical Examination	$59.00	$109.00	$117.00
BHC	Optometry	42.00	77.00	82.00
BHD	Audiology	30.00	55.00	58.00
BHE	Speech Pathology	81.00	149.00	159.00
BHF	Community Health	41.00	75.00	80.00
BHG	Occupational Health	59.00	108.00	115.00
BHH	TRICARE Outpatient	42.00	78.00	83.00
BHI	Immediate Care	82.00	152.00	162.00
BHZ	Primary Care NEC	43.00	79.00	84.00
	H. Emergency Medical Care			
BIA	Emergency Medical	$107.00	$198.00	$211.00
	I. Flight Medical Care			
BJA	Flight Medicine	$85.00	$157.00	$167.00
	J. Underseas Medical Care			
BKA	Underseas Medicine	$32.00	$58.00	$62.00

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
	K. Rehabilitative Services			
BLA	Physical Therapy	$29.00	$54.00	$57.00
BLB	Occupational Therapy	53.00	98.00	104.00

I. Ambulance Rate 14/

Per Visit

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
FEA	Ambulance	$32.00	$60.00	$64.00

J. Laboratory and Radiology Services Requested by an Outside Provider 8/

Per Procedure

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
	Laboratory procedures requested by an outside provider CPT-4 Weight Multiplier	$9.00	$13.00	$14.00
	Radiology procedures requested by an outside provider CPT-4 Weight Multiplier	23.00	35.00	37.00

K. AirEvac Rate 15/

Per Visit

MEPRS Code 4/	Clinical Service	International Military Education & Training (IMET)	Interagency & Other Federal Agency Sponsored Patients	Other (Full/ Third Party)
	AirEvac Services - Ambulatory	$113.00	$209.00	$223.00
	AirEvac Services - Litter	323.00	598.00	638.00

NOTES ON REIMBURSABLE RATES:

1/ Percentages can be applied when preparing bills for both inpatient and outpatient services. Pursuant to the provisions of 10 U.S.C. 1095, the inpatient Diagnosis Related Groups and inpatient per diem percentages are 96 percent hospital and 4 percent professional charges. The outpatient per visit percentages are 88 percent outpatient services and 12 percent professional charges.

2/ DoD civilian employees located in overseas areas shall be rendered a bill when services are performed. Payment is due 60 days from the date of the bill.

3/ The cost per Diagnosis Related Group (DRG) is based on the inpatient full reimbursement rate per hospital discharge, weighted to reflect the intensity of the principal and secondary diagnoses, surgical procedures, and patient demographics involved. The adjusted standardized amounts (ASA) per Relative Weighted Product (RWP) for use in the direct care system is comparable to procedures used by the Health Care Financing Administration (HCFA) and the Civilian Health and Medical Program for the Uniformed Services (CHAMPUS). These expenses include all direct care expenses associated with direct patient care. The average cost per RWP for large urban, other urban/rural, and overseas will be published annually as an adjusted standardized amount (ASA) and will include the cost of inpatient professional services. The DRG rates will apply to reimbursement from all sources, not just third party payers.

4/ The Medical Expense and Performance Reporting System (MEPRS) code is a three digit code which defines the summary account and the subaccount within a functional category in the DoD medical system. MEPRS codes are used to ensure that consistent expense and operating performance data is reported in the DoD military medical system. An example of the MEPRS hierarchical arrangement follows:

	MEPRS CODE
Outpatient Care (Functional Category)	B
Medical Care (Summary Account)	BA
Internal Medicine (Subaccount)	BAA

5/ Hyperbaric services charges shall be based on hours of service in 15 minute increments. The rates listed in Section III.B. are for 60 minutes or 1 hour of service. Providers shall calculate the charges based on the number of hours (and/or fractions of an hour) of service. Fractions of an hour shall be rounded to the next 15 minute increment (e.g., 31 minutes shall be charged as 45 minutes).

6/ Ambulatory procedure visit is defined in DOD Instruction 6025.8, "Ambulatory Procedure Visit (APV)," dated September 23, 1996, as immediate (day of procedure) pre-procedure and immediate post-procedure care requiring an unusual degree of intensity and provided in an ambulatory procedure unit (APU). Care is required in the facility for less than 24 hours. This rate is also used for elective cosmetic surgery performed in an APU.

