JOB STRESS RESEARCH AT NIOSH: 1972–2002

Lawrence R. Murphy

ABSTRACT

This chapter presents an overview of job stress research at the National Institute for Occupational Safety and Health (NIOSH) from its inception in 1972 through current and proposed research in 2002. During this 30-year period, NIOSH funded a wide range of job stress projects and a detailed account of each is not possible in a single chapter. In some cases, the research will be discussed in great depth, especially if the work was unique to NIOSH (e.g. mass psychogenic illness) or was large in magnitude (e.g. Job Demands and Worker Health study). In many other cases, however, the research will be mentioned briefly and citations provided. Since many of the early reports referenced in this chapter are long out of print, the chapter makes liberal use of "Text Boxes" that contain sections of narrative text from NIOSH reports. The inclusion of such narrative text will provide the reader with a more authentic 'feel' for the research than would a summary statement.

The chapter does not include NIOSH research in the areas of ergonomics, musculoskeletal disorders, or indoor air pollution, although psychosocial factors and job stress were elements of many studies in these areas.

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FORMATION OF NIOSH

The National Institute for Occupational Safety and Health (NIOSH) is the principal Federal agency responsible for research and recommendations for the prevention of work-related disease and injury. NIOSH was established by Public Law 91–596 (Occupational Safety and Health Act of 1970) and was charged with assuring, in so far as possible, safe and healthful working conditions for America's workers (Key, 1971). That behavioral and motivational factors were important was acknowledged in certain provisions of the Act. For example, Sections 20(a)(1) and 20(a)(4) explicitly directed NIOSH to include psychological, behavioral and motivational factors in researching problems of worker safety and health, and in developing remedial approaches for offsetting such problems. Section 20(a)(7), in referencing the need to undertake industry-wide studies of certain worker groups, authorized the evaluation of job conditions to assess the potential for illness, disease, or loss of functional capacity. Job conditions were broadly interpreted to include those of a psychological nature, consisting of undue task demands, work conditions, or work regimens which, apart from or combined with exposures to physical and chemical hazards, may degrade worker physical or mental health (Cohen & Margolis, 1973). Public Law 91–596 also created the Occupational Safety and Health Administration (OSHA) and they were charged with setting, promulgating, and enforcing industrial safety and health standards. OSHA uses research conducted by NIOSH to develop new workplace safety and health standards.

Structurally, NIOSH is part of the Centers for Disease Control and Prevention (CDC) within the Department of Health and Human Services (DHHS), and has research facilities in Cincinnati, OH, Morgantown, WV, Pittsburgh, PN, and Spokane, WA. The placement of NIOSH within DHHS, instead of in the Department of Labor with OSHA, was done to separate NIOSH from the regulation and enforcement process and allow the Institute to conduct research and develop recommendations independently of those activities. NIOSH research addresses all issues related to safety and health at work, and topic areas include toxicology, physical agents (noise, vibration, etc.), respiratory disease, safety, and hazard evaluation. Other prominent activities include health and hazard surveillance, training, respirator certification, and technical assistance. Job stress research activities are located primarily in Cincinnati, Ohio in the Work Organizational and Stress Research Section, Organizational Science and Human Factors Branch, Division of Applied Research and Technology, although researchers at other Institute locations often collaborate.

At its inception, the NIOSH job stress research group was small, consisting of four full-time, Ph.D. level researchers. By the late 1980s and early 1990s,

the size of the stress section had grown to seven researchers and has remained at about that level ever since. NIOSH has supplemented the research staff by funding postdoctoral positions that are filled through the National Research Council Associateship program.

The primary impetus for NIOSH job stress studies has always been ideas submitted by bench level researchers. Even today, new research ideas submitted by NIOSH researchers remain the fundamental source for NIOSH job stress studies. A second mechanism that drives NIOSH job stress research is requests from workers, unions, and/or organizations for technical assistance (*http://www.cdc.gov/niosh/request.html*). While most NIOSH technical assistance requests over the years have concerned exposure to physical or chemical agents, a handful of requests dealt with job stress issues, and these became more frequent over the next 10 years as job stress became a more widely recognized workplace health and safety topic. For instance, NIOSH studies of mass psychogenic illness were generated from technical assistance requests, as were studies of machine-pacing, postal workers, video display terminal (VDT) operators and organizational downsizing. For this reason, most of the job stress research conducted by NIOSH has a distinct applied, as opposed to basic, research flavor.

More recently, NIOSH job stress research benefited from funding initiatives that targeted certain health conditions or industry sectors (e.g. HIV/AIDS, agriculture, and construction) and also from the commencement of the National Occupational Research Agenda (NORA) in 1996. NORA includes Organization of Work as one of 21 safety and health priority areas having a national focus, and highlights organizational factors as potential contributors to stress-related illnesses or injuries.

The NIOSH research program operates on a project-based system, wherein bench-level researchers submit ideas for new research and these are evaluated at the Section, Branch, Division, and Institute levels for approval. Projects typically run 3–5 years and often involve collaborations among intramural and extramural researchers. NIOSH can establish cooperative arrangements with other agencies and organizations to perform research that would be difficult to perform independently. Finally, NIOSH has a competitive, extramural grant program that is administered independently from the internal research program.

Table 1 presents a list of the major NIOSH activities in the area of job stress from 1972 to 2002. The list shows major project work and related activities, and provides reference citations for each listing. Glancing through the table gives the reader a sense of the nature and scope of NIOSH research over the past 30 years.

Table 1. List of Major NIOSH Job Stress Studies and Activities: 1972–2002.

Year	Activity	Citation
1970	NIOSH created by OSHAct	Public Law 91-596 (1970)
1972	Job stress items added to the 1972–1973 Quality of Employment Survey	Margolis, Kroes and Quinn (1974).
1972	Police officers and administrators	Kroes and Hurrell (1975); Hurrell, Pate and Kliesmet (1984)
1972	1st Cornell conference on stress	McLean (1974)
1972	Job demands and worker health	Caplan, Cobb, French, Harrison and Pinneau (1975)
1973	Coal miners	Althouse and Hurrell (1977)
1974	State of Tennessee health records study	Colligan, Smith and Hurrell (1977)
1974	Shift work and health	Tasto, Colligan, Skjei and Polly (1978); Smith, