To the Graduate Council:

I am submitting herewith a dissertation written by Lisa Marie Vogelsang entitled "The Relationship of Lifestyle Management to the Development of Carpal Tunnel Syndrome." I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Education.

Robert L. Williams
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We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Associate Vice Chancellor and
Dean of the Graduate School

THE RELATIONSHIP OF LIFESTYLE MANAGEMENT TO THE DEVELOPMENT OF CARPAL TUNNEL SYNDROME

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Lisa Marie Vogelsang

August 1992

DEDICATION

This dissertation and all the knowledge attained while obtaining the Ph.D. degree are dedicated to the giver of all knowledge and the source of all truth, my Lord and Savior, Jesus Christ, Yeshua Ha Mashiach, El Shaddai, God Almighty. "Thy Word is a lamp unto my feet and a light unto my path" (Psalms 119:105, ... from the greatest book of all time - God's Holy Word, the Bible).

ACKNOWLEDGMENTS

I would like to express my appreciation to all the members of my doctoral committee, Dr. Robert L. Williams as chairperson, Dr. Kathleen Lawler, Dr. Schuyler Huck and Dr. John Hungerford. Special thanks go to Dr. Hungerford for suggesting I look into logistic regression and especially to Dr. Williams for his patience, guidance, recommendations, and suggestions throughout the process. Dr. Williams has been a role model and continuing source of inspiration for the self-management that he has taught and practiced in his own life through the years. His timeliness and efforts towards the end were most appreciated.

I would also like to express special thanks to Paul Wright from the Department of Statistics, who gave unselfishly of his time checking my SAS programs, running special programs, and giving feedback on the results.

I would like to thank Gary Sanderson from CSUN for all the help that he and his staff gave for obtaining the subject pool from California. Thanks also go to all the companies that allowed the research to take place and to all the people who participated.

I want to especially thank Dollie Sauls for being my friend for all these years and for continuing to support and encourage me as well as lend a helping hand with scoring and typing for the dissertation. I also want to thank my other friends and church family at New Covenant Fellowship for their prayers and support, especially pastor Russ Porcella for being a man with integrity who listens to God and truly lives what he believes.

Special thanks go to my parents whose love has been appreciated throughout the years and especially to my mother, Lottie Gillig, without whose love and support I could not have made it. Finally, I want to thank God for giving me the grace and ability to do a lot of work in a short amount of time, who was and is "that ever-present help in time of need" (Psalms 46:1).

Abstract

The purpose of this study was to test the hypothesis that life event stress, perceived stress, and/or other psychological variables such as self-management and self-control are highly related to the development of Carpal Tunnel Syndrome (CTS) and may be important discriminating factors in CTS etiology. The subjects included 100 workers, 50 pairs, from the areas of automobile parts assembly, keyboard operation, electronic assembly, the garment industry, and interpreters for the deaf. The pairs were matched as closely as possible according to such physiological risk factors as age, sex, race, weight or general body size, job duties, and length of time on the job, with one worker having CTS and the other worker not having CTS.

The instruments used in the study were the Social Readjustment Rating Scale (SRRS), Perceived Stress Scale (PSS), the Life Style Approaches (LSA), the Self-Control Schedule (SCS), the Self-Control Questionnaire (SQ), the Cohen-Hoberman Inventory of Physical Symptoms (CHIPS), and the Lisa Vogelsang Inventory (LVI), an arbitrarily named inventory developed by the author to measure joint problems other than the wrist and specific medical problems previously identified as risk factors for CTS.

Logistic Regression was used to determine the differences between the two groups on the independent variables as well as to find the combination (model) of psychological variables that best predicts membership in the CTS and non-CTS groups. The results indicated that five out of the seven inventories (SRRS, PSS, LSA, CHIPS, and LVI) demonstrated significant differences between CTS and non-CTS subjects as single factor models to at least the $p<.05$ level. The SQ and SCS were not found to discriminate between the two groups/pairs as independent models.

The best model was a combination of the LSA, SRRS, and LVI, which was significant at the $p<.01$ level. The best model using only the psychological variables was the combination of the LSA and SRRS, which was significant at $p<.05$. Although there can be no statements of clear causality, the results of this present study may indicate that stressful life events and poor self-management skills, especially in the presence of current or past problems with other joints, are indeed highly discriminating factors in CTS etiology when other physical factors are relatively even. Further studies demonstrating a direct causal link between psychological variables (e.g., stressful life events and poor self- management) and CTS are recommended.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Carpal tunnel syndrome (CTS) is one of the top five injuries that plague industrial workers in the United States. It is a repetitive motion injury (RMI) that, according to the U.S. Department of Labor, accounts for about half of all reported occupational illnesses (cited in Cergol, 1991). Reported cases of repetitive motion injuries were five times greater in 1988 than in 1981. RMI affects workers in various fields such as the garment industry, meat cutting and packing industry, automotive and other mechanical assembly, electronics assembly, keyboard operators, and most recently, interpreters for the deaf (Cergol, 1991; Cohn, Lowry, & Hart, 1990; Meals, Payne, & Gaines, 1988; Sanderson, 1987; Stedt, 1989).

There are many factors involved in the etiology of CTS including both occupational and nonoccupational causes, but few researchers are looking toward the psychological end of the spectrum because they are involved in surgery, physical or occupational therapy, or other medically-oriented fields (Silverstein, Fine, & Armstrong, 1986). Most studies on the etiology of CTS focus on the physical causes of the malady,

and most prevention programs in turn focus on physical interventions. However, a few researchers have found psychological variables such as stress to be risk factors in the etiology of CTS (Arndt, 1987; Lutz & Hansford, 1987; Murphy & Hurrell, 1979).

Arndt (1987) postulated that worker reactions to external stressors may be an important factor in the explanation of why some workers develop CTS and some workers don't. Many studies have shown how piecework with production wage incentives and machine pacing is a major source of worker stress, possibly contributing to CTS and other upper-extremity, repetitive motion problems (Murphy & Hurrell, 1979). Stress-management techniques are known to reduce some physiological risk factors of CTS, and prevention exercises used intermittently during the work day have been shown to have both physiological and psychological benefit for employees (Lutz & Hansford, 1987). Yet no studies have tested whether stress alone can be a major discriminating factor when other physical risk factors are held constant.

We do not yet know how important psychological variables besides stress may be in the etiology of CTS. For example, the way individuals manage their daily lives may serve to prevent or set the stage for physical problems such as CTS. Seeman (1989) has demonstrated a strong relationship between personal mastery and health. Other

researchers have found that lifestyle organization is fundamentally related to physical and psychological health and that stress is often a by-product of poor planning and improper management of one's time and resources (Williams, Moore, Pettibone, & Thomas, in press). CTS may be one of many physical evidences of a poorly managed and highly stressed lifestyle.

Psychologists have recently become involved in preventive-health issues, such as the prevention of coronary heart disease (CHD). CHD prevention used to be considered only within the purview of the medical profession. If CHD is linked to psychological domains such as stress and hostility, perhaps CTS also may be linked to psychological variables.

The proposed study would test whether perceived stress and/or other psychological variables such as self-control and self-management play a role in the etiology of CTS and can help to explain why some people develop CTS and others do not. Thus, the present study is geared towards answering the following question(s): When physical variables don't account for CTS and non-CTS differences, do psychological factors help to account for those differences? If so, what combination of psychological factors best predicts membership in CTS and non-CTS groups?

Hypothesis

It is predicted that the selected psychological factors will partially account for the differences between the CTS and non-CTS groups/individuals. Specifically, it is predicted that CTS groups will have significantly higher levels of life event and perceived stress and significantly lower scores on self-control and self-management variables than non-CTS groups/individuals.

Assumptions

Current research has demonstrated that personal mastery and lifestyle organization have been related to improved physical and psychological health, and lack of such mastery and organization has resulted in stress for individuals (Seeman, 1989; Williams et al., in press). It is therefore assumed that the self-management and self-control variables as measured by the various inventories are another way of looking at the stress component, although in a less direct fashion.

Rationale

Stress has been suggested in the literature as one of many causal factors in the etiology of CTS, and some

articles have even suggested that stress may be a primary factor in CTS etiology (Arndt, 1987; Cergol, 1991; Lutz & Hansford, 1987; Murphy & Hurrell, 1979). Conversely, CTS will surely increase the stress in an individual's life. So in working with retrospective inventories, it is difficult to determine which came first, the stress or the CTS.

To overcome the above obstacle, the author selected several psychological measures that may be individually linked to stress but which should be minimally affected by CTS. Presumably, self-management and self-control variables are conceptually less affected by CTS than a more direct measure of stress. As a result, they are more likely to be seen as possible causal factors of CTS than a direct measure of stress.

Definition of Terms

Carpal Tunnel Syndrome (CTS)

CTS is a condition that occurs when too much pressure is placed on the median nerve in the wrist, causing pain, numbness, tingling, and/or neuropathy in the hands and fingers. The condition is so named because the median nerve and the tendons of the hand pass through a "tunnel" formed by the U-shaped cluster of carpal bones on one side and the transverse carpal ligament on the other.

Electromyography (EMG)

EMG measures the electrical signal from skin electrodes representing the amount of force exerted by the muscles being tested.

Ligament

Ligaments are the body structures that connect bone to bone.

Locus of Control (LOC)

Location or place where one perceives the control of the origin of events in one's life. People with internal LOC see themselves as responsible for events in life, and people with external LOC see powerful others or chance circumstances as responsible for events in life.

Neuropathy

Neuropathy is a general term denoting functional disturbances and pathological changes in the peripheral nervous system.

Self-efficacy

The belief in one's ability to perform whatever behaviors are necessary to achieve a particular goal.

Sprain

A sprain is the stretching or tearing of ligaments.

Strain

A strain is the over-stretching of muscles or tendons.

Stress

Stress is the perception that the demands of one's life are unpredictable, uncontrollable, and/or overloading.

Stressor

A stressor is a stimulus event (e.g., daily hassles, life change), whether positive or negative in valence, that can cause a bodily reaction or adaptation (physiological, cognitive, or behavioral).

Stress Response

A stress response is the bodily reaction or adaptation (physiological, cognitive, or behavioral) to a stressor. The physiologic aspect of the stress response activates the autonomic nervous system, which can elicit many different chemical and physiological reactions in the body (can be measured by EMG activity).

Tendon

Tendons are the body structures that connect muscles to bones.

Tendinitis

Tendinitis is the inflammation and swelling of tendons. It is usually caused by repeated, forceful strain.

Tenosynovitis

Tenosynovitis is the inflammation and swelling of the synovial (joint lining) of the tendons. It is usually caused by repeated, forceful strain.

Limitations

The sample of subjects used in the present study was limited to workers in the various industries in Los Angeles County, California and in Blount, Knox, and Sevier Counties, Tennessee who volunteered to participate. In all cases, permission was obtained first from the management and, when required, additional permission was obtained from union representatives. Any generalization of the results of this study is limited to workers who are likely to submit to filling out inventories upon request and who have permission from both management and union representatives, where applicable.

CHAPTER II

REVIEW OF LITERATURE

Physical Causes of CTS

As defined in the definition of terms, CTS occurs when too much pressure is placed on the median nerve in the wrist. A variety of conditions can contribute to this pressure on the median nerve in three basic ways: (a) by decreasing the cross-sectional area of the carpal canal (malaligned fracture, chronic trauma, arthritis, bone disease, increase in thickness of transverse carpal ligament, and congenital defects of the carpal canal), (b) by enlarging the median nerve itself (endoneurial edema, amyloid, mucopoly-sacharrides, neuroma of median nerve, and pseudoneuroma of median nerve), and/or (c) by increasing the volume of the contents of the carpal tunnel (tenosynovitis, tendinitis, granulomatous tenosynovitis, ganglion cysts, lipoma, calcium deposits, amyloid, aberrant artery, anomalous muscles, hematoma, fluid retention, increase growth of connective tissues, acromegaly, and venous distension) (Bleecker, 1987).

Although CTS is most commonly attributed to work factors, nonoccupational factors have also been implicated (Silverstein et al., 1986). Silverstein, Fine, and

Armstrong have enumerated six major occupational/physical factors that contribute to CTS:

> (a) repetitive movement of the wrists or fingers with loading of the tendons in the carpal tunnel, (b) forceful contractions of these tendons, (c) extreme flexion or extension of the wrist, pinching or other awkward postures, (d) mechanical stresses over the course of the median nerve in the hand, (e) exposure to vibration, and (f) use of poorly fitting gloves [from: pressure at the base of the palm or wrist and cold studies] (Silverstein et al., 1986, p. 213).

These six causes represent Silverstein et al.'s compiled list of ten specific physical contributors to CTS:

> ... hands held in fixed position over a prolonged period, repeated wrist and finger flexion, tight highly repetitive wrist and finger movement, repeated flexion or hyperextension of the wrist, repeated low grade trauma, pressure at the base of the palm or wrist, prolonged strenuous use of the hands, vibration, pinching or grasping, wrist ulnar deviation and flexion in repetitive tasks, and wrist extension with forceful pinch that were common in several major reference articles (Silverstein et al., 1986, p. 214).

The researchers contend that the data are insufficient to determine which of these factors is the most important cause

of CTS and that frequently workers have more than one of these factors operating at once.

Silverstein et al., (1986) also compiled and discussed a list of common and uncommon nonoccupational causes of CTS. The common nonoccupational causes included rheumatic conditions, Colles fracture, other trauma (e.g., sprains, strains), rheumatoid arthritis, pregnancy, hormonal agents including bilateral oophorectomy, and osteoarthritis. The uncommon nonoccupational causes listed were Paget's disease of the bone, neoplasms and multiple melanoma, gout, myxedema, acromegaly, and pyridoxine (B_6) deficiency.

Many of the jobs that are at risk for CTS and other RMI's are assembly jobs (e.g., automotive, electronic), sewing jobs (hand and machine sewing), keyboard operation (e.g., secretarial, data entry), meat-processing jobs (e.g., meat cutting, boning, and packing), and various other factory work that involves repetitive use of the hands and/or wrists. A field that has recently identified itself as having significant problems in the area of RMI's or CTS is interpreting for the deaf. Researchers from both the medical community and the field of deafness have described how interpreters for the deaf fall prey to RMI's such as CTS (Cergol, 1991; Cohn et al., 1990; Meals et al., 1988; Sanderson, 1987; Stedt, 1989). The motions of sign language involve ulnar deviation, wrist and finger flexion, and various pinching motions for both signing and

fingerspelling. Feuerstein and Fitzgerald (in press) analyzed the biomechanical features of sign interpreters. They found that those experiencing pain had more hand/wrist deviations from neutral, more exaggerated wrist positions, more rapid hand and finger movement, and fewer rest breaks.

While some deaf people and teachers who use sign language can be affected with CTS, interpreters for the deaf are by far the group of signers most affected according to the researchers. The reason is that deaf people and teachers using sign language can regulate the pace of their signing and take natural rest breaks, but interpreters are forced to keep up with the speaker. It is the forced pace of interpreting that put interpreters at such high risk. In one California survey, over 44% of the respondents had some form of overuse syndrome (Sanderson, 1987). Like many other jobs, such as sewing in the garment industry and assembly work in various industries, the field of interpreting for the deaf is primarily made up of women.

Many articles have suggested that women are at greater risk than their male counterparts in the work force because of anatomic, physiological, and ergonomic factors. However, many of these articles also suggest that the increased risk for women is small when compared to the risk of the forcefulness and repetitiveness of the work involved (Armstrong, Fine, Goldstein, Lifshitz, & Silverstein, 1987). Although much of the early research involved more women than

men with CTS because of the demographics of the work force, gender is still considered an important variable in assessing CTS risk.

Stress as a Factor in CTS Etiology

Recent evidence in the literature has identified stress as a major contributor to CTS, and there may be other important psychological factors that contribute to the problem as well. For example, Arndt (1987) asserts:

> Self-reported perceptions of work pressure and tension have been correlated with the incidence of hand and arm complaints among keyboard operators. Similar observations by others have led to contentions that mental or psychogenic factors may play an important role in the development of upper extremity complaints. . . . Individual reactions to stress may be an additional factor that can help to explain why some workers experience cumulative trauma injuries while others remain free of symptoms. The reaction to stress can be highly volatile and easily changed by the physical and psychosocial environment (Arndt, 1987, p. 869).

Altering the workplace environment to reduce worker stress is extremely important; several studies have

indicated that piecework with production-wage incentives and machine pacing is a major source of worker stress related to upper-extremity complaints (Arndt, 1987; Murphy & Hurrell, 1979).

Arndt (1987) devised an experiment that demonstrated that "stress" may be a major factor in the etiology of CTS. In his study, the author used electromyographic (EMG) data from involved muscles to determine the potential roles of work pace and work pressure (stress) as risk factors in the development of cumulative trauma disorders during highly repetitive tasks. Some workers were told to "speed up" and although no increase in actual pace was noted, there was a significant increase in the EMG activity in the muscles. Similarly, another worker was told to "slow down" and there was a decrease in EMG activity with no actual slowing down of work pace. It seems there were psychological factors affecting EMG activity, rather than the pace of activities per se. The author described how this stress may increase the incidence of cumulative trauma disorders:

> The observations described suggest that work pace may produce job pressures that lead to increased muscular tension in the hands and arms when repetitive work is performed. It is suggested that this could accelerate fatigue in the muscles used or increase the biomechanical stress on tendons, synovial membranes, joints, and nerves,

> thereby increasing the risk of musculoskeletal complaints and cumulative trauma disorders (Arndt, 1987, p. 868).

The author postulated further that while it was possible that the measured responses may have been indicative of a generalized response to stress, it was observed in several cases that only the muscles involved in the task were affected.

Other research that emphasized CTS prevention suggested that stress-prevention or stress-management was an important part of CTS prevention (Lutz & Hansford, 1987). Lutz and Hansford believed that appropriate exercise helped both physical and psychological dimensions and stated: "We now believe that exercises used intermittently during the work day have both physiologic and psychologic benefit for our employees" (Lutz & Hansford, 1987, p. 865).

Cergol (1991) discussed some epidemiological findings of CTS among academic interpreters for the deaf that point to job stress as the major factor in obtaining CTS or other repetitive motion injuries in interpreters. She discussed how deaf teachers who may use sign language for eight or more hours per day do not have much incidence of CTS, whereas interpreters who may only work four hours per day have a very high incidence rate (20% among academic interpreters at NTID). Interpreters must listen, process the information, and then translate it into sign language

simultaneously. Although other explanations are possible, Cergol postulated that the mental stress of the extra processing involved in interpreting led to greater muscle tension, which causes increased local blood pressure, reduced circulation, and increased pressure on local nerves such as the medial nerve in CTS. This increased muscle tension can therefore put one at greater risk for acquiring CTS and/or other repetitive motion injuries.

Although stress has been suggested in the literature as one of the factors related to the development of CTS, stress is a concept that is very difficult to define (for the definitions used in this manuscript, see the Definition of Terms in Chapter I). Arndt (1987, p. 869) refers to stress in two different contexts: first as "self-reported perceptions of work pressure" and then discusses "individual reactions to stress." Arndt is referring to stress both as a source (stimulus event) or "stressor" and also as a reaction to a stressor or stress response. Stressors represent the stimulus or event that requires some type of adaptation or adjustment. Feuerstein, Labbe and Kuczmierczyk (1986) define stress as follows:

> Stressors can be such external physical stimuli as heat, cold, crowding, loud noise, or interpersonal difficulties with a loved one or such internal stimuli as interoceptive stimuli (pain or cognitions including thoughts and feelings). Two

> important points can be made regarding stressors: (1) They may have positive as well as the more commonly assumed negative valence and (2) there is considerable variability as to what is considered a stressor across individuals. Positive events may require as much adjustment or adaptation as negative events. Simply because an event is associated with a negative consequence does not somehow identify it as a stressor. Positive experiences and their concomitant emotions can activate neurohumoral mechanisms characteristic of the stress response (p. 98).

These authors define the stress response as a rather complex reaction pattern that often has physiological, cognitive, and behavioral components. The physiologic aspect of the stress response activates the autonomic nervous system and elicits many physiological and chemical reactions in the body.

Although there are many different definitions of stress, most researchers agree that it is the perception or personal assessment of the stress or stressor that will trigger a stress response. Not everyone views the same events as potentially "stressful." However, some researchers have identified a number of general stressors such as in the life events identified by Holmes and Rahe (1967), which are events or situations in life that require

some form of adjustment. Holmes and Rahe's (1967) research indicated that the presence of many of these "life event" factors occurring within the same year often resulted in physical or even emotional illness in the individual. The life events one cannot control are more likely to produce illness than those events one can control. Williams and Long (1991a) suggest that when a number of uncontrollable events are occurring during a season of one's life (e.g., college years, new child in the home), one should try to avoid adding changes.

Other forms of "stressors" that have been shown to lead to physical and emotional illness are daily "hassles" (Lazarus, 1981). Research has established a strong relationship between daily "hassles" and such common health problems as the flu, sore throats, headaches, and even backaches (DeLongis, Folkman, & Lazarus, 1988). Lazarus suggests that one try to offset the negative effect of the hassles (e.g., having traffic problems, running late, having car trouble) with daily "uplifts" (e.g., eating out, visiting friends, completing a task, sleeping well). To balance those positive and negative effects, he suggests a two-to-one ratio of uplifts to hassles. Recently, many researchers have established a relationship with various forms of life events and physical manifestations, such as tension headaches, low back pain, and upper neck and shoulder pain (Adams, Feuerstein & Fowler, 1980; Feuerstein,

Bush, & Corbisiero, 1982; Feuerstein, Carter, & Papciak, 1987; Feuerstein, Sult, & Houle, 1985).

Do all stressful life events and hassles necessarily lead to illness? No. "People who manage their time well, who exercise on a regular basis, who eat nutritionally balanced meals, who minimize substance abuse, and who consistently get adequate rest greatly reduce the amount of stress in their lives" (Williams & Long, 1991a, p. 200). In other words, people who manage their lives in such a way as to promote their personal health are less likely to be adversely affected by major stressors and daily hassles than those who don't.

Others have asked whether there is a "hardy" personality that protects one against stress and stressors. Kobasa (1979) and colleagues answered that question with a series of studies looking at two groups of male managers who were identified as either high stress/high illness or high stress/low illness and were matched on many variables (e.g., income, stable family) (Kobasa, Hilker, & Maddi, 1979). A discriminant function analysis (similar to logistic regression) was done to see what combination of variables explained the differences between the groups. The variables included such measures as alienation from self, measures of perceived control, tendency to seek novelty and challenge, and endurance, which were all hypothesized to be associated with health. The results indicated that those in the high

stress/high illness group were more alienated from self than were the high stress/low illness subjects, who tended to believe they could control events in their environment, to show more endurance, to be more interested in novel experience, and to be more oriented towards goals and achievement. Commitment to self, sense of personal control, clear goals, and lack of intimidation by change seemed to distinguish these high stress/low illness or "hardy" subjects from their illness-prone peers.

These elements of hardiness relate to the concepts of self-efficacy and locus of control, which are the primary elements needed for effective self-management. Locus of control relates to the beliefs about who or what causes events in one's life to occur. One who believes that events and occurrences in life are related to one's own decisions and behaviors (controlled by self) have an "internal" locus of control. Those who believe that events and occurrences in life are controlled by chance or powerful others have an "external" locus of control. If individuals believe they can control outcomes in their life, they are more apt to attempt change. For example, if individuals have an internal locus of control and value health, they are more likely to participate in good health habits, because they can see the connection between their behavior or habits and health outcomes (Abella & Heslim, 1984).

High self-efficacy is the belief that one is capable of performing those behaviors that will lead to a good result or goal such as health. One can have an internal locus of control, but if he or she does not believe (s)he can change or perform the behavior leading to a good outcome, self-management is unlikely. Similarly, one who has an external locus of control will not attempt change because he or she believes those outcomes are controlled by chance or others and sees no relation between behavior and health. Those with high self-efficacy also tend to work longer and try more strategies to develop particular skills than those with low self-efficacy (Weinberg, 1986).

The self-management literature claims that adults are capable of self-directed change and that change can be explained from several different theoretical perspectives: behavioral, cognitive, developmental, and humanistic (Williams & Long, 1991a). The approach to change described in an earlier Williams and Long text (1983) requires a person to look at the important areas of life, set goals for each area, assess where one stands relative to those goals, and then to develop appropriate strategies for reaching those goals. The authors contend that the greatest challenge is to identify the individual internal variables and external environmental factors that can help facilitate attaining those goals. They believe it is necessary to

manipulate and arrange for internal and external events to occur to facilitate the desired behavior change.

Based on the hardiness and self-management literature, it would seem that self-management behavior may be somewhat enduring across time and situation. For instance, hardy executives maintained their self-management characteristics in the presence of extreme life event stress (Kobasa et al., 1979). Because of the stability of self-management practices, CTS would not likely cause a large disruption in one's life other than the normal disruption any injury would cause.

Selection of Variables for Matching Subjects

Some important matching variables have been mentioned in the section on the Physical Causes of CTS, such as the sex of the subject (Armstrong et al., 1987). Many other important variables can be inferred from a logical examination of the literature. Examples of such variables are age, which is important in relation to menopause and other medical conditions that put one at greater risk for CTS, and weight or general body size, which is important in relation to water retention problems and/or having excess fat press on the medial nerves in the wrist. Race is important because of fat distribution factors prevalent in different races (e.g., blacks tend to have less subcutaneous

fat than whites). Job duties and the length of time on one's job are also potential risk factors (Silverstein et al., 1986).

The six variables mentioned above (age, sex, race, weight or general body size, job duties, and length of time on the job) correspond well to the variables selected by Cannon, Bernacki, and Walter (1981) in their research on CTS. They also used other variables such as worker compensation status, history of diabetes mellitus, presence of hypertension, history of arthritis, history of hyperthyroidism, use of oral contraceptives, use of postmenopausal estrogens, and a history of gynecological surgery in their research. Although it was not practical to try to prematch CTS and non-CTS subjects on these variables, such factors have been identified in the literature as strongly related to CTS.

Although some articles have alluded to pyridoxine or vitamin B_6 deficiency as an important causal factor in the etiology of CTS (Folkers, Ellis, Watanabe, Saji, & Kaji, 1978; Ellis et al., 1979), the most current research downplays the importance of the deficiency in most cases (Amadio, 1987). Amadio demonstrated with a literature analysis and review that "There is currently no good scientific evidence to support pyridoxine deficiency as the cause of isolated carpal tunnel syndrome" (1987, p. 878). He suggested that further research would need to be done

such as with a prospective, controlled, randomized, and double-blind study with a large number of patients to be able to test the efficacy of pyridoxine in CTS treatment. Therefore, pyridoxine or vitamin B_6 deficiency will not be a variable on which to match subjects in the current study.

Summary

In summary, one can see from the literature review that workers in certain jobs (e.g., keyboard operators, automotive assemblers, electronic assemblers, garment industry workers, meat cutters, and interpreters for the deaf) are at risk for repetitive motion injuries such as CTS (Sanderson, 1987; Silverstein, 1986). Physiological risk factors were identified (e.g., job duties, the length of time on that job, age, sex, race, and general body size) as well as other specific medical conditions that increased CTS risk (e.g., hypertension, diabetes mellitus, arthritis, hyperthyroidism, use of oral contraceptives, use of post-menopausal estro-gens, and a history of gynecological surgery, especially oophorectomy) (Armstrong et al., 1987; Cannon et al., 1981). Stress has been reported as another factor related to CTS etiology (Arndt, 1987; Murphy & Hurrel, 1979). Poor self-management skills and lack of self-control have been related to a stressful lifestyle and

greater perceived stress (Williams et al., in press; Williams & Long, 1991a).

The question remains: why do some people obtain CTS and others do not when placed under the same working conditions with similar physical and medical risk factors? That is the basic question this study will try to help answer. It is postulated that when physiological and medical risk factors are relatively even, that stress (life event and perceived), self-management, and self-control variables can differentiate between CTS and non-CTS subjects.

A proposed model of the interrelationships between the psychological variables and membership in CTS or Non-CTS groups can be found in Figure 1. The primary factors hypothesized are the self-management and self-control factors that can help to moderate the factor of perceived stress. Low self-management and self-control, and high perceived stress are hypothesized to lead towards inclusion in the CTS group. Conversely, higher scores on self-management and self control, and lower perceived stress scores should lead towards inclusion in the Non-CTS group. Higher life event stress is hypothesized to lead towards inclusion in the CTS group, with some modifiability from self-management and self-control factors based on the literature review of "hardiness". Factors influence one another in both directions as indicated by straight lines.

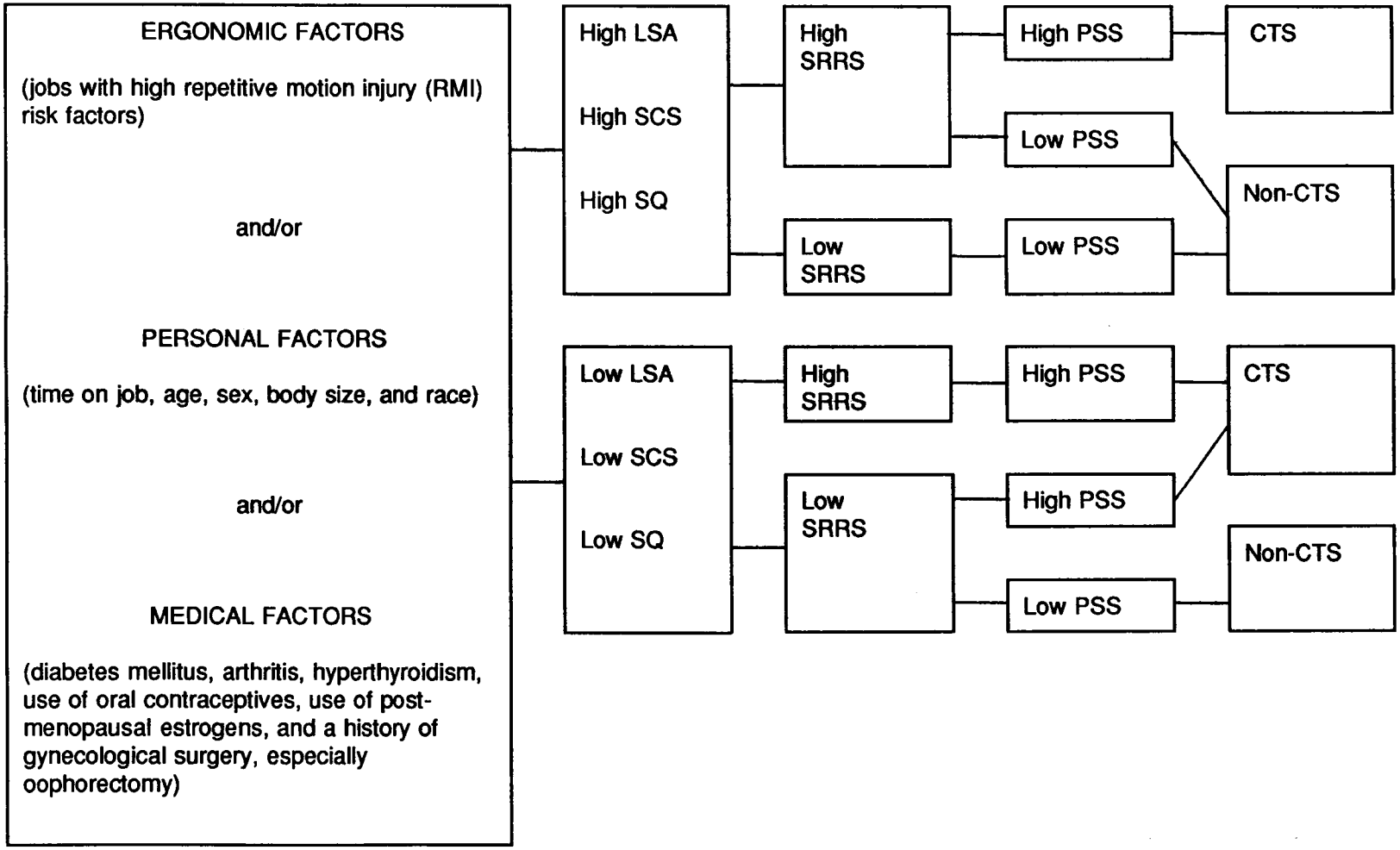


Figure 1. Hypothetical Model of Relationships of Psychological Variables Between CTS and Non-CTS Subjects.

CHAPTER III

METHODS

Subjects

The subjects tested in the study included automotive parts assembly workers, keyboard operators, electronics industry workers, garment industry workers from Blount, Knox, and Sevier Counties in Tennessee, and interpreters for the deaf from the National Center on Deafness at California State University, Northridge in California and from the Knoxville Tennessee Registry of Interpreters for the Deaf (KTRID) in Blount and Knox Counties, Tennessee who had CTS and others who did not have CTS.

The sample included current employees who were placed into pairs matched as closely as possible on selected criteria. Each pair was matched from the same industry and same job title and had similar physiological risk factors (e.g., age, sex, race, general body size or weight, job duties, and length of time on the job). One member of the pair had had CTS within the last two years and the other had not. There were fifty subjects with CTS matched to fifty subjects without CTS (see Appendix E). The CTS subjects were selected from Worker's Compensation and other records from each industry.

The other variables suggested by Cannon et al. (1981) (i.e., a history of diabetes, hypertension, arthritis, hyperthyroidism, gynecological surgery [especially oophorectomy], and use of oral contraceptives and estrogens) were identified in the inventories and were originally intended to be factored into the logistic regression separately. But, when the matched pairs were compared on these variables after completion of the inventories, there were more non-CTS subjects who had greater numbers of problems in these areas than did CTS subjects. Therefore, there was no need to factor these medical variables into the logistic regression separately, because none would have been selected into the model anyway. These special medical problems were combined with other health-related questions about joint problems other than the wrist and put into one inventory, the Lisa Vogelsang Inventory (LVI), which was originally designed for matching purposes.

Instrumentation

Social Readjustment Rating Scale

The Social Readjustment Rating Scale (SRRS) developed by Holmes and Rahe (1967) has been a standard in stress research for many years. The SRRS was developed to quantify life stress, emotional stress, and object loss into a cluster of social or life events in rank order of the

personal adjustment needed to deal with the events. The intent of the instrument was to more accurately predict the onset of illness when life events accumulate in a relatively short time span.

The original work of developing a consensus and relative order and magnitude produced high correlations (Pearson's) between the discrete groups in the sample. The magnitudes of the life events for each item were calculated for the entire sample. Groups were compared one with another in terms of the weightings they assigned to different life events. All correlation coefficients between the different groups were above 0.90 except for that between white and black subjects, which was 0.82. Kendall's coefficient of concordance (W) for the 394 U.S. Navy subjects was 0.477, significant at $p=<0.0005$. The inventory has been widely used, and similar life event magnitudes have emerged across cultures (Komaroff, Masuda & Holmes, 1968; Masuda & Holmes, 1967; Rahe, 1969; Rahe, Lundberg & Bennett, 1971).

The SRRS has been used in research to establish relationships between life events and physical and emotional illness and injury (Coddington, 1972; Feuerstein et al., 1987; Feuerstein et al., 1985; Paykel, 1974; Rahe, 1974). The format of the SRRS used in this study was the same as that used in Feuerstein et al.'s (1985) study on low back pain; that is, people responded to how many times each event

had occurred in the past two years and that was multiplied by the rating factor for a total score. A cap of ten was arbitrarily put on the number of occurrences of each life event to prevent outrageous scores. There were no data in the original articles or subsequent articles (one article used a simplified scaling method to compare the 1967 original data with data from a 1977 sample) that discussed test-retest reliability or internal consistency (Rahe, Ryman, & Ward, 1980).

Perceived Stress

The Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) (PSS) measures the degree to which respondents find their lives to be unpredictable, uncontrollable, and overloading. Health researchers say that the degree of stressfulness is, to some degree, determined by one's perceptions of his/her stressfulness. The variables of unpredictability, uncontrollability, and overloadedness have been found to be central components of the experience of stress according to the researchers. Scores on this scale have been shown to be negatively correlated with self-management, life satisfaction, self-efficacy, health habits, health status, optimism, and purpose in life and positively correlated with total anger, anger-in, anger-out, and anger symptoms (Williams & Long, 1991b).

Test-retest reliability for the PSS was .84 and .85. for the two college student samples and .86 for a smoking cessation sample (mean age of 38.4 years). Internal consistency coefficient alphas for the three original samples ranged from .84 to .86. The PSS also has strong criterion-related validity and is therefore considered a good measure of perceived stress.

Self-Control Schedule

The Self-Control Schedule (SCS) (Rosenbaum, 1980) measures the tendency to apply self-control strategies to behavioral problems. Several factors are included under one total score for the inventory: a) the use of cognitive strategies to control physiological and emotional sensations, b) the tendency to use problem-solving, c) the perceived ability to delay gratification and d) general expectation of self-efficacy (Rosenbaum, 1980). The self-control strategies are aimed at maintaining specific behaviors in the absence of immediate external support.

Test-retest reliability for the SCS was found to be .86 ($p<.01$) using undergraduate engineering students at Haifa University in Israel. Kuder-Richardson Formula 20 alpha coefficients ranged from .78 to .84 across different samples (i.e., college students and non-students from Israel and the U.S.A.), indicating strong internal consistency. Concurrent, criterion, and construct validity were quite strong. The SCS correlated -.40 ($p<.01$) with Rotter's I-E

scale (a high Rotter score indicates external locus of control), -.48 with the Irrational Beliefs Test, .30 ($p<.001$) with the G Factor of the 16 PF (the G Factor is assumed to measure self-control as a personality trait) (Rosenbaum, 1980).

Self-Control Questionnaire

The Self-Control Questionnaire (SQ) (Brandon, Oescher, & Loftin, 1990) was developed to operationalize self-control in several different areas. Self-control issues are very much related to self-responsibility and health-related behavioral decision-making according to the authors of the instrument. The authors believe that self-control is highly related to self-management from either a behavioral or cognitive perspective. They also believe that through therapeutic manipulation of self-efficacy, self-control can be learned.

Five factors emerged from the factor analysis of this instrument: weight control, time management, emotional control, financial planning, and social behavior. Reliability as measured by Cronbach's alpha was 0.80 for the undergraduate and graduate college student sample. Likert's Criterion of Internal Consistency coefficients for the items ranged from 0.37 to 0.65 ($p<.001$). Criterion and construct validity were also rated highly on this instrument as evidenced by a moderate correlation of .33 ($p<.001$) between the SQ and the Self-Control Subscales of the California

Personality Inventory (CPI-SC) and with a measure of fitness level (.42).

Life Style Approaches

The Life Style Approaches (LSA) (Williams et al., in press) was originally developed to assess the application of self-management strategies that individuals can use to improve both physical and psychological health. The factor analysis and validation assessment led to the inclusion of four factors in the final version of the instrument: performance focus and efficiency, goal directedness, timeliness of task accomplishment, and organization of physical space.

The performance focus and efficiency factor reflects self-reported ability to judge what is important to do and then to concentrate on the task until its completion. Goal directedness assesses people's perceptions of whether their actions or behaviors are guided by clearly defined priorities and goals. Timeliness of task accomplishment is the self-reported tendency to start and work through tasks in a timely fashion. Organization of physical space indicates how well organized, clean, and attractive people reportedly keep their work and living space.

The LSA was positively correlated with self-efficacy, life satisfaction, purpose in life, health status, and health habits with r's ranging from .18 to .67 ($p<.0001$). Conversely, it was negatively correlated with an external

locus of control (-.17) and perceived stress (-.47, $p<.0001$). The variable most strongly related to the LSA was self-efficacy. The authors stated that believing one can perform the cognitive or behavioral operations needed for self-management is highly related to the self-reported performance of self-management tasks. The internal consistency coefficients using Cronbach's alphas were high, ranging from .64 to .71 for the four factors. The test-retest reliability of the four factors ranged from r=.65 to r=.90, with the composite LSA score at r=.90 across college student and non-student samples. The convergent validity of the LSA was determined through comparisons with the SCS and SQ. Although all factors of all the inventories were interrelated, the total scores on the SCS and SQ yielded the highest correlations with the LSA total (i.e., r=.68 with the SCS and r=.69 with the SQ). Although the older 22-item version of the instrument was used in the inventory packets, the total LSA score was based on the total of the four factors included in the 16-item final version of the instrument.

Inventory of Physical Symptoms

The Cohen-Hoberman Inventory of Physical Symptoms (CHIPS) (Cohen & Hoberman, 1983) measures thirty-nine common physical symptoms. The items were selected to exclude symptoms of an obviously psychological nature (e.g., felt nervous or depressed); however, the scale does include many

physical symptoms that are considered psychosomatic in nature (e.g., headache, weight loss or gain).

The CHIPS was found to be significantly correlated with the use of student health services within five weeks after the completion of the scale in college student samples. The CHIPS is moderately correlated with the Center for Epidemiologic Studies Depression Scale (CES-D), which was designed to measure a current level of depressive symptomology (r=.44, p<.001). The CHIPS scale was developed to measure the physical symptoms as an indirect measure of the outcome of life stress. The CHIPS has strong internal consistency as measured by Cronbach's alpha (.88). Test-retest data and other validity measures were not included in the original article.

Lisa Vogelsang Inventory (LVI)

The LVI is not a psychometrically tested instrument. It was originally included in the inventory battery to assist in matching subjects and provide a location for questions related to medical conditions that put individuals at higher risk for CTS. It included 3 questions related to symptoms, diagnosis, and surgery for CTS to insure that non-CTS subjects had never had CTS from other sources, such as from home or a previous job, not in Worker's Compensation records. The other questions related to symptoms, diagnosis, and surgery of other joints in the body (back,

neck, shoulders, elbows, knees, or ankles) were included to make the purpose of the research less obvious.

The inventory was arbitrarily given the author's name and the acronym LVI so it would look like any other inventory in the packet. It was placed after the CHIPS to look like a continuation of health inventories. The specific medical-condition risk factors for CTS as identified by Cannon et al. (1981) were included to assess equity in the distribution of the medical variables across the CTS and non-CTS groups/pairs, because it was impossible to pre-match the subjects on these variables. It was originally thought that CTS subjects might score higher on other joint problems (especially back, shoulder, and neck problems), because of the relationship of stress to back, neck, and shoulder pain found in other research (Feuerstein et al., 1985; Feuerstein et al., 1987).

Design and Procedure

The procedure for acquiring subjects varied slightly at each company. Worker's Compensation and other files containing medical records were used to select first the CTS subjects from each company. The company nurse, a human resource representative, or this author searched the files for the CTS subjects. Each CTS subject was then matched on job duties, length of time on the job, sex, age, race, and

general body size (e.g., somatotype [obese=endomorph, slender=ectomorph, and average=mesomorph] or relative height and weight values) with another person from the same job title who had never had CTS.

In all cases, help was solicited from immediate supervisors for assistance in matching. The supervisors knew their work force better and were given the selection criteria on which to match the subjects. The hierarchy for the matching criteria was as follows: (1) gender matches were accomplished in all cases, (2) job duties, (3) length of time on the job, (4) general body size, (5) age, and (6) race. Because of confidentiality of medical records, some companies chose to do the selections themselves.

Because perfect matches were seldom feasible, inexact matches were handled in a variety of ways. In a few cases CTS subjects were not used in the study, because it was not possible to find a suitable match (e.g., one had diabetes and many other serious medical risk factors as well as a longer work history than anyone in her area) (see Appendix E for a chart showing comparisons of the pairs on the selection criteria). If the pairs did not have the exact same job, the supervisors picked parallel jobs that had equal ergonomic risk. When exact matches on body size, age, and years at work were not possible, attempts were made to select greater risk in the non-CTS person (e.g., greater

body size or weight, greater age, and a greater number of years on the same job at work).

After the subject pairs were selected, all subjects received the full battery of psychological inventories. All informed consent letters were signed prior to handing out the inventory packets. Eight pairs of subjects completed the inventories at the work site and the remainder of subjects took the packets home to be completed. Each packet contained a letter of instruction explaining how to complete the packet, an ID numbered fill-in inventory set which included a brief demographic form with personal and work information used for matching subjects, the computerized inventory set, an ID numbered computer answer sheet from the UTK State Testing Service, and a sharpened #2 pencil in an ID numbered large envelope. This author's name and telephone number were included on the instruction sheet so that all participants had the opportunity to call to ask questions if any part of the inventory packet or research was unclear. There were many other subjects tested who could not be put into pairs, and the results of their tests were not used in the data analysis. Each participant who participated in the research will obtain individual results and general suggestions for stress management and general lifestyle management.

CHAPTER IV

RESULTS

Introduction

Logistic Regression was used to identify independent variables that predict membership in the CTS and non-CTS groups. Regression methods have become a standard in data analysis when describing relationships between a response variable and one or more explanatory variables. The difference is that the response or outcome variable in logistic regression is binary or dichotomous, whereas the outcome variable in linear regression is continuous. Logistic regression has become a useful method when analyzing dichotomous outcome variables in many fields, especially in health research. Logistic regression was first used individually on all seven independent variables to determine each one's potential to discriminate between membership in the CTS or non-CTS group.

Hosmer and Lemeshow (1989, p. 1) describe the goal of an analysis using this method as being the same as any model-building technique used in statistics: "To find the best fitting and most parsimonious, yet biologically reasonable model to describe the relationship between an

outcome (dependent or response variable) and a set of independent (predictor or explanatory) variables."

In preparation for processing the data using SAS (SAS Institute Inc., 1990), the author had to determine whether to run the data as matched or unmatched. A rationale for running the data as unmatched was that the matches were not "perfectly" equivalent in age, race, time on the job, job duties, weight, and general body size. However, support for running the data as a matched pairs logistic regression was provided by approximate matching within pairs. When exact matches were not achievable on the matching criteria, the author attempted to stack greater risk factors (e.g., greater age, greater weight, more time at work, more high risk job) into the non-CTS person than the CTS. There were some cases in which the non-CTS match did have lesser risk on criterion variables, but these were the only matches possible in those instances. Table 1 lists the descriptive statistics for the matching variables between CTS and non-CTS subjects. Gender was matched in every case and race was primarily white. The two groups appear least well-matched in terms of weight, with the CTS group having a greater range of weight and higher mean weight (See Appendix E for matching criteria).

One of the goals of finding the best model (combination of inventories) is for a company to be able to use the results to target people at risk for CTS and follow up with

Table 1

Descriptive Statistics for Matching Variables: CTS and Non-CTS Subjects

Matching Variable	M	SD	Min.	Max.
		CTS Subjects[a]		
Age (years)	37.30	7.86	24	56
Weight (pounds)	155.74	43.27	95	280
Height (inches)	64.58	2.42	60	71
Total Years (current site)	8.76	6.79	0.5	27
		Non-CTS Subjects[b]		
Age (years)	36.40	7.96	23	59
Weight (pounds)	148.90	35.89	105	245
Height (inches)	64.82	2.35	60	71
Total Years (current site)	8.84	6.37	1.0	27

[a] n = 50 subjects.

[b] n = 50 subjects.

appropriate prevention measures. Because representatives from the companies will not be matching workers and will be testing in groups, the unmatched data analysis would seem more useful. Initially, the data were run both matched and unmatched to see if the two methods yielded different conclusions. The results turned out essentially the same. Thus, because of imperfections in matching and the greater practicality of the unmatched analysis, this dissertation presents the results only from the unmatched analysis.

Another problem that surfaced was that three of the questions on the LVI inventory related directly to CTS (questions #101, 102, and 103). These questions related to the symptoms of CTS, the diagnosis of CTS, and whether or not the person had CTS surgery. The questions were put into the LVI originally to insure proper matching (e.g., that a non-CTS did not have CTS previously from another job, or CTS from sources not job related and not in Worker's Compensation records). However, to prevent a score bias for CTS versus non-CTS subjects, those three questions were deleted from the scoring in the LVI.

Findings

Descriptive Statistics

Descriptive statistics are included to show the differences between the CTS and non-CTS groups on the different inventories. The LVI has been separated into two parts, the medical risk factors and other joint problems (see Table 2). Notice that there is little difference in the means of the medical risk factors but considerable difference between the means of the other joint problems. Because the LVI was hand checked prior to running the matched pairs for equity between CTS and non-CTS subjects on the medical questions, those questions did not need to be factored into the logistic regression separately. The non-CTS subjects had more or greater problems than the CTS subjects as a whole (i.e., 17 non-CTS subjects had more problems on the medical risk factors than their CTS counterparts, and 15 CTS subjects had more problems than their non-CTS matches, and the remaining pairs were evenly matched on these problems).

Published norms are available on only three of the inventories. The means (M) and standard deviations (SD) of the current sample of 100 subjects fall fairly close to the published norms (see Table 3). Because there were only 2 male subjects (1 pair) and 98 females in the current study, the following M's and SD's are based on female normative

Table 2

Descriptive Statistics for all Inventories: CTS and Non-CTS Subjects

Inventory	M	SD	Min.	Max.
		CTS Subjects[a]		
SRRS	750.1	603.5	0.0	2536.0
SCS	24.4	29.3	-56.0	83.0
LSA	40.6	11.3	15.0	61.0
SQ	47.7	9.4	23.0	72.0
PSS	29.7	10.3	10.0	48.0
CHIPS	35.3	20.5	5.0	100.0
LVI Total	12.7	7.0	2.0	32.0
Medical Risk	3.5	3.1	0.0	13.0
Joint Problems	9.2	5.2	1.0	24.0
		Non-CTS Subjects[b]		
SRRS	522.9	397.7	0.0	1465.0
SCS	32.6	24.4	-21.0	91.0
LSA	45.3	9.5	25.0	63.0
SQ	50.2	8.3	32.0	67.0
PSS	25.6	8.8	9.0	47.0
CHIPS	25.7	18.6	4.0	86.0
LVI Total	8.6	5.1	2.0	20.0
Medical Risk	3.2	2.8	0.0	12.0
Joint Problems	5.3	3.7	0.0	15.0

[a]n = 50, [b]n = 50.

Table 3

Descriptive Statistics for all Inventories: CTS and Non-CTS Combined

Inventory	M	SD	Min.	Max.
	CTS and Non-CTS Combined[a]			
SRRS	635.5	521.2	0.0	2536.0
SCS	28.5	27.1	-56.0	91.0
LSA	42.9	10.6	15.0	63.0
SQ	49.0	8.9	23.0	72.0
PSS	27.7	9.7	9.0	48.0
CHIPS	30.5	20.1	4.0	100.0
LVI	10.6	6.4	2.0	32.0

[a]*n* = 100 subjects (CTS = 50, Non-CTS = 50).

scores. On the LSA, the full sample of 100 subjects was only slightly higher than the published norms of M = 42.72 and SD = 8.33. The CTS subjects scored lower than the published norms, while the non-CTS subjects scored higher. The published norms for the PSS are M = 25.6 and SD = 8.24. Again the full sample scored somewhat higher. The CTS subjects scored considerably higher on the PSS, and the non-CTS subjects had the exact same mean as the normative data. The SCS showed the largest difference between published norms and the full sample and the non-CTS subjects, which were both greater than the norms. The CTS subjects scored slightly lower than the published norms. The SCS norms are M = 24.6 and SD = 23.1.

Logistic Regression - Single Variable Model Results

The extent to which each independent variable by itself distinguished between CTS and non-CTS groups and pairs is reflected in Table 4 with Chi-square statistics and p values. Five out of the seven inventories were significant discriminators between CTS and non-CTS subjects at the $p<.05$ level. The LVI showed significant differences at the $p<.01$ level. There were predictable and significant differences between CTS and non-CTS subjects in life event stress (SRRS), in perceived stress (PSS), in physical stress symptoms (CHIPS), in the combination of other joint pain and problems and medical risk factors for CTS (LVI) (from the descriptive statistics, it appears that the other joint

Table 4

Chi-Square Statistics And P Values For Each Inventory As Single Model Predictors For CTS: Unmatched Logistic Regression

Inventory	X^2	P
	Unmatched[a]	
SRRS	4.7977*	0.0285
SCS	2.3044	0.1290
LSA	4.8205*	0.0281
SQ	2.1262	0.1448
PSS	4.6063*	0.0319
CHIPS	5.8086*	0.0159
LVI	10.4393**	0.0012

Note. df = 1 for each inventory score.
[a]n = 100 subjects.
*p<.05. **p<.01.

problems section is the portion of the LVI that distinguishes between CTS and non-CTS subjects), and in the use of self-management and life-management strategies (LSA). It is interesting to note that the self-control based inventories (SQ and SCS) were not significant by themselves in distinguishing between CTS and non-CTS subjects as hypothesized. However, three out of the five psychological variables (SRRS, LSA, and PSS) were significant predictors of CTS membership as stated in the hypothesis.

Inventory Intercorrelations

Intercorrelations between inventories for all subjects combined, CTS and non-CTS, are given in Table 5. There were significant correlations between all inventories except for the LVI with the SCS and the LVI with the SQ. Highly correlated variables are more difficult to model in logistic as well as standard regression statistics. However, there was no way to avoid the intercorrelations when examining the different stress variables and/or different measures that can reflect the stress component (i.e., self-management, self-control, and physical symptoms). When variables within logistic regression models are highly correlated, the [Wald] Chi-Square statistics of each variable within the analysis [maximum likelihood estimates] are reduced.

All seven inventories were run to see if the full model taken together could distinguish between CTS and non-CTS subjects. The full seven-variable model did not yield

Table 5

Pearson's Intercorrelations Between Inventories: CTS and Non-CTS Combined

	SRRS	SCS	LSA	SQ	PSS	CHIPS	LVI
SRRS	----	-.31*	-.44*	-.31*	.49*	.59*	.40*
SCS		----	.77*	.74*	-.74*	-.41*	-.16
LSA			----	.67*	-.70*	-.45*	-.29*
SQ				----	-.73*	-.46*	-.16
PSS					----	.54*	.30*
CHIPS						----	.55*
LVI							----

Note. n = 100 subjects.

*p<.01.

significant differences between CTS and non-CTS subjects. A possible explanation for the full model not yielding significant differences, besides the lack of significance for the SCS and SQ, is the tremendous intercorrelations among the inventories. These high correlations tend to weaken models that have numerous variables. Therefore, given the lack of individual significance of the SQ and SCS and high intercorrelation of variables, it is not surprising that the full model was not significant.

The intercorrelations between inventories were then separated into CTS and non-CTS groups (see Tables 6 and 7). These correlations support the primary hypothesis of the difference between CTS and non-CTS subjects on psychological variables. Overall, the psychological variables tend to be somewhat more strongly linked to one another in the CTS than in the non-CTS group. However, the LSA (self-management) was slightly more correlated with the PSS (perceived stress [negatively]) and with the SQ in the non-CTS than in the CTS groups.

The SRRS was highly correlated with the CHIPS (physical stress symptoms) in both the CTS and non-CTS groups, as the life event stress literature would suggest. The PSS was strongly correlated with the CHIPS in the CTS subjects, and only moderately correlated with the CHIPS in the non-CTS subjects, a pattern which is also predictable from the literature review.

Table 6

Pearson's Intercorrelations and p values Between Inventories: CTS Subjects

	SRRS	SCS	LSA	SQ	PSS	CHIPS	LVI
SRRS	----	-.364	-.434	-.296	.558	.587	.367
p		.0093	.0016	.0371	.0001	.0001	.0088
SCS		----	.801	.818	-.748	-.267	-.267
p			.0001	.0001	.0001	.0001	.0608
LSA			----	.636	-.684	-.486	-.409
p				.0001	.0001	.0003	.0032
SQ				----	-.717	-.545	-.224
p					.0001	.0001	.1177
PSS					----	.594	.372
p						.0001	.0078
CHIPS						----	.454
p							.0009
LVI							----

Note. n = 50.

Table 7

Pearson's Intercorrelations and p values Between Inventories: Non-CTS Subjects

	SRRS	SCS	LSA	SQ	PSS	CHIPS	LVI
SRRS	----	-.160	-.368	-.272	.310	.541	.350
p		.2662	.0086	.0560	.0285	.0001	.0128
SCS		----	.705	.628	-.719	-.170	-.114
p			.0001	.0001	.0001	.2378	.4316
LSA			----	.707	-.693	-.344	.041
p				.0001	.0001	.0145	.7772
SQ				----	-.720	-.305	-.041
p					.0001	.0312	.7760
PSS					----	.409	.046
p						.0032	.7499
CHIPS						----	.601
p							.0001
LVI							----

Note. n = 50.

Logistic Regression: Selection of Best Model

The total number of possible models using different combinations of all seven variables is 126. Of those 126 models, over 70 of them yielded significant differences between CTS and non-CTS subjects. The question remains: of those 70+ significant models, which model "best" predicts membership in the CTS group?

The first step in ascertaining the answer to that question was a stepwise logistic regression using all seven variables (see Table 8). When using forward selection, backward selection, or stepwise selection in processing data, one is having the statistical package pick out the best model from all the variables, based on different methods of statistical procedures and goodness of fit parameters. Many prominent statisticians do not rely on the results of a stepwise procedure alone, and prefer to select their own best model.

Sometimes the best "statistical" model is not always the "best" model in terms of biological and other factors. Hosmer and Lemeshow (1989) discuss including a variable within a model because the variable is known to be "biologically important" even when the variable, itself, may not be statistically significant when entered into the model. They claim a decision to include or exclude a variable should be made in conjunction with subject matter experts. For example, logistic regression was used to

Table 8

Criteria for Assessing Model Fit Stepwise Logistic Regression: SRRS, SCS, PSS, LSA, SQ, CHIPS, & LVI

Criterion	Intercept Only	Intercept And Covariates	X^2 for Covariates
	Step 1. Variable LVI entered		
AIC	140.629	131.422	-----
SC	143.235	136.632	-----
-2 Log L	138.629	127.422	11.207* df=1 (p=.0008)
Score	-----	-----	10.439* df=1 (p=.0012)
	Step 2. Variable LSA entered		
AIC	140.629	131.334	-----
SC	143.235	139.150	-----
-2 Log L	138.629	125.334	13.295* df=2 (p=.0013)
Score	-----	-----	12.162* df=2 (p=.0023)

Note: n = 100 subjects. *p<.005.

determine the best model for the odds of testing HIV positive (Yarandi & Simpson, 1991). Two variables were included in the model that were known to be biologically important (i.e., IV drug use and a high number of short term sex partners in the last ten years) that did not meet a .05 p value. The p value was raised to .10 to include those variables that were known to be biologically important by the authors.

Because the variables had such high intercorrelations, any selection procedure would have a built-in bias to favor models with lower numbers of variables. In order to prevent statistical bias, other goodness-of-fit statistics were used in selecting the best model. One such statistic is the Classification Table, which is a 2X2 frequency table of observed and predicted responses of event and no-event data (e.g., CTS and non-CTS). The C-table statistics are given for the best two, three, and four-variable models (see Tables 9, 10, and 11).

One can see that the three-variable model (SRRS-LSA-LVI) was superior in predicting membership in the CTS group and had fewer false positives and negatives than the two-variable model (LSA-LVI) selected by the stepwise procedure. It is also evident that the four-variable model (SRRS-LSA-CHIPS-LVI-) is exactly the same as the three-variable model, which indicates that the fourth variable added nothing significant to the model.

Table 9

Classification Table of Predicted and Observed Results of Best 2 Variable Model (LSA and LVI): Unmatched Logistic Regression

	Predicted		
Observed	Event	No Event	Total
Event	34	16	50
No Event	21	29	50
Total	55	45	100

Note. n = 100. Sensitivity = 68.0% (34/50, row 1).

Specificity = 58.0% (29/50, row 2).

Correct = 63.0% (34+29/100, rows 1 and 2).

False Positive Rate = 38.2% (21/55, column 1).

False Negative Rate = 35.6% (16/45, column 2).

Table 10

Classification Table of Predicted and Observed Results of Best 3 Variable Model (SRRS, LSA, and LVI): Unmatched Logistic Regression

	Predicted		
Observed	Event	No Event	Total
Event	34	16	50
No Event	20	30	50
Total	54	46	100

Note. n = 100. Sensitivity = 68.0%.

Specificity = 60.0%. Correct = 64.0%.

False Positive Rate = 37.0%.

False Negative Rate = 34.8%.

Table 11

Classification Table of Predicted and Observed Results of Best 4 Variable Model (SRRS, LSA, CHIPS, LVI): Unmatched Logistic Regression

	Predicted		
Observed	Event	No Event	Total
Event	34	16	50
No Event	20	30	50
Total	54	46	100

Note. n = 100. Sensitivity = 68.0%.
Specificity = 60.0%. Correct = 64.0%.
False Positive Rate = 37.0%.
False Negative Rate = 34.8%.

Other informal statistics from some of the participating companies have indicated that for many workers who had worked for ten years or more before obtaining CTS, the year they obtained the CTS was the same year in which they had experienced a divorce, or death of a spouse or other close family member. These findings represent an informal, "biological" relationship between life event stress and CTS.

Looking at all the criteria for the best model fit, it is this author's decision that the best model for predicting CTS membership is the three-variable, SRRS-LSA-LVI model (see Table 12). This model is very consistent with the original hypothesis linking high life event stress and low self-management with CTS. This model includes the addition of the variable, LVI, which discriminates between the two groups by measuring other joint problems. The LVI was the greatest single predictor of CTS membership of all the single-variable models. But, the LVI was not mentioned in the original hypothesis. It was originally thought that the physical symptoms inventories of CHIPS and LVI might yield higher scores in the CTS groups, but was not stated as part of the formal hypothesis.

According to the Standardized Estimate, which is equivalent to a Standardized Beta in standard regression, the LVI value was .35, the LSA value was .15, and the SRRS value was .08. These values relate to the relative

Table 12

Criteria for Assessing Model Fit of Best 3 Variable Models (SRRS, LSA, and LVI): Unmatched Logistic Regression

Criterion	Intercept Only	Intercept And Covariates	X^2 for Covariates
		Unmatched[a]	
AIC	140.629	133.041	-----
SC	143.235	143.462	-----
-2 Log L	138.629	125.041	13.589* df=3(p=.0035)
Score	-----	-----	12.438* df=3(p=.0060)

[a]n = 100 subjects.

*p<.01.

contribution of each variable, but are not the same as a partial correlation. These scores indicate that the LVI was over twice as strong as the LSA, and the LSA was nearly twice as strong as the SRRS for this model. The Standard Estimates for the LVI-LSA model in stepwise selection were .38 for the LVI and .18 for the LSA.

Stepwise Logistic Regression with Psychological Variables

Because the original hypothesis only mentioned the psychological variables, the author ran a stepwise logistic regression to determine the best model of the five psychological variables (SRRS, LSA, PSS, SCS, SQ) used (see Table 13). Inasmuch as the best single model predictor of CTS membership was the LVI and the second best single predictor was the CHIPS, this stepwise logistic regression was run without the physical variables to test the strength of the psychological variables alone. Running these psychological variables alone was also important because the LVI was so strong relative to the LSA and SRRS in the best model.

As can be seen from Table 13, the LSA and SRRS were selected as the best model. That result is very consistent with the original hypothesis as well as with the selection of the best overall model (SRRS-LSA-LVI). The Standardized Estimates for the LSA and SRRS were .18 and .19 respectively.

Table 13

Criteria for Assessing Model Fit Stepwise Logistic Regression: SRRS, SCS, PSS, LSA, & SQ

Criterion	Intercept Only	Intercept And Covariates	X^2 for Covariates
	Step 1. Variable LSA entered		
AIC	140.629	137.702	-----
SC	143.235	142.912	-----
-2 Log L	138.629	133.702	4.928* df=1 (p=.0264)
Score	-----	-----	4.821* df=1 (p=.0281)
	Step 2. Variable SRRS entered		
AIC	140.629	137.610	-----
SC	143.235	145.425	-----
-2 Log L	138.629	131.610	7.020* df=2 (p=.0299)
Score	-----	-----	6.697* df=2 (p=.0351)

Note: n = 100 subjects. *p<.05.

Post Hoc Analysis: Forced Interaction of LSA X SRRS

Because the LSA and SRRS were such strong predictors of CTS membership, it was decided to look at a forced interaction of the two variables. The LSA was multiplied by the SRRS and used as a separate variable. Although the LSAxSRRS was not significant, itself, as a single model predictor, a stepwise logistic regression of the LSA, SRRS, and LSAxSRRS resulted in the selection of the LSA and LSAxSRRS as the best model (see Table 14). The Standardized Estimate scores were .25 for the LSA and .16 for the LSAxSRRS variable.

The results of the forced interaction would seem to indicate that the LSA or lifestyle management is really the major difference between the two groups. As life event stress increases, lifestyle management tends to decrease in the CTS group. The non-CTS group does better and does not experience such a drop in lifestyle management when life event scores increase. These effects can be seen in the differences between the correlations of the LSA and SRRS in the CTS and non-CTS groups (refer back to Tables 6 and 7). Notice that the CTS group has a moderately high Pearson's correlation of -.434 at p=.0016 and the non-CTS group had a lower correlation of -.367 at p=.0086.

The LSA also had a strong correlation with the LVI in the CTS subjects and no correlation with the LVI in the non-CTS subjects. This result may indicate that the CTS

Table 14

Criteria for Assessing Model Fit Stepwise Logistic Regression: SRRS, LSA, & LSAxSRRS (Product)

Criterion	Intercept Only	Intercept And Covariates	X^2 for Covariates
	Step 1. Variable LSA entered		
AIC	140.629	137.702	-----
SC	143.235	142.912	-----
-2 Log L	138.629	133.702	4.928* df=1 (p=.0264)
Score	-----	-----	4.821* df=1 (p=.0281)
	Step 2. Variable LSAxSRRS entered		
AIC	140.629	137.537	-----
SC	143.235	145.353	-----
-2 Log L	138.629	131.537	7.092* df=2 (p=.0288)
Score	-----	-----	6.883* df=2 (p=.0320)

Note: n = 100 subjects. *p<.05.

subjects may tend to react to stress with more joint problems as a group than non-CTS subjects. But, CTS subjects also had a much stronger correlation than non-CTS subjects between the LSA and CHIPS, indicating that self-management is also negatively associated with illnesses other than joint problems in CTS subjects. There may be a protective element to strong self-management and life-management as measured by the LSA, but that cannot be specifically determined through correlational data. But, it is evident that the LSA is the most important psychological factor to come out of this present study.

Stepwise Logistic Regression of Four LSA Factors

Inasmuch as the LSA is the most important psychological variable to emerge from this present study, it was deemed appropriate to test which factor(s) of the LSA is(are) the best predictor(s) of CTS versus non-CTS membership. A stepwise logistic regression was run to determine which of the four factors could differentiate between CTS and non-CTS subjects as single models as well as to determine the best model of self-management from the four factors (see Table 15). The four factors were performance focus and efficiency, goal directedness, timeliness of task accomplishment, and organization of physical space.

Both goal directedness and timeliness of task were significant individual (single model) predictors for CTS membership. However, as can be seen from Table 15, only

Table 15

Criteria for Assessing Model Fit Stepwise Logistic Regression: LSA Factors (perform, goals, time, & space)

Criterion	Intercept Only	Intercept And Covariates	X^2 for Covariates
Step 1. Variable Goal Directedness entered			
AIC	140.629	132.607	-----
SC	143.235	137.817	-----
-2 Log L	138.629	128.607	10.023* df=1 (p=.0015)
Score	-----	-----	9.527* df=1 (p=.0020)

Note: n = 100 subjects. *p<.005.

goal directedness was selected into the model. Therefore, the most important and predictive component of self-management is having clearly defined priorities and goals.

CHAPTER V

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

Discussion

The purpose of this study was to determine if selected psychological factors would distinguish between CTS and non-CTS subjects. It was predicted that CTS groups would have significantly higher levels of perceived and life event stress (PSS and SRRS) and significantly lower scores on self-control (SQ and SCS) and self-management (LSA) variables than non-CTS subjects. It was considered likely, but not predicted, that CTS groups might score higher on physical stress symptoms (CHIPS and LVI).

Although the present study reported unmatched data, the results confirmed significant differences between CTS and non-CTS data, whether analyzed as matched or unmatched data, in all categories except self-control (SQ and SCS). The SQ and SCS were the only two inventories that did not achieve independent significance. The other variables (SRRS, LSA, PSS, CHIPS, and LVI) were all significant at least at $p<.05$ level as independent models. Of all the possible combinations of the seven variables, calculated both as matched and unmatched, most models showed significant differences between the CTS and non-CTS subjects.

After determining that there were significant differences between the CTS and non-CTS subjects via single variable models, the author then determined which combination of inventories (variables) best predicted membership in the CTS groups (best model).
The SRRS-LSA-LVI model was selected as the best model to differentiate between CTS and non-CTS subjects based on the C-tables, the biological feasibility of the SRRS, and the fact that logistic regression discriminates against choosing multiple variables in models with highly correlated data. Another strong reason for choosing the three variable model (SRRS-LSA-LVI) is the established fact that stress increases local muscular tension, thus creating greater risk for CTS development.

Because the original hypothesis only predicted relationships between CTS and the psychological variables, the stepwise logistic regression was run with only the five psychological independent variables (SRRS, LSA, PSS, SCS, and SQ). The LSA-SRRS was chosen as the best model.

A post hoc analysis was done to look at the interaction of the SRRS and LSA. A forced interaction was accomplished by multiplying the LSA and SRRS scores; it was not significant as a single model predictor. That interaction variable was then combined with the LSA and SRRS in a stepwise logistic regression to determine the best interaction model. The best model included the LSA and the

LSAxSRRS interaction variable, indicating that the interaction is important, but that the single best psychological predictor for CTS is the self-reported practice of self-management (LSA).

The importance of that interaction was also underscored by the correlation between the LSA and the SRRS for the CTS subjects. The correlation between the two inventories was somewhat stronger in the CTS than non-CTS subjects. The LSA was also more strongly linked to the physical variables in the CTS than in the non-CTS group. The LSA was strongly correlated (negatively) with the LVI in CTS subjects but had no correlation with the LVI in non-CTS subjects. This result could suggest a protective aspect of self-management among subjects who might have a propensity toward joint problems, as evidenced by their CTS diagnosis. The LSA was also much more strongly correlated with the CHIPS in the CTS than in the non-CTS group, suggesting that the protective element of self-management may extend beyond joint problems into other physical stress symptoms and illnesses.

Inasmuch as the self-management (LSA) was the best psychological predictor for CTS, a stepwise logistic regression was run to determine the best model using the four LSA factors as independent variables. Although goal directedness and timeliness of task were both independent predictors (single variable models) for CTS, the stepwise procedure selected goal directedness as the best model or

best predictor for CTS. That result is very consistent with the "hardiness" research and other self-management research as well. Goal directedness matches the hardiness construct's orientation towards goals and achievement quite specifically.

It is interesting to note that life event stress (SRRS) was slightly more correlated with the LVI in CTS than non-CTS subjects and that perceived stress (PSS) was moderately correlated with the LVI in CTS subjects and not correlated with the LVI in non-CTS subjects. The CHIPS had a much stronger correlation with the LVI in non-CTS subjects than CTS subjects. Perhaps physical problems have a purer physical etiology for non-CTS than CTS subjects. The results indicate that the CTS person tends to have a slightly stronger relationship between joint problems and life event stress than does the non-CTS person. However, the CTS subjects yielded a moderate correlation between perceived stress and joint problems, whereas the non-CTS subjects showed no relationship between these variables.

Conclusions

The basic hypothesis was supported that there are significant differences between CTS and non-CTS subjects along selected psychological factors. Specifically, the predictions of significantly higher scores on perceived

stress (PSS) and life event stress (SRRS) and significantly lower scores on the use of self-management strategies (LSA) by CTS subjects were upheld. The prediction that the CTS subjects would score significantly lower on self-control variables (SQ and SCS) was not upheld. This study suggests that stress and self-management or lifestyle management could be major discriminating factors in CTS development when all other factors are held relatively constant.

Although it was not predicted, the CTS subjects also scored significantly higher in physical stress symptoms (CHIPS) and in medical risk factors for CTS combined with joint problems other than the wrist (LVI). CTS literature points to medical risk factors such as arthritis, hyperthyroidism, oophorectomy, and the use of estrogens or birth control as increasing the risk for CTS development. However, the LVI showed no apparent differences between the means of the CTS and non-CTS subjects on the medical questions. It seems that the discriminating elements on the LVI are the joint problems other than the wrist.

The relationship between CTS and joint problems other than the wrist has not been investigated in the literature except for arthritic conditions. If stress causes the local and general muscular tension that leads to reduced circulation and venous pooling, then stress could cause other musculo-skeletal problems in a variety of body regions. Of all seven inventories, the LVI was the best

single variable model that predicted CTS membership. The LSA was highly correlated with the LVI in CTS subjects and not correlated with the LVI in non-CTS subjects.

After determining that there were significant differences between CTS and non-CTS subjects, the author selected the combination (model) of inventories (variables) that best predicted membership in the CTS versus non-CTS group. The model selected was the three variable SRRS-LSA-LVI model. The C-tables showed that the three variable model was the superior predictor of CTS membership. C-tables are not taken into consideration during a stepwise logistic regression analysis. The three variable model was also chosen as the best model from a practical standpoint, based on informal input from participating companies. One primary purpose of choosing the best model for discriminating CTS membership is to use the inventories to identify other workers who may be at risk for developing CTS and then apply appropriate preventive measures.

One of the biggest problems in attempting to fit a model to the data was the high correlations between the inventories/variables. Those high correlations are probably at least partially responsible for the stepwise logistic regression's only choosing the two variable model LSA-LVI in the analysis. Although the choice of a two variable model as best model may have the stronger statistical support, the choice for best model remains the three variable model

(SRRS, LSA, LVI) for all of the reasons previously addressed.

The best model contains the life event stress (SRRS), the use of self-management and lifestyle management practices (LSA), and the presence (past or current) of joint pains and difficulties other than the wrist (LVI). It has been discussed that stress can cause other musculo-skeletal and joint problems besides CTS, and perhaps people who tend towards joint problems also obtain CTS, especially in the presence of other risk factors.

The life event stress as measured by the SRRS appears not to be highly influenced by CTS development. The presence of CTS would add 53 points for a major illness. However, other factors possibly influenced by CTS include the following: change in personal habits (24 points), change in work hours or conditions (20 points), change in recreation (19 points), change in church activities (19 points), change in social activities (18 points), change in sleeping habits (16 points), change in the number of family gatherings (15 points), and change in eating habits (15 points). All of these add up to 199 points and the SD for the total sample in the study was 521 points. Additionally, all of the CTS subjects in the study were back at work at the same level as prior to either surgical or non-surgical treatment for the CTS except for one. So, many of the above

changes may not be applicable, causing the SRRS scores to drop further.

The best model to predict CTS membership using only the predicted psychological variables (i.e., SRRS, LSA, PSS, SCS, and SQ) was the LSA-SRRS model. There was an interaction between the SRRS and LSA as seen in the differential correlations for CTS and non-CTS groups and in the forced interaction between the two variables within the stepwise regression of the LSA, SRRS, and LSAxSRRS interaction variables.

Self-management skills are highly related to a number of physical and psychological health measures (Williams et al., in press). Although a large amount of stress in one's life could impinge upon one's lifestyle organization, one would think that the latter variable would be more stable than the former. Good self-management would tend to help a person overcome or cope with the stresses that life brings and maintain a relatively stable lifestyle organization. The data tended to support this idea, because some of the non-CTS subjects had very high SRRS scores in combination with relatively high scores on the LSA and low scores on the PSS and the physical symptoms as measured by the CHIPS.

The intercorrelations of the psychological inventories tended to be stronger within the CTS than non-CTS group. The LVI scores were significantly lower for the non-CTS subjects, indicating fewer joint problems. From the present

study, it is not known whether self-management has a protective element, or whether there is a tendency for those in the CTS group to react to stress with several joint problems, one of which is CTS.

A model of the primary relationships of the psychological factors and physical symptoms between CTS and non-CTS subjects can be found in Figure 2. The final model differs from the hypothetical model by the deletion of the SCS and SQ inventories and by the addition of the physical symptoms (CHIPS and LVI). The CHIPS and LVI were not included in the original hypothesis. But, the LVI and CHIPS were added to the final model because these variables were significant discriminators of CTS membership.

This author does not want to have the reader to focus concern on the selection of a best model, when there are over 70 models (combinations of different inventories) out of 126 possible model combinations for the data that significantly discriminated between CTS and non-CTS subjects. The primary concern of this research is whether there are significant differences between CTS and non-CTS subjects on selected psychological criteria. According to the literature review, no previous research has discriminated between CTS and non-CTS groups or pairs on psychological variables. The present study is most likely the first study in the U.S.A. to significantly discriminate between CTS and non-CTS subjects who have been matched on

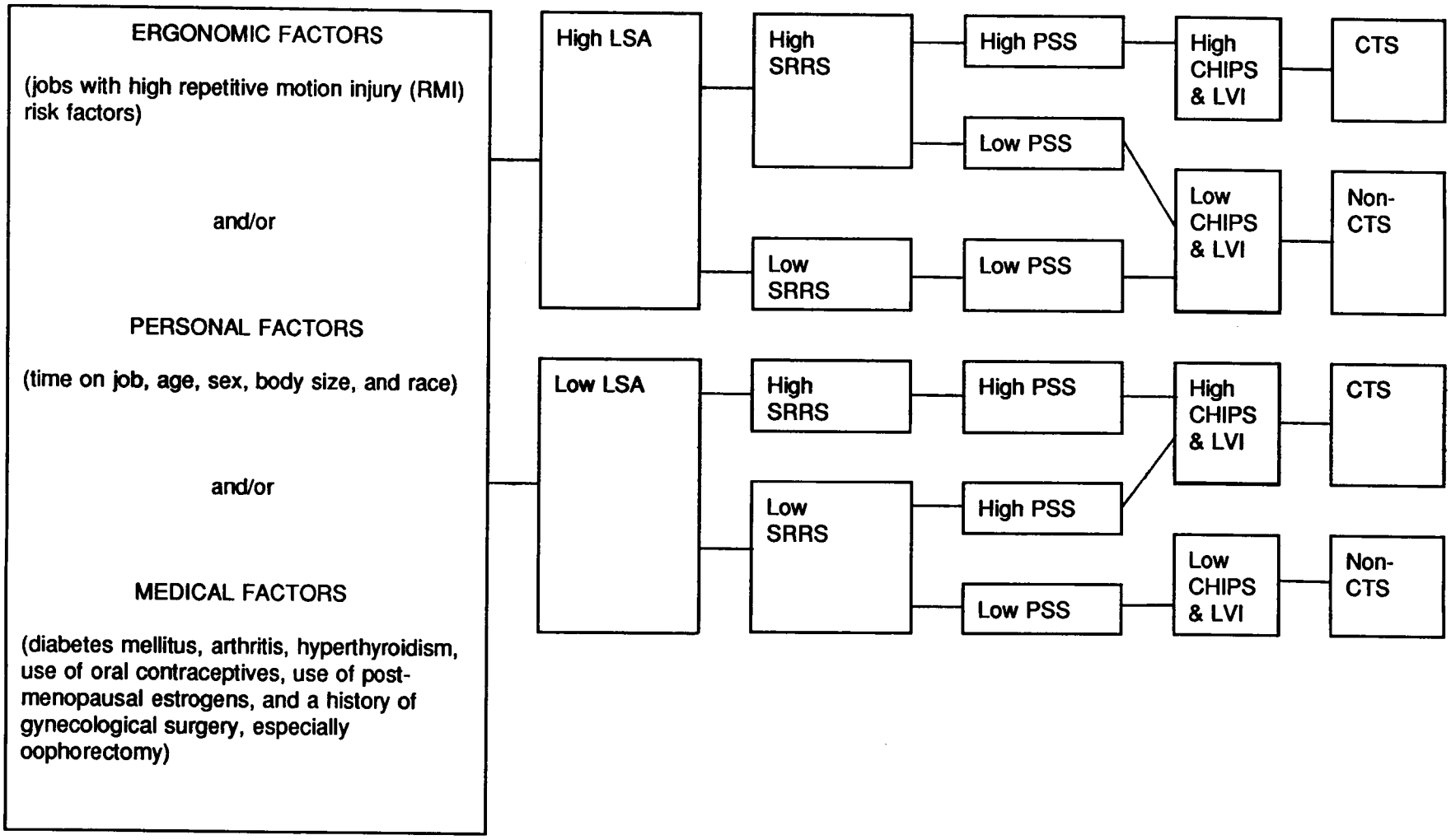


Figure 2. Model of Primary Relationships of Psychological Variables and Physical Symptoms Between CTS and Non-CTS Subjects.

most every ergonomic, personal, and medical risk factor for obtaining CTS.

The results of this study indicate that people who have obtained CTS generally have a higher amount of life event stress (SRRS), perceive their lives as more unpredictable, uncontrollable and overloading (PSS), report using fewer self-management and life-management strategies (LSA), have more stress-related physical symptoms (CHIPS), and have more problems with other joints as well (LVI). The implications of these results suggest that CTS subjects are beset with stress and physical stress symptoms from many sources. Although one cannot always control life events, there are many preventive measures that can be applied to prevent or control the stress that one may experience. Self-management may serve as a lifestyle buffer towards life event and perceived stress.

The most important of these preventive measures is the application of self-management practices. Through the application of these practices, a number of positive effects can be set into motion. One can improve one's self-efficacy or belief in oneself, thus helping to develop a "hardy" personality. Hardiness allows one to better control the stress and adjust to changes in life, resulting in lower perceived stress as well. If one could achieve a decrease in perceived stress, an increase in self-management skills, and a sense of control over one's life, fewer physical

symptoms of stress would probably occur. Perhaps CTS along with other stress symptoms is preventable through appropriate education and training in psychological dimensions. The present research also suggests that the most important factor of self-management (LSA) is goal directedness. After inventory testing, workers found to be at risk could be given prevention training in self-management, particularly in developing clear priorities and goals for work and personal life.

Although one cannot make causal claims from retrospective data, the results of the present study may indicate that stress and lifestyle management are related to the development of CTS and are important discriminating factors in CTS etiology. Future research is suggested to evaluate the possibility of a causal relationship between stress, self-management or lifestyle management, and CTS development.

Recommendations for Future Research

Because the LVI was such a strong predictor of CTS or non-CTS membership, it is suggested that the differences be teased out concerning the recency of other joint problems experienced by CTS subjects and perhaps which other joints are most affected. Perhaps a psychometrically sound inventory could be developed out of the LVI to more

accurately distinguish between CTS and non-CTS subjects. The LVI is obviously a strong predictor of CTS membership, but determining exactly why it is such a good predictor and improving it as a psychometric instrument may be worthy of future research.

Longitudinal research using some of the current inventories could be pursued to establish a true causal relationship between stress, life-management, and CTS development. The only problem with such research is that it is expensive and not always practical, because CTS can take less than one year to over 10 years of high risk work to develop.

Many researchers are currently investigating ergonomic and other physical risk factor prevention. Some researchers have shown stress as a physical risk factor for the kind of muscle tension that can lead to CTS development (Arndt, 1987), and other researchers have demonstrated that exercise programs during work are more beneficial to restoring circulation and reducing CTS risk than is rest (Lutz & Hansford, 1987). Research is suggested using combinations of ergonomic factors, exercise, stress-management, and self-management strategies to reduce the number of CTS cases in high risk industries. Perhaps a best model of prevention could be developed from such research.

There has been so little research on the psychological factors affecting CTS, that numerous studies relating

various psychological factors such as stress and life-management could make a valuable contribution to the body of knowledge about CTS. The area is ripe for much research on the linkages between psychological and psychosocial factors and CTS, because the American National Standards Institute (ANSI), a national organization that establishes standards for workers, is currently looking for research on Cumulative Trauma Disorders (CTD's) relating to psychological stressors and psychosocial factors (D. McLeod, personal communication, August 23, 1991). ANSI is trying to develop standards for CTD guidelines, because there is currently no body of literature to support present NIOSH (National Institute for Occupational Safety and Health) standards beyond the physical dimensions.

This author hopes that the significant differences between CTS and non-CTS subjects along the dimensions of stress and lifestyle management found in this current study can be a springboard to further research on other psychological predictors of CTS.

