Perceived Psychological Stress and Upper Extremity Cumulative Trauma Disorders

by Patricia B. Strasser, PhD, RN, COHN-S, Sally L. Lusk, PhD, RN, FAAN, Alfred Franzblau, MD, and Thomas J. Armstrong, PhD, MPH

Abstract

This report presents data exploring the relationship between perceived psychological stress and several variables implicated in the etiology of upper extremity cumulative trauma disorders (UECTDs). The sample was 354 workers from three different manufacturing companies. The primary job exposure for the subjects was that they were engaged in jobs that involved repetitious movements of the upper extremities, primarily of the hands and arms. Data collection included a detailed health history, a comprehensive physical examination of the upper extremities, limited electrodiagnostic testing, Cohen's Perceived Stress Scale, Karasek's Job Content Questionnaire, demographic information, and a measurement of repetition.

Descriptive analyses, analysis of variance, correlational analyses, and multiple linear regression were used to examine the data. Perceived stress, as measured in this study, was only weakly associated with repetition, job dissatisfaction, and subjective complaints related to UECTDs. In addition, factors generally accepted as related to UECTDs (e.g., repetition, female gender, hormonal influences, and existing medical conditions) were not robust predictors of perceived stress. The major limitation is related to the measurement of perceived psychological stress. Like most psychosocial phenomena, perceived stress is a complex construct, one that is difficult to measure and correlate with health outcomes. Further research is necessary to examine what role, if any, perceived stress may have in the etiology of UECTDs.

Dr. Strasser is owner, Partners in BusinessHealth Solutions, Inc., Toledo, OH, and Adjunct Assistant Professor, University of Michigan School of Nursing, Ann Arbor, MI. Dr. Lusk is Professor and Director, Occupational Health Nursing Program, University of Michigan School of Nursing, Ann Arbor, MI. Dr. Franzblau is Associate Professor, and Dr. Armstrong is Professor, Occupational Health Program, Department of Environmental and Industrial Health, The University of Michigan School of Public Health, Center for Ergonomics, Department of Industrial and Operations Engineering, The University of Michigan College of Engineering Ann Arbŏr, MI.

TABLE 1
Operational Definitions

Variable	*Operational Definition*
Perceived stress	Perceived Stress Scale developed by Cohen (1983). Based on Lazurus' theory, the 14 items measure the degree to which a person finds life unpredictable, uncontrollable, and overloading. Five point Likert scale. Good reliability and validity reported in several studies. (Griffen, 1993; Thomas, 1991; Walker, 1989). Reliability in this study was .80 (Cronbach Alpha).
Repetition	Jobs were assessed as described by Latko (1997) based on the frequency of repetitious hand motion. Measured on a 0-10 interval scale as well as a trichotomous classification: low repetition (0-3.5), moderate repetition (3.6-7), or high repetition (7.1-10).
Job control	Karasek's (1985) Job Content Survey (JCS). The JCS was developed using factor analysis from three large national surveys with good reliability and validity reported (Karasek, 1990).
Job satisfaction	Karasek's (1985) Job Content Survey
Medical history	Four dichotomous variables: • History of medical diseases (diabetes, rheumatoid arthritis, degenerative arthritis, thyroid disease, gout, peripheral neuropathy); • Hormone influence (e.g., pregnant, on oral contraceptives, menopause [surgical or natural]); • Soft tissue conditions (tendonitis, prior carpal tunnel syndrome, ganglion, thoracic outlet syndrome, rotator cuff injury, strains/sprains); and • Surgery/trauma (fracture, surgery of the upper extremity). Test-retest reliability for the questionnaire used to elicit health history was good to excellent using the kappa coefficient (Franzblau, 1997).

UECTD	Measured in several ways, all based on self report of symptoms as well as physical examination results, and electrodiagnostic testing:
	• Categorical classification
	  • Diagnosed UECTD — physician determination based on above information and predetermined diagnostic criteria
	  • Nonspecific discomfort only — subjective complaints that do not meet diagnostic criteria
	  • No objective or subjective symptoms of UECTDs
	• Self report of subjective symptoms were measured as continuous level variables by summing the subjective complaints (e.g., pain, burning, numbness) for each of three anatomical areas (neck/shoulders/upper arms; elbow/forearm; hand/wrist/fingers). A total score was also calculated to measure the sum of all subjective symptoms (for each of the three anatomical areas). Test-retest reliability for the symptom reporting was good to excellent using the kappa coefficient (Franzblau, 1997).