7/ Prescription services requested by outside providers (e.g., physicians or dentists) are relevant to the Third Party Collection Program. Third party payers (such as insurance companies) shall be billed for prescription services when beneficiaries who have medical insurance obtain medications from a Military Treatment Facility (MTF) that are prescribed by providers external to the MTF. Eligible beneficiaries (family members or retirees with medical insurance) are not personally liable for this cost and shall not be billed by the MTF. Medical Services Account (MSA) patients, who are not beneficiaries as defined in 10 U.S.C. 1074 and 1076, are charged at the "Other" rate if they are seen by an outside provider and only come to the MTF for prescription services. The standard cost of medications ordered by an outside provider includes the cost of the drugs plus a dispensing fee per prescription. The prescription cost is calculated by multiplying the number of units (e.g., tablets or capsules) by the unit cost and adding a $5.00 dispensing fee per prescription. The final rule at 32 CFR Part 220, estimated to be published October 1, 1997, will eliminate the dollar threshold for high cost ancillary services (by changing the threshold from $25 to $0) and the associated term "high cost ancillary service." In anticipation of that change, the phrase "high cost ancillary service" has been replaced with the phrase "ancillary services requested by an outside provider." The elimination of the threshold also eliminates the bundling of costs whereby a patient is billed if the total cost of ancillary services in a day (defined as 0001 hours to 2400 hours) exceeded $25.00.

8/ Charges for ancillary services requested by an outside provider (physicians, dentists, etc.) are relevant to the Third Party Collection Program. Third party payers (such as insurance companies) shall be billed for ancillary services when beneficiaries who have medical insurance obtain services from the MTF that are prescribed by providers external to the MTF. Laboratory and Radiology procedure costs are calculated using the Physicians' Current Procedural Terminology (CPT)-4 Report weight multiplied by either the laboratory or radiology multiplier (Section III.J). Eligible beneficiaries (family members or retirees with medical insurance) are not personally liable for this cost and shall not be billed by the MTF. MSA patients, who are not beneficiaries as defined by 10 U.S.C. 1074 and 1076, are charged at the "Other" rate if they are seen by an outside provider and only come to the MTF for services. The final rule at 32 CFR Part 220, estimated to be published October 1, 1997, will eliminate the dollar threshold for high cost ancillary services (by changing the threshold from $25 to $0) and the associated term "high cost ancillary service." In anticipation of that change, the phrase "high cost ancillary service" has been replaced with the phrase "ancillary services requested by an outside provider." The

elimination of the threshold also eliminates the bundling of costs whereby a patient is billed if the total cost of ancillary services in a day (defined as 0001 hours to 2400 hours) exceeded $25.00.

9/ The attending physician is to complete the CPT-4 code to indicate the appropriate procedure followed during cosmetic surgery. The appropriate rate will be applied depending on the treatment modality of the patient: ambulatory procedure visit, outpatient clinic visit or inpatient surgical care services.

10/ Family members of active duty personnel, retirees and their family members, and survivors shall be charged elective cosmetic surgery rates. Elective cosmetic surgery procedure information is contained in Section III.G. The patient shall be charged the rate as specified in the FY 1998 reimbursable rates for an episode of care. The charges for elective cosmetic surgery are at the full reimbursement rate (designated as the "Other" rate) for inpatient per diem surgical care services in Section I.B., ambulatory procedure visits as contained in Section III.C, or the appropriate outpatient clinic rate in Sections II.A-K. The patient is responsible for the cost of the implant(s) and the prescribed cosmetic surgery rate. (Note: The implants and procedures used for the augmentation mammaplasty are in compliance with Federal Drug Administration guidelines.)

11/ Each regional lipectomy shall carry a separate charge. Regions include head and neck, abdomen, flanks, and hips.

12/ These procedures are inclusive in the minor skin lesions. However, CHAMPUS separates them as noted here. All charges shall be for the entire treatment, regardless of the number of visits required.

13/ Dental service rates are based on a dental rate multiplier times the American Dental Association (ADA) code and the DoD established weight for that code.

14/ Ambulance charges shall be based on hours of service in 15 minute increments. The rates listed in Section III.I are for 60 minutes or 1 hour of service. Providers shall calculate the charges based on the number of hours (and/or fractions of an hour) that the ambulance is logged out on a patient run. Fractions of an hour shall be rounded to the next 15 minute increment (e.g., 31 minutes shall be charged as 45 minutes).

15/ Air in-flight medical care reimbursement charges are determined by the status of the patient (ambulatory or litter) and are per patient. The charges are billed only by the Air Force Global Patient Movement Requirement Center (GPMRC).