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APPENDIXES

APPENDIX A

Informed Consent Letter

The purpose of this study is to further understand the relationship between stress and the workplace. The attached questionnaires are to help identify those relationships. Please fill out the questionnaires and return them to the researcher, Lisa M. Vogelsang, at the time she specifies. Some of the questions are fill-in and most are multiple choice with a computer scoring sheet on which to mark your answers. Try to work quickly and not linger too long on any one question. Your first impression that most closely reflects your view is usually the best. Filling out the questionnaires should take between 30 and 45 minutes.

This study will help us understand more clearly the relationship between stress and work. There are no known risks to this testing procedure, although you may experience mild fatigue from reading and answering the questions. You are not timed and you may pause to rest and take as much time as you need to complete the questionnaire. We do ask that you try to complete it before turning it back in for scoring.

Your identity will be kept confidential. Only the investigator and her advisor, Dr. Robert L. Williams, will have access to your numbered score sheets, which will be kept in a locked filing cabinet in an office at the University of Tennessee. Only composite results will be reported from your industry as well as others participating in the study. You will obtain a personal copy of your individual score results and a handout on stress management procedures that can be used while at work. A list of names corresponding to the numbered scoring sheets will exist only long enough to return individual score results and will then be destroyed to assure anonymity.

If you have any questions about the research, either now or later, please contact Ms. Lisa M. Vogelsang, 108 Claxton Education Bldg., University of Tennessee, Knoxville, TN, 37996-3400, or call 573-9114 (with answering machine). Your participation in this study is voluntary, and you may refuse to participate. You may withdraw at any time during the testing without penalty.

****

I have read and understand the explanation of this study and agree to participate.

_____ _____

Name: Date:

_____

Signature:

APPENDIX B

INSTRUCTIONS FOR THE UNIVERSITY OF TENNESSEE RESEARCH

"STRESS AND THE WORKPLACE"

Contact Person: Lisa Vogelsang [phone:(615) 573-9114]

In this envelope are a stapled set of Fill-In Inventories, a computer answer sheet, and a stapled set of Computerized Inventories along with a #2 pencil. Please do not fold or tear the computer answer sheet in any way. The computer answer sheet will only be used for marking the answers to the Computerized Inventories and marking your sex on the form. Do not put your name, birthdate, etc. on the computer answer sheet. You should only fill in the circles "M" for male or "F" for female on the form and 1, 2, 3, 4, or 5 for the inventory answers.

You will notice the Fill-In Inventories and the computer answer sheet have the same number on them. These are the papers on which you'll write your answers. The Computerized Inventories set has no number on it and you should not write on that set.

You should do the Fill-In Inventories first and follow the directions for each inventory in the set. Next, follow the directions on the Computerized Inventories set and mark your answers on the computer answer sheet with the #2 pencil given to you. Remember, mark the circle "M" or "F" for your sex and then mark only the answers to the questions. Do not put your name, birthdate or any other information on the computer sheet. Make sure you answer all the questions and make your marks complete and clear, and erase completely any changed answers. Look on the back side of the computer answer sheet for complete directions for filling in the circles properly.

Please return all the inventories in the envelope back to the designated box at your worksite within three days. You may keep the pencil. The inventory only takes about 30 min. to complete, so please get it in as soon as possible. Your participation is very important and can really help you and your company to find out about stress and how to control it in your life and the lives of other workers. You will get complete individual results and suggestions (2 - 4 pages) in six to eight weeks.

If you have any questions while taking the inventory, don't hesitate to call me at home. My telephone number is (615) 573-9114 and there is an answering machine hooked up if I'm not at home. Leave your name and number on the machine and I'll get back to you. I really appreciate your participation! Thank you!

LMV

APPENDIX C

WORKER DEMOGRAPHIC SURVEY

Instructions: Fill in the spaces below with the information asked for and follow directions as accurately as possible. If you are not sure on a question, give your best estimate.

1. Age:_____ 2. Gender:_____

3. Height:_____ 4. Weight:_____

5. Number of years at your current place of employment or hire date:_____

6. Current job title or job description: _____
_____

7. Amount of time in your current position at work (Years and/or months):_____

8. Average number of hours worked per week in your current job:_____

9. How would you rate your own performance/output as a worker?
Circle one: Poor Average Good Excellent

10. How well do you get along with your co-workers?
Circle one: Poor Average Good Excellent

11. How well do you get along with your supervisor(s)?
Circle one: Poor Average Good Excellent

12. Have you had any problems at work in recent years?
(e.g., reprimands or disciplinary action) Yes___ No___

Circle one letter of each of the following questions:

13. Highest Grade Level Completed

A. Less than high school
B. High school or GED
C. Technical/vocational school
D. College (B.A. or B.S.)
E. Graduate degree (Master's or doctorate)

14. Present state of physical health

A. Poor
B. Somewhat below average
C. Average
D. Somewhat above average
E. Excellent

15. Present stress level

A. High level of stress
B. Medium level of stress
C. Low level of stress

SRRS INVENTORY

Instructions: Write in the space next to each number the number of times that each life event has occurred in your life during the past two years. If a particular life event has not occurred in your life in the past two years then put a 0 (zero) in the space.

No.	Life Event	No.	Number of Occurrences
1.	Death of spouse	1.	_____
2.	Divorce	2.	_____
3.	Marital separation	3.	_____
4.	Jail term	4.	_____
5.	Death of close family member	5.	_____
6.	Personal injury or illness	6.	_____
7.	Marriage	7.	_____
8.	Fired at work	8.	_____
9.	Marital reconciliation	9.	_____
10.	Retirement	10.	_____
11.	Change in health of family member	11.	_____
12.	Pregnancy	12.	_____
13.	Sex difficulties	13.	_____
14.	Gaining a new family member	14.	_____
15.	Business readjustment	15.	_____
16.	Change in financial status	16.	_____
17.	Death of a close friend	17.	_____
18.	New job or changing line of work	18.	_____
19.	Change in # of arguments with spouse	19.	_____
20.	Mortgage	20.	_____
21.	Foreclosure of mortgage or loan	21.	_____
22.	Change in responsibilities at work	22.	_____
23.	Son or daughter leaving home	23.	_____
24.	Trouble with in-laws	24.	_____
25.	Outstanding personal achievement	25.	_____
26.	Spouse starts or stops working	26.	_____
27.	Start or finish school	27.	_____
28.	Change in living conditions	28.	_____
29.	Major change in personal habits	29.	_____
30.	Trouble with boss	30.	_____
31.	Change in work hours or conditions	31.	_____
32.	Change in residence	32.	_____
33.	Change in schools	33.	_____
34.	Change in recreation	34.	_____
35.	Change in church activities	35.	_____
36.	Change in social activities	36.	_____
37.	Small loan	37.	_____
38.	Change in sleeping habits	38.	_____
39.	Change in number of family gatherings	39.	_____
40.	Change in eating habits	40.	_____
41.	Vacation	41.	_____
42.	Christmas	42.	_____
43.	Minor violations of the law	43.	_____

SCS INVENTORY

Instructions: Because the response format for this inventory has more options than are available on the answer sheet, you should respond directly on the questionnaire. Indicate how characteristic or descriptive each of the following statements is of you by using the code given below. Give your responses in the spaces to the left of the items.

+3 very characteristic of me, extremely descriptive
+2 rather characteristic of me, quite descriptive
+1 somewhat characteristic of me, slightly descriptive
-1 somewhat uncharacteristic of me, slightly undescriptive
-2 rather uncharacteristic of me, quite undescriptive
-3 very uncharacteristic of me, extremely nondescriptive

_____ 1. When I do a boring job, I think about the less boring parts of the job and the reward that I will receive once I am finished.

_____ 2. When I have to do something that is anxiety arousing for me, I try to visualize how I will overcome my anxieties while doing it.

_____ 3. Often by changing my way of thinking I am able to change my feelings about almost everything.

_____ 4. I often find it difficult to overcome my feelings of nervousness and tension without any outside help.

_____ 5. When I am feeling depressed, I try to think about pleasant events.

_____ 6. I cannot avoid thinking about mistakes I have made in the past.

_____ 7. When I am faced with a difficult problem, I try to approach its solution in a systematic way.

_____ 8. I usually do my duties quicker when somebody is pressuring me.

_____ 9. When I am faced with a difficult decision, I prefer to postpone making a decision even if all the facts are at my disposal.

_____ 10. When I find that I have difficulties in concentrating on my reading, I look for ways to increase my concentration.

_____ 11. When I plan to work, I remove all the things that are not relevant to my work.

_____ 12. When I try to get rid of a bad habit, I first try to find out all the factors that maintain this habit.

_____ 13. When an unpleasant thought is bothering me, I try to think about something pleasant.

_____ 14. If I would smoke two packages of cigarettes a day, I probably would need outside help to stop smoking.

_____ 15. When I am in a low mood, I try to act cheerful so my mood will change.

_____ 16. If I had the pills with me, I would take a tranquilizer whenever I felt tense and nervous.

_____ 17. When I am depressed, I try to keep myself busy with things that I like.

_____ 18. I tend to postpone unpleasant duties even if I could perform them immediately.

_____ 19. I need outside help to get rid of some of my bad habits.

_____ 20. When I find it difficult to settle down and do a certain job, I look for ways to help me settle down.

_____ 21. Although it makes me feel bad, I cannot avoid thinking about all kinds of possible catastrophes in the future.

_____ 22. First of all I prefer to finish a job that I have to do and then start doing the things I really like.

_____ 23. When I feel pain in a certain part of my body, I try not to think about it.

_____ 24. My self-esteem increases once I am able to overcome a bad habit.

_____ 25. In order to overcome bad feelings that accompany failure, I often tell myself that it is not so catastrophic and that I can do something about it.

_____ 26. When I feel that I am too impulsive, I tell myself "stop and think before you do anything."

_____ 28. Facing the need to make a decision, I usually find out all the possible alternatives instead of deciding quickly and spontaneously.

_____ 29. Usually I do first the things I really like to do even if there are more urgent things to do.

_____ 30. When I realize that I cannot help but be late for an important meeting, I tell myself to keep calm.

_____ 31. When I feel pain in my body, I try to divert my thoughts from it.

_____ 32. I usually plan my work when faced with a number of things to do.

_____ 33. When I am short of money, I decide to record all my expenses in order to plan more carefully for the future.

_____ 34. If I find it difficult to concentrate on a certain job, I divide the job into smaller segments.

_____ 35. Quite often I cannot overcome unpleasant thoughts that bother me.

_____ 36. Once I am hungry and unable to eat, I try to divert my thoughts away from my stomach or try to imagine that I am satisfied.

APPENDIX D

COMPUTERIZED INVENTORIES

Life Style Approaches

Instructions: For the items in this questionnaire, indicate how different or similar that item is to your life style. Use the following scale:

(A) Very different from me
(B) Somewhat different from me
(C) Uncertain
(D) Somewhat similar to me
(E) Very similar to me

Simply indicate your answer for each item by darkening the appropriate circle for each item on the answer sheet.

1. In most situations, I have a clear sense of what behaviors would be right or wrong for me.

2. When confronted with many different things to do, I have difficulty deciding what is most important to do.

3. After making a decision about what is most important to do at any given time, I easily get sidetracked from that activity.

4. Once I decide what is most important to do at any given time, I start on that task right away.

5. I write down the pro's and con's of any behavior change I am considering.

6. I have difficulty judging how long it will take me to complete a task.

7. I seldom analyze what I am saying to myself regarding problem areas in life.

8. I have written down my life goals.

9. When I begin a personal change project, I generally keep my plans to myself.

10. I keep my work space well-organized.

11. I have a clear sense of what I most want to experience in my life.

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

Response code: (A) Very different from me, (B) Somewhat different from me, (C) Uncertain, (D) Somewhat similar to me, (E) Very Similar to me.

12. I seldom ask for feedback from others about behaviors I need to change and how best to change those behaviors.

13. I complete tasks at the time I say I'm going to complete them.

14. I seldom write down my yearly goals.

15. I'm confused as to the kind of personal qualities I want to develop in my life.

16. I have difficulty matching various tasks with my energy level.

17. I subdivide big tasks into a series of smaller tasks.

18. I have little idea as to what I most want to achieve in my life.

19. I actively work to make the place where I spend a lot of time more attractive.

20. I complete major tasks well in advance of deadlines.

21. When I deviate from my selected goal, I have a hard time getting back on track.

22. My living space is quite messy.

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

Situations Questionnaire

Instructions: Each of the 16 statements in this questionnaire describes a specific situation. You are to decide the extent to which you agree that the statement is typical of your behavior. Use the following scale in responding to the items in the questionnaire;

A = Strongly Disagree
B = Disagree
C = Neutral
D = Agree
E = Strongly Agree

Simply darken the appropriate circle after each item number on the answer sheet.

23. I manage my personal or family budget well.

24. I manage my time carefully.

25. I snack between meals.

26. I control my anger in interpersonal conflicts.

27. I make major purchases on impulse.

28. I exercise regularly.

29. I procrastinate on work/study assignments.

30. I find it difficult to assert my own needs and desires.

31. I control the size of the portions of the food I eat.

32. I avoid eating high-caloric, fatty, or sweet foods.

33. I schedule leisure activities regularly.

34. I have nervous habits like nail-biting, smoking, or grinding my teeth.

35. I lose my temper regularly.

36. I have difficulty saying "no" to others.

37. I eat a balanced diet.

38. I prioritize activities and work on the most important ones first.

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

4

PSS

Instructions: The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the alternative that seems like a reasonable estimate. Use the following response code in marking your choices on the answer sheet.

A. Never
B. Almost never
C. Sometimes
D. Fairly often
E. Very often

39. In the last month, how often have you been upset because of something that happened unexpectedly?

40. In the last month, how often have you felt that you were unable to control the important things in your life?

41. In the last month, how often have you felt nervous and "stressed"?

42. In the last month, how often have you dealt successfully with irritating life hassles?

43. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?

44. In the last month, how often have you felt confident about your ability to handle your personal problems?

45. In the last month, how often have you felt that things were going your way?

46. In the last month, how often have you found that you could not cope with all the things that you had to do?

47. In the last month, how often have you been able to control irritations in your life?

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

5

Response code: (A) Never, (B) Almost never, (C) Sometimes, (D) Fairly often, (E) Very often

48. In the last month, how often have you felt that you were on top of things?

49. In the last month, how often have you been angered because of things that happened that were outside of your control?