The term upper extremity cumulative trauma disorders (UECTD) is used to describe injury to the structures of the upper body that occurs over time (Armstrong, 1986). The term is only one of several (e.g., repetitive strain injuries, overuse syndrome) that have been attached to a variety of musculoskeletal conditions. Consensus has not been reached in relation to terminology nor to a definition of UECTDs. Although exact prevalence rates are unknown, UECTDs have been found to occur in a variety of work settings, including meat processing plants, manufacturing firms, telecommunications industry, supermarkets, and among persons working with video display terminals (Armstrong, 1982; Burt, 1990; Jensen, 1983).

Psychological stress, related to work as well as to personal circumstances, has been hypothesized to contribute to the development of cumulative trauma disorders (Hess, 1997; Stock,.1991). After a review of studies examining work related psychosocial factors and musculoskeletal disorders, Bongers (1993) recommended expanding the examination of psychosocial phenomena, such as job satisfaction, to include self reported stress to capture the effect interpersonal characteristics may exert on musculoskeletal disorders.

This article presents data exploring the relationship of perceived psychological stress and several variables implicated in the etiology of UECTDs. The entire study, which examined a conceptual model developed to inte-

TABLE 2
Demographic Characteristics of the Sample

Characteristic		n (Percent)
Gender		
Males		179 (50.5)
Females		175 (49.5)
Total		354 (100)
Education Level		
≤Grade 8		1 (0.3)
Some high school		20 (5.7)
High school graduate		244 (69.6)
Junior college/technical school		42 (11.9)
Attended 4 year college		28 (7.9)
4 year college graduate		12 (3.5)
Graduate/professional school		4 (1.1)
Total		351 (100)
Race		
White		312 (89.1)
African American		17 (4.8)
Asian		7 (2.1)
Hispanic		13 (3.7)
Other		1 (0.3)
Total		350 (100)
Age (yrs)	M=41.48 Range=19.66	SD=10.88 N=352

grate physical and psychosocial factors and UECTDs, is reported elsewhere (Strasser, 1996). The data were collected as part of a National Institute for Occupational Saftey and Health funded research project focused on ergonomic risk factors and UECTDs.

REVIEW OF THE LITERATURE

Psychological Stress

According to Lazarus (1985), no issue in the area of health psychology has garnered as much attention as the subject of stress. Although not without some controversy (Schroeder, 1984), it is generally accepted that stress, variously defined, is linked with health outcomes (Bhagat, 1985; Dohrenwend, 1985; House, 1981; Rossi, 1989; Sarason, 1978). Lazarus (1984) defined stress as:

> an inharmonious fit between the person and the environment, one in which the person's resources are taxed or exceeded, forcing the person to struggle, usually in complex ways, to cope.

Stress is a complex construct like other psychological phenomena (e.g., emotion), rather than a discrete variable. Stress is presumed to be made up of many elements and processes reflected in the person's appraisal of a relationship with the environment as either relevant to well being or exceeding resources and, therefore, a threat to well being (Lazarus, 1985).

Psychological Stress and Health

As mentioned above, the relationship between stress and health has been examined extensively. Possibly because the concept of health is as elusive as the concept of stress, the majority of the research has focused on stress and disease rather than on stress and health (Antonovsky, 1979). According to Kasl (1984), a thorough review of the empirical literature relating psychological stress with health/disease outcomes is perhaps an impossible task. Kasl (1984) cited serious conceptual and methodological flaws inherent in most examinations of stress and disease. These flaws include such factors as the inability to control confounding variables in human studies, thus precluding clear cut causal inference.

In a review of nursing research related to stress and health, concerns similar to Kasl's related to the methodological difficulties of stress and health research and the resultant knowledge were expressed (Barnfather, 1993). According to Werner (1993),

> The knowledge generated from the study of stressors conducted in the nursing research is much like the field of stress research itself. A vast amount of research has been conducted, yet there are few clear cut findings.

Psychological Stress and UECTDs

The conceptual difficulties discussed above are most evident when reviewing studies that examined psychological stress and musculoskeletal disorders of the upper extremities. One study was identified that measured psychological stress in the same manner as the current study. Hess (1997) collected data from 274 state employees about their computer usage and symptoms of UECTDs. Significant correlations were reported between perceived stress and self reported symptoms of UECTDs (r= 0.38, *p*=.0001 for the "at risk" group [increased time spent on computer]; r=.52, *p*=.0001 for the "not at risk" group). One of the primary limitations of this study is that both exposure and outcome were based on subjective data only (i.e., self report). Two other studies (Hazlett, 1992; Moulton, 1992) measured stress using methods similar to this study and reported tentative evidence of a relationship between stress and UECTDs, while acknowledging the difficulty of measuring the concept of stress.

Upper Extremity Cumulative Trauma Disorders

Exact incidence and prevalence rates of UECTDs are generally unknown (Armstrong, 1993). Some of the problems with determining occurrence rates include nonuniform diagnostic criteria, assorted definitions, and dis-

TABLE 3

Variables Measured in the Study

Variable	*n*	*Mean*	*SD*	*Sample Range*	*Possible Range*
Perceived stress	353	23.9	7.1	4.46	0, 56
Repetition (overall)	342	4.98	2.72	0.7, 8.5	0, 10
Low group	107	1.41	0.62	0.7, 3.1	0, 3.5
Moderate group	96	5.03	0.95	3.7, 7.0	3.6, 7.0
High group	139	7.69	0.29	7.2, 8.5	7.1, 10
Job dissatisfaction	350	0.26	0.20	0.0, 0.9	0.0, 1.0
Job control	346	57.73	12.48	24, 92	24, 96
BMI (kg/m^2)	354	28.60	5.86	17.8, 53.4	n/a
Height (cm)		168.3	9.02	145, 191	
Weight (kg)		81.2	17.85	44, 141.5	

Medical History Variable	*Number With Positive History*	*Percent of Total Sample*
Soft tissue injury	161	45.5
Surgery/trauma	139	39.3
Hormone influence	75	21.2
Medical disease	68	19.2

Abbreviation: BMI=body mass index.

parate reporting and recordkeeping procedures (Armstrong, 1993). A review of more than 50 studies (Strasser, 1996) demonstrated incidence rates from 0.6% to 81% depending on the measurement methods used and population differences. Most of the UECTD research to date has relied on self reports of musculoskeletal complaints without verification of precise diagnoses. It is generally believed that UECTDs are associated with such ergonomic factors as: repetition, force, posture (e.g., extreme joint positions), vibration, mechanical stress, and low temperatures (Armstrong, 1986: Putz-Anderson, 1988; Rempel, 1992; Stock, 1991). The number of well designed studies examining ergonomic factors and UECTDs is small, with methodological flaws such as imprecise measurements of workplace exposure and outcomes.

Empirical evidence exists which links highly forceful and repetitious work with certain disorders of the hands and wrists (Stock, 1991). Much less is known about causal links between ergonomic factors and UECTDs of the neck, shoulder, and elbow or about the other ergonomic factors and UECTDs in general. Numerous studies have cited associations of various personal characteristics such as gender, age, assorted medical conditions, etc with UECTDs. There is some evidence, albeit not conclusive nor consistent, that psychosocial aspects of the workplace, especially job satisfaction and possibly job control/decision latitude, are associated with symptoms of UECTDs (Bernard, 1992; Faucett, 1994; Sauter, 1983; Tola, 1988).

Research and theories pertaining to psychological stress and stress and health abound. Yet no consensus about the definition of stress exists, nor is there empirical certainty about the relationship between stress and health. Evidence suggests a relationship between some psychosocial phenomena and musculoskeletal disorders. Although the phenomena which have been implicated are quite broad and labeled as anxiety, tension, depression, Type A personality, and irritability, among others (Bongers, 1993). Further, it is generally accepted that stress, however variously defined, does affect biological functioning and health, albeit in an undetermined manner. Additionally, there is some evidence that perceived stress is related to self reported subjective symptoms suggestive of UECTDs. Hence, the purpose of this study was to explore the relationship between perceived psychological stress and several variables that have been implicated in the etiology of UECTDs.

METHODS

The study used a nonexperimental, cross-sectional design. Table 1 contains the operational definitions of the variables examined. In addition to these variables, demographic information (i.e., age, gender, education) and body mass index (weight divided by height squared) also was obtained. The sample consisted of 354 industrial,

TABLE 4
Prevalence of UECTDs

Diagnosis	*n (%)*
Carpal tunnel syndrome	60 (17)
Unilateral	37 (10.4)
Bilateral	23 (6.5)
Cubital tunnel syndrome	1 (0.2)
Epicondylitis	33 (9.3)
Rotator cuff injury	18 (5.9)
Radiculopathy	0 (0)
Tendonitis/bursitis	60 (17)
Ganglion	6 (1.7)
Arthritis	27 (7.6)
Trigger finger	2 (0.4)
Other diagnoses	9 (2.5)
Median mononeuropathy	106 (30)
Unilateral	46 (13)
Bilateral	60 (17)
Non-specific discomfort	
Elbows, forearms	59 (16.7)
Fingers, wrists, hands	107 (30.2)
Neck, shoulders, upper arms	119 (34)

blue collar workers employed at three manufacturing locations (two automotive parts plants and an industrial containers plant) in the Midwest. The combined participation rate at the three plants was 68%. The plants were eligible for inclusion in the study because they each had at least 20 workers in each of the three strata of repetition (see Table 1). Workers were invited to participate in the study if they had at least 6 months tenure in the jobs selected for inclusion in the study. Individuals who agreed to participate signed a consent form which had been approved by the University of Michigan Institutional Review Board.

All data were collected within the manufacturing facility. The participants progressed through the various data collection stations, including the physical examination, with the final component the medical consultation with the physician to determine whether the individual had a diagnosed UECTD. The entire data collection process for an individual subject took approximately 75 minutes. Data were coded and entered into a personal computer by trained research assistants. All data were double entered to insure accuracy.

RESULTS

Tables 2-4 contain information about the study participants and the variables measured. The 354 participants were fairly evenly split by gender (179 males and 175 females). The average age was 41.5 and the majority were high school graduates (69.6%).

The only variables significantly associated with perceived stress were: repetition ($r=.16$; $p=.003$), job dissatisfaction ($r=.15$; $p=.004$), subjective complaints of the neck/shoulder/upper arm ($r=.16$; $p=.003$) and total subjective symptom reporting ($r=.15$; $p=.005$). As participants' level of job dissatisfaction increased, they reported higher levels of perceived stress via the perceived stress scale (PSS). In addition, as the repetitiousness of the job increased, the PSS score also increased. Subjects who reported more subjective symptoms in their necks, shoulders, and upper arms and those with more total subjective complaints reported higher levels of perceived stress than those reporting fewer symptoms.

Analysis of variance (ANOVA) was used to determine whether there was a difference in the reported level of perceived psychological stress among individuals with:

- No symptoms of UECTDs;
- Subjective complaints only; and
- One or more diagnosed UECTDs.

An additional ANOVA was carried out with all the subjects split into two groups, those with no complaints/symptoms of UECTD and those with complaints/symptoms. No significant differences in PSS scores were found among any of these groups.

Mean PSS scores differed significantly between males and females and by repetition categories (see Table 5). Post-hoc multiple comparison analyses examining repetition category and mean PSS scores verified that subjects working in high repetition jobs reported significantly higher levels of perceived stress than subjects in low repetition jobs. No significant differences were found in the PSS scores between subjects working in medium versus low repetition jobs, or medium versus high repetition jobs.

The effects of all of the variables on perceived stress were assessed via the following process. The initial step involved regressing perceived stress on all variables using a forced method entry. Variables were subsequently removed to arrive at the most parsimonious model with an optimal goodness of fit as indicated by the adjusted R square. A significance level of .05 was used as the primary criteria for deleting variables. All potential interactions among the variables were also entered into the regression and subsequently deleted as with the individual variables. The model that appeared to be the best predictor of perceived psychological stress in these subjects included the following variables: age, gender, job dissatisfaction, repetition, and an interaction term, age and job dissatisfaction. Table 6 contains the regression statistics from this model. The R square for the model was .11 (adjusted r square = .10), indicating that these variables explain 10% of the variance in perceived psychological stress. No significant multicollinearity was found among the variables in the model. Analysis of the residuals indicated there were no obvious violations of linearity assumptions.

TABLE 5

Differences in PSS Scores for Gender and Repetition

Category	Number	Mean PSS Score (SD)	Test Statistic
Males	179	22.7 (6.1)	t= -3.5 (*p*=.001)
Females	174	25.3 (7.6)	
Low repetition	107	22.7 (6.5)	
Medium repetition	95	23.8 (7.2)	F= 4.1 (*p*=.013)
High repetition	139	25.3 (7.2)	

When examining the betas, it can be seen that a one unit increase in repetition (e.g., from 3 to 4, on the 0-10 scale) resulted in approximately a 0.37 increase in the PSS score. Therefore, an increase in repetition of six units (e.g. from the low repetition group to the high repetition group) would result in raising the PSS by approximately two points. The beta for gender demonstrates that women, on average, were 2.3 points higher on the PSS than men.

To comprehend the interaction between age and job dissatisfaction in this model, a scatterplot with fit lines was produced demonstrating that for individuals with the highest level of job dissatisfaction, perceived stress increased with age. However, subjects with low levels of job dissatisfaction experience less perceived stress as they age. Subjects in the moderate job dissatisfaction category showed less change in perceived stress with age, although perceived stress appears to slightly decrease with increasing age. To further illustrate, when comparing a 60 year old person in the low job dissatisfaction group versus a 60 year old with high dissatisfaction, approximately a seven point increase is seen in the PSS for the person highly dissatisfied with the job. In contrast, the difference in stress levels related to the interaction of stress and job dissatisfaction for individuals in the 20 to 40 age group was more narrow.

DISCUSSION

Limitations

The primary limitation concerns measurement of perceived psychological stress. Perceived stress, like most psychosocial constructs, is an extremely complex phenomena and therefore difficult to measure. The instrument used in this study, the PSS, which has demonstrated validity, asks about psychological stress within the past month. This may be too limiting a definition when trying to examine stress in the context of health outcomes not measured by symptoms occurring in the previous month only. In addition, as Lazarus (1984) suggested, stress should be viewed as a transaction and ultimately examined over time. However, realistically speaking, a prospective study was not feasible for many reasons (e.g., loss of workers over time, changes in the jobs performed by the subjects, expense, etc.). Another limitation was that the conceptual definition of stress (Lazarus, 1984) used in this study depends on the person's appraisal of stress. Coping mechanisms are theorized to be an important part of the appraisal process. No coping mechanisms were measured in this study. Thus, only part of the concept of perceived stress was measured.

Perceived Stress

The mean perceived stress score (23.9) was very similar to Cohen's (1983) college age samples (23.18 and 23.67), but slightly lower than their smoking cessation group (25.0). Hess (1997) reported higher mean PSS scores for the "at risk" group (25.16) but lower scores for the "not at risk" group (21.97). The significant difference in PSS mean scores between males and females in this study was in the same direction as Cohen's (1983) results, although the gender differences did not achieve significance in that study.

Perceived stress was mildly correlated with repetition, job dissatisfaction, female gender, subjective complaints of the neck, shoulder, and upper arm, and total subjective symptom reporting. The correlations, although statistically significant, do not indicate a strong relationship between perceived stress and these factors. The results in this study are not consistent with Hess's (1997) findings of a moderate association between symptoms of UECTDs and perceived stress, as measured by the PSS. The difference may be related to the type of work in the two samples. Hess's study involved clerical workers, whereas this study examined manufacturing workers. The subjects in Hess's study reported neck/shoulder pain primarily rather than complaints related to their hands, while subjects in this study reported hands/wrists/fingers symptoms almost as frequently as symptoms in the neck/shoulder/upper arm area.

Evidence from several studies illustrates significant correlations between psychosocial workplace factors (e.g. job stress, job satisfaction) and neck/shoulder complaints (Bergenudd, 1988; Faucett, 1994; Linton, 1989; Makela, 1991; Ryan, 1988; Tola, 1988; Westgaard, 1993). It seems plausible that persons with pain primarily in the neck/shoulder area perceive more psychological stress than those with discomfort in other areas of the upper extremities.

TABLE 6

Regression of Variables Predicting Perceived Psychological Stress

Variable	*Beta*	*SE B*	*St. Beta*	*T*	*Sig. T*
Repetition	.3695	.1467	.1435	2.52	.0123
Job dissatifaction	-17.4119	8.0055	-.4974	- 2.17	.0303
Age	-.0304	.0345	-.0472	- 3.27	.0012
Gender	2.3257	.8018	.1662	2.90	.0040
Age*/Job dissatisfaction	.5535	.1827	.6987	3.03	.0026

Beta = the partial regression coefficients
SE B=the standard error of Beta
St. Beta=the standardized regression coefficient
*Age*Job dissatisfaction=the interaction of age and job dissatisfaction (centered)*
Gender: Males=0, Females=1

R square=.11
Adj. R square=.10

The differences in perceived stress scores were divided among three groups which were not statistically significant:

- Those who have no symptoms of UECTDs;
- Those with upper extremity subjective complaints only; and
- Those with one or more diagnosed UECTDs.

Although subjects with no subjective complaints did have a lower mean PSS score than subjects with complaints, as was expected, the difference did not achieve significance. Of the several possible explanations for this finding, the first is that the hypothesis underlying this question is flawed. Another likelihood relates to the operational definition of perceived stress as discussed above.

The results of the perceived stress regression analyses demonstrated that only 10% of the variance in perceived stress was explained by the variables measured. Female gender, repetition, and job dissatisfaction were the primary predictors of perceived stress. It is plausible there are numerous non-work and other work related factors that may contribute to a person's perceived stress. The omission of these variables and the manner in which perceived stress was measured may account for the low prediction. Of note is the fact that neither of the two UECTD outcome variables (subjective symptoms of the neck, shoulder, and upper arm and total upper extremity subjective symptom reporting) that were significantly correlated with perceived stress remained as predictors in the final model.

Repetition was a weak, albeit significant predictor of perceived stress, possibly validating hypotheses concerning job stress and repetitiousness. Based on the repetition metric used in this study, highly repetitive jobs have less recovery time than low repetition jobs. It seems plausible that such rapidly paced jobs are potentially hazardous, as Karasek (1985) suggested.

The bivariate relationship between perceived stress and job dissatisfaction was as expected. The significant interaction between age and job dissatisfaction in the regression analysis is also theoretically sound. In this study, as people age it appears that job dissatisfaction may contribute significantly to their overall stress level. Younger individuals unhappy with their jobs could conceivably envision a job change in their future, whereas older individuals may realize that the chances for a job change are minimized, resulting in additional stress.

Implications For Theory, Future Research, and Nursing Practice

Factors generally accepted as related to UECTDs (e.g., repetition, female gender, hormonal influences, existing medical conditions) were not robust predictors of perceived stress, as measured in this study. Additionally, perceived stress was not strongly associated with diagnosed UECTDs or subjective symptom reporting. However, women in this study as well as other investigations report more perceived psychological stress than men report. In addition, participants in this study working in repetitious jobs reported significantly higher levels of perceived stress than workers whose jobs were less repetitious. These findings should alert nurses in the workplace to target women and workers in repetitious jobs for stress management interventions as appropriate.

The etiology of UECTDs, like most health conditions, is theorized as related to numerous physical, personal, and psychosocial factors. Perceived stress may still be one of the components of the puzzle, as evidenced by the weak correlations with upper extremity subjective symptom reporting and repetition. However, measuring the concept may need to be performed in a different fashion, as discussed above.

Occupational and environmental health nurses practice from a holistic framework, recognizing psychological factors are inextricably linked with health. Although this study did not provide strong evidence of a relation-

What Does This Mean for Workplace Application?

Possibly due to the measurement of the concept of perceived stress used in this study, no evidence of a strong relationship between perceived stress and UECTDs exists. However, nurses must continue to include psychosocial data when assessing employees with complaints of UECTDs. The etiology of UECTDs is still poorly understood. It remains very likely that psychosocial factors are part of the puzzle.

Based on this study as well as other data, there appear to be several groups more likely to report higher levels of perceived stress than comparison groups including women, persons who work in highly repetitious jobs, and older workers who are unhappy in their jobs. Occupational and environmental health nurses need to target these groups of employees for appropriate stress management intervention.

ship between perceived stress and UECTDs, nurses must continue to include psychosocial data when assessing employees with complaints related to UECTDs and plan interventions accordingly.

SUMMARY

This report presents data exploring the relationships between perceived psychological stress and several variables implicated in the etiology of UECTDs. Subjects were recruited from three manufacturing sites. The primary job exposure for the subjects was they were engaged in jobs that involved repetitious movements of the upper extremities, primarily of the hands and arms.

Perceived psychological stress, as operationally defined in this study, was only weakly associated with repetition, job dissatisfaction, and subjective complaints related to UECTDs. In addition, factors generally accepted as related to UECTDs (e.g., female gender, hormonal influences, existing medical conditions) were not robust predictors of perceived stress. Like most psychosocial phenomena, perceived stress is a complex construct, difficult to measure and correlate with health outcomes. Further research is necessary to examine what role, if any that perceived stress may have in the etiology of UECTDs.

This research was supported by grant number RO1-OH02941-01 from the National Institute for Occupational Safety and Health.

This research project was awarded the Mary Louise Brown Reseach Award in 1996.

REFERENCES

Antonovsky, A. (1979). *Health, stress and coping.* San Francisco: Josey-Bass.

Armstrong, T.J. (1986). Ergonomics and cumulative trauma disorders. *Hand Clinics, 2,* 553-565.

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

Armstrong, T.J., Foulke, J.A., Joseph, B.S., & Goldstein, S.A. (1982). Investigation of cumulative trauma disorders in a poultry processing plant. *American Industrial Hygiene Association Journal, 43,* 103-116.

Barnfather, J.S. & Lyons, B.L.(Eds.) (1993). Stress and coping: State of the science and implications for nursing theory, research, and practice. *Monographs of Sigma Theta Tau International,* 93, 2-31.

Bergenudd, H., Lindegarde, F., Nilsson, B., & Peterson, C.J. (1988). Shoulder pain in middle age: A study of prevalence and relation to occupational work load and psychosocial factors. *Clinical Orthopaedics and Related Research, 231,* 234-238.

Bernard, B, Sauter, S.L., Fine, L.J. Peterson, M.R., & Hales, T.R. (1992). Psychosocial and work organization risk factors for cumulative trauma disorders in the hands and wrists of newspaper employees. *Scandinavian Journal of Work, Environment, and Health, 18*(Supp. 2), 119-120.

Bhagat, R.S., McQuaid. S.J., Lindholm, H., & Segovis, J. (1985). Total life stress: A multimethod validation of the construct and its effects on organizationally valued outcomes and withdrawal behaviors. *Journal of Applied Psychology, 70,* 202-214.

Bongers, P.M., deWinter, C.R., Kompier, M.A., & Hildebrandt, V.H. (1993). Psychosocial factors at work and musculoskeletal disease. *Scandinavian Journal of Work, Environment, and Health, 18,* 297-312.

Burt, S., Hornung, R., Fine, L., Silverstein, B., & Armstrong, T. (1990). *National Institute for Occupational Safety and Health.* (HETA 89-250-2046), Melville, NY: Newsday, Inc.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24,* 385-96.

Dohrenwend, B.S., Dohrenwend, B.P., Dodson, M., & Shrout, P.E. (1984). Symptoms, hassles, social supports, and life events: Problems of confounded measures. *Journal of Abnormal Psychology, 93,* 222-230.

Faucett, J., & Rempel, D. (1994). VDT related musculoskeletal symptoms: Interactions between work postures and psychosocial work factors. *American Journal of Industrial Medicine, 26,* 597-612.

Franzblau, A., Salerno, D.F., Armstrong, T.J., & Werner, R.A. (1997). Test-retest reliability of an upper-extremity discomfort questionnaire in an industrial population. *Scandinavian Journal of Work, Environment, and Health, 23,* 299-307.

Griffen, K.W., Friend, R., Eitel, P., & Lobel, M. (1993). Effects of environmental demands, stress, and mood on health practices. *Journal of Behavioral Medicine, 16,* 643-661.

Hazlett, R.L., & Haynes, S.N. (1992). Fibromyalgia: A time-series analysis of the stressor-physical symptom association. *Journal of Behavioral Medicine, 15,* 541-557.

Hess, D.R. (1997). Employee perceived stress: Relationship to the development of repetitive strain injury symptoms. *AAOHN Journal, 45*(3), 115-123.

House, J.S. (1981). *Work stress and social support.* Reading, MA: Addison-Wesley.

Jensen, R.C., Klein, B.P., & Sanderson, L.M. (1983). Motion related wrist disorders traced to industries, occupational groups. *Monthly Labor Review, 106,* 13-16.

Karasek, R. (1985). *Job content instrument: Questionnaire and users guide.* University of Southern California, Department of Industrial and Systems Engineering.