50. In the last month, how often have you found yourself thinking about things that you have to accomplish?

51. In the last month, how often have you been able to control the way you spend your time?

52. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

CHIPS

Instructions: The questions in this inventory ask you about your health and how much you have been bothered by some physical symptoms that people often experience. Mark the letter for each statement that best describes HOW MUCH THAT PROBLEM HAS BOTHERED OR DISTRESSED YOU DURING THE PAST TWO WEEKS INCLUDING TODAY. Mark only one letter for each item. Use the following response code in marking your choices on the answer sheet.

A. Not at all
B. A little bit
C. Moderately
D. Quite a bit
E. Extremely

53. Sleep problems (can't fall asleep, wake up in middle of night or early in morning)

54. Weight change (gain or loss of 5 pounds or more)

55. Back pain

56. Constipation

57. Dizziness

58. Diarrhea

59. Faintness

60. Constant fatigue

61. Headache

62. Migraine headache

63. Nausea and/or vomiting

64. Acid stomach or indigestion

65. Stomach pain (e.g., cramps)

66. Hot or cold spells

67. Hands trembling

68. Heart pounding or racing

69. Poor appetite

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

Response code: (A) Not at all, (B) A little bit, (C) Moderately, (D) Quite a bit, (E) Extremely

70. Shortness of breath when not exercising or working hard
71. Numbness or tingling in parts of your body
72. Felt weak all over
73. Pains in heart or chest
74. Feeling low in energy
75. Stuffy head or nose
76. Blurred vision
77. Muscle tension or soreness
78. Muscle cramps
79. Severe aches and pains
80. Acne
81. Bruises
82. Nosebleed
83. Pulled (strained) muscles
84. Pulled (strained) ligaments
85. Cold or cough

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

LVI

Instructions: The following questions are an extension of the previous inventory about your health. Note, however, that the response code is different. Mark the letter of each statement that best describes if you (A) have never had the problem, (B) have had the problem in the past, or (C) currently have the problem. Use the following response code in marking your answers on the answer sheet and use only one letter for each item.

A. No (Never)
B. Not currently, yes in the past
C. Yes (Currently)

86. Is your face frequently flushed?

87. Have you ever been diagnosed as having high blood pressure?

88. Have you ever used blood pressure medication?

89. Do you have sleep problems?

90. Have you ever been diagnosed as having insomnia?

91. Do you use any medication to help you sleep (e.g., over-the-counter or prescription medication)?

92. Do you ever have mid or lower back pain, numbness or tingling?

93. Have you ever been diagnosed as having a mid or low back problem?

94. Have you ever had mid or low back surgery?

95. Have you ever had upper back or neck pain, numbness or tingling?

96. Have you ever been diagnosed as having upper back or neck problems?

97. Have you ever had upper back or neck surgery?

98. Have you ever had shoulder or elbow pain, numbness or tingling?

99. Have you ever been diagnosed as having a shoulder or elbow problem?

100. Have you ever had shoulder or elbow surgery?

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

Response code: (A) No (Never), (B) Not currently, yes in the past, (C) Yes (Currently)

101. Have you ever had pain, numbness or tingling in your wrists, hands or fingers?

102. Have you ever been diagnosed as having carpal tunnel syndrome?

103. Have you ever had carpal tunnel surgery?

104. Have you ever had pain, numbness or tingling in your knee(s)?

105. Have you ever been diagnosed as having a knee problem?

106. Have you ever had knee surgery?

107. Have you ever had pain, numbness or tingling in your ankle(s)?

108. Have you ever been diagnosed as having an ankle problem?

109. Have you ever had ankle surgery?

110. Have you ever had diabetes mellitus?

111. Have you ever had arthritis?

112. Have you ever had hyperthyroidism?

(For Women Only)

113. Have you ever used oral contraceptives?

114. Have you ever used postmenopausal estrogens?

115. Have you ever had gynecologic surgery (e.g., hysterectomy)?

116. If so, did you have your ovaries removed?

PLEASE RE-CHECK THE ANSWER SHEET TO BE SURE YOU HAVE MISSED NO ITEMS ON THIS PAGE.

APPENDIX E

CTS

Pair #	Sex	Race	Age	Ht/Wt (lbs)	Job Title	# of Years on Job/Hours or Total # of Years With Company
1	F	White	40	5'3"/159	Interpreter	5+yrs/10hrs per week
2	F	White	29	5'8"/260	Interp/Part Time	1yr/3hrs per month
3	F	White	36	5'6"/135	Auto Assembler	3yrs/9yrs
4	F	White	38	5'1"/190	Auto Assembler	10yrs/10yrs
5	F	White	46	5'6"/165	Auto Assembler	5yrs/12yr
6	F	White	36	5'4"/160	Auto Press Oper	6yrs/13yr
7	F	White	47	5'4"/140	Keyboard Operator	3yrs/7yrs
8	F	White	42	5'6"/135	Interp/Admin	5yrs/46hrs per week
9	F	White	25	5'6"/133	Interpreter	1/2yr/9hrs per week
10	F	White	34	5'7"/120	Interpreter	9yrs/25hrs per week
11	F	White	34	5'4"/140	Interpreter	2yrs/20hrs per week
12	F	White	34	5'5"/135	Interpreter	13yrs/30hrs per week
13	M	White	28	5'11"/195	Interp/Admin	1yr/30hrs per week
14	F	White	35	5'3"/114	Interpreter	11yrs/33hrs per week
15	F	White	28	5'7"/130	Interpreter	3yrs/40hrs per week
16	F	White	49	5'8"/230	Interpreter	19yrs/20+hrs per week
17	F	White	45	5'2"/115	Garment Inspector	2yrs/12yrs
18	F	White	42	5'2"/170	Garment Press Oper	7yrs/7yrs
19	F	White	33	5'6"/170	Seconds Grader	1 1/2yrs/10yrs
20	F	White	34	5'4"/101	Mender	6 1/2yrs/6 1/2yrs
21	F	White	36	5'5"/220	Gar Sundries Clerk	5yrs/14yrs
22	F	White	30	5'5"/155	Garment Inspector	7yrs/8yrs
23	F	White	42	5'2"/112	Keyboard Operator	7yrs/8yrs
24	F	Black	32	5'3"/150	Keyboard Operator	2yrs/2yrs
25	F	White	32	5'3"/266	Electronic Assembly	1yr/2yrs
26	F	White	38	5'4"/125	Cone Assembler	6yrs/9yrs
27	F	White	30	5'7"/145	Electronic Assembly	1yr/2yrs
28	F	White	42	5'5"/180	Elec VC Assembly	4yrs/4yrs
29	F	White	39	5'3"/130	Elec Assembly	1yr/3yrs
30	F	White	35	5'2"/120	Elec Assembly	8yrs/9yrs
31	F	White	32	5'4"/129	Cone Assembler	6yrs/6yrs
32	F	White	31	5'7"/280	Keyboard Operator	1yr/1yr
33	F	Black	36	5'7"/220	Topstitch Dart	11yrs/11yrs
34	F	White	34	5'9"/223	Sideseamer	3yrs/3yrs
35	F	White	24	5'8"/165	Sideseamer	3yrs/3yrs

NON-CTS

Sex	Race	Age	Ht/Wt (lbs)	Job Title	# of Years on Job/Hours or Total # of Years With Company
F	White	46	5'3"/115	Interpreter	2yrs/40hrs per week
F	White	36	5'2"/200	Interp/Mgt	1yr/40mgr/2int
F	White	33	5'11"/155	Auto Assembler	2yrs/8yrs
F	White	35	5'2"/165	Auto Assembler	1yr/8yrs
F	White	53	5'5"/175	Auto Assembler	12yrs/12yrs
F	White	50	5'6"/159	Auto Press Oper	12yrs/12yrs
F	White	44	5'6"/138	Keyboard Oper	4yrs/12yrs
F	White	31	5'5"/130	Interp/Admin	5yrs/45hrs per week
F	White	37	5'4"/135	Interpreter	3yrs/20hrs per week
F	White	27	5'3"/140	Interpreter	3yrs/20hrs per week
F	White	33	5'8"/150	Interpreter	4yrs/20+hrs per week
F	White	28	5'4"/110	Interpreter	6yrs/25hrs per week
M	White	27	5'6"/230	Interpreter/Telecom	3yrs/40hrs per week
F	White	28	5'5"/130	Interpreter	3yrs/30hrs per week
F	White	35	5'1"/139	Interp/Instructor	12yrs/45hrs per week
F	White	38	5'1"/180	Interp/Instructor	12yrs/45hrs per week
F	White	31	5'5"/145	Garment Inspector	5yrs/5yrs
F	White	30	5'3"/105	Garment Inspector	5yrs/8yrs
F	White	48	5'5"/145	Gar Press Operator	6yrs/6yrs
F	White	50	5'7"/136	Gar Press Operator	3yrs/5yrs
F	White	36	5'4"/128	Gar Packer	3yrs/10yrs
F	White	31	5'2"/140	Garment Inspector	8yrs/8yrs
F	White	32	5'1"/108	Keyboard Operator	2yrs/2yrs
F	Black	29	5'5"/130	Keyboard Operator	2yrs/10yrs
F	White	34	5'7"/150	Elec Assembly/Solder	1yr/4yrs
F	White	28	5'4"/195	Cone Assembler	7yrs/8yrs
F	White	37	5'7"/140	Elec Assembly	1yr/2yrs
F	White	30	5'6"/150	Elec VC Assembly	8yrs/8yrs
F	White	32	5'3"/110	Elec Assembly	2yrs/2yrs
F	White	43	5'2"/104	Elec Assembly/Supvr	1/2yr/10yrs
F	White	44	5'6"/140	Cone Assembly	9 1/2yrs/10yrs
F	White	27	5'0"/210	Keyboard Operator	10yrs/10yrs
F	White	35	5'8"/200	Topstitch back	4yrs/4yrs
F	White	39	5'8"/245	Sideseamer	3yrs/3yrs
F	White	42	5'4"/158	Sideseamer	4yrs/4yrs

CTS

Pair #	Sex	Race	Age	Ht/Wt (lbs)	Job Title	# of Years on Job/Hours or Total # of Years With Company
36	F	White	54	5'1"/170	Inseam	3yrs/19yrs
37	F	White	34	5'1"/114	Sideseam	1yr/13yrs
38	F	white	52	5'4"/125	Inseam	3yrs/7yrs
39	F	White	33	5'4"/186	Topstitch Sideseam	2yrs/5yrs
40	F	Asian	50	5'0"/110	Folder Set Fly	5yrs/5yrs
41	F	White	32	5'3"/125	Topstitch Dart	1yr/7yrs
42	F	White	39	5'4"/120	Face Front Pockets	10yrs/16yrs
43	F	Asian	41	5'0"/95	Sewing Serger	2weeks/13yrs
44	F	White	27	5'6"/125	Topstitch Hip Pocket	3yrs/3yrs
45	F	White	31	5'7"/165	Sideseam	2yrs/5yrs
46	F	White	46	5'3"/130	Machine Operator	27yrs/27yrs
47	F	White	56	5'6"/145	Sewing Auditor	2yrs/27yrs
48	F	White	28	5'7"/135	Belt Loops	1mo/3yrs
49	F	White	54	5'2"/180	Quality Control	2yrs/26yrs
50	F	White	40	5'4"/145	Hem Pant Legs	3yrs/21yrs

NON-CTS

Sex	Race	Age	Ht/Wt (lbs)	Job Title	# of Years on Job/Hours or Total # of Years With Company
F	White	47	5'7"/230	Inseam	3yrs/26yrs
F	White	35	5'5"/134	Sideseam	6yrs/7yrs
F	White	35	5'8"/???	Inseam	3yrs/15yrs
F	White	59	5'6"/120	Face Front Pockets	25yrs/26yrs
F	Black	31	5'7"/138	Folder Set Fly	3yrs/7yrs
F	White	23	5'3"/106	Dart Hemback Pt	3yrs/3yrs
F	White	36	5'5"/107	Face Front Pockets	16yrs/18yrs
F	White	34	5'4"/120	Topstitch Dart	14yrs/14yrs
F	White	30	5'6"/155	Topstitch Hip Pocket	4yrs/4yrs
F	White	42	5'5"/120	Sideseam	2yrs/16yrs
F	White	45	5'7"/148	Machine Operator	8yrs/27yrs
F	White	50	5'0"/135	Tack Button	4yrs/18yrs
F	White	30	5'8"/140	Belt Loops	2yrs/10yrs
F	White	30	5'5"/230	Quality Control	18yrs/18yrs
F	White	34	5'6"/123	Hem Pant Legs	8yrs/8yrs

VITA

Lisa Marie Vogelsang was born in Santa Monica, California, on February 24, 1954. She attended Notre Dame Academy and graduated from St. Bernard High School in 1972. She earned the Bachelor of Science degree in Kinesiology and California Secondary and Community College Teaching Credentials from the University of California, Los Angeles and the UCLA Graduate School of Education in 1977.

She moved to Europe in 1978 and worked in Munich, Germany and Gavle, Sweden while training for the 1980 United States Olympic Team in Track and Field (1980 US Olympic Team member - women's discus). She moved back to the Los Angeles area in 1979 and taught part-time in the Los Angeles Unified School District (secondary). Later in 1979, she began teaching and coaching at West Los Angeles College, where she remained for two years. She left WLAC in 1981 to pursue a Master of Science degree at The University of Tennessee, Knoxville. She taught in the Physical Education Department at UTK for one year and obtained her M.S. in Exercise Physiology in 1982.

She worked in some Knoxville area health clubs as an exercise physiologist from 1982 through 1984 and went back to UTK in 1983 to pursue other graduate degrees in Counseling. She worked with the UTK Postsecondary Education

Consortium for the Deaf as a graduate and research assistant from 1984 to 1987. She received an M.S. and Ed.S. in Educational and Counseling Psychology in 1985 and 1986, respectively, and worked as a counselor in the Withdrawal Office with UTK from 1986 to 1987.

She began the doctoral program for Educational Psychology in 1986. In 1987, she became the Program Director for Physical Rehabilitation at The Rehabilitation & Wellness Corporation in Knoxville and set up and established a successful program. She left the RWC in 1990 and has been doing independent consulting work in the area of health psychology and wellness since that time. She received the Doctor of Philosophy degree in Education with a major in Educational Psychology emphasizing a health psychology perspective in August of 1992. Her career objective is to teach and pursue research in a university setting.