Karasek, R., & Theorell, T. (1990). *Healthy work: Stress, productivity, and the reconstruction of working life.* Basic Books.

Kasl, S.V. (1984). Stress and health. *Annual Reviews of Public Health, 5,* 319-341.

Latko, W.A., Armstrong, T.J., Foulke, J.A., Herrin, G.D., Rabourn, R.A., & Ulin, S.S. (1997). Development and evaluation of an observational method for assessing repetition in hand tasks. *American Industrial Hygiene Association Journal, 58*(4), 278-285.

Lazarus, R.S. (1984). Puzzles in the study of daily hassles. *Journal of Behavioral Medicine, 7,* 375-389.

Lazarus, R.S., DeLongis, A., Folkman, S., & Gruen, R. (1985). Stress and adaptational outcomes: The problem of confounded measures. *American Psychologist, 40*, 770-779.

Linton, S.J., & Kamwendo, K. (1989). Risk factors in the psychosocial work environment for neck and shoulder pain in secretaries. *Journal of Occupational Medicine, 31*, 609-613.

Makela, M. Heliovaara, M., Sievers, K., Knekt, P., & Aromaa, A. (1991). Prevalence, determinants, and consequences of chronic neck pain in Finland. *American Journal of Epidemiology, 134*, 1356-1367.

Moulton, B. & Spence, S. (1992). Site specific muscle hyper-reactivity in musicians with occupational upper limb pain. *Behavioral Research and Therapy, 30*, 375-386.

Putz-Anderson, V. (Ed.) (1988). *Cumulative trauma disorders: A manual for musculoskeletal diseases of the upper limbs*. Philadelphia: F.A. Davis Company.

Rempel, D.M., Harrison, R.J., & Barnhart, S. (1992). Work related cumulative trauma disorders of the upper extremity. *JAMA, 267*, 838-842.

Rossi, A.M., & Lubbers, A.M. (1989). Stressed at work: Identification of physiological responses to occupational stressors. *AAOHN Journal, 37*(7), 258-264.

Ryan, G.A., & Bampton, M. (1988). Comparison of data process operators with and without upper limb symptoms. *Community Health Studies, XII*, 63-68.

Sarason, I.G., Johnson, J.H., & Siegel, J.M. (1978). Assessing the impact of life changes: Development of the life development survey. *Journal of Consulting and Clinical Psychology, 46*, 932-946.

Sauter, S.L., Gottlieb, M.S., Jones, K.C., Dodson, V.N., & Rohrer, K.M. (1983). Job and health implications of VDT use: Initial results of the Wisconsin-NIOSH study. *Communications of the Association for Computing Machinery, 26*, 284-294.

Schroeder, D.H., & Costa, P.T. (1984). Influence of life event stress on physical illness: Substantive effects or methodological flaws? *Journal of Personality and Social Psychology, 46*, 853-862.

Stock, S.R. (1991). Workplace ergonomic factors and the development of musculoskeletal disorders of the neck and upper limbs: A meta-analysis. *American Journal of Industrial Medicine,19*, 87-107.

Strasser, P.A. (1996). Perceived psychological stress and upper extremity cumulative trauma disorders. Dissertation Abstracts International, 57 (06), 3661B. (University Microfilms # AAC96-35620)

Thomas, S.P., & Williams, R.L. (1991). Perceived stress, trait anger, modes of anger expression, and health status of college men and women. *Nursing Research, 40*, 303-307.

Tola, S., Rihimaki, H., Vidman, T., Viikari-Juntura, E., & Hanninem, K. (1988). Neck and shoulder symptoms among men in machine operating, dynamic physical work, and sedentary work. *Scandinavian Journal of Work, Environment, and Health, 14*, 299-305.

Walker, L.O. (1989). Stress process among mothers of infants: Preliminary model testing. *Nursing Research, 38*, 10-16.

Westgaard, R.H., Jensen, C., & Hansen, K. (1993). Individual and work related factors associated with symptoms of musculoskeletal complaints. *Archives of Occupational and Environmental Health, 64*, 40-413.

Werner, J.S. (1993). Stressors and health outcomes: Synthesis of nursing research, 1980-1990. In J. S. Barnfather & B. L. Lyons (Eds.). Stress and coping: State of the science and implications for nursing theory, research, and practice. *Monographs of Sigma Theta Tau International, 93*, 11-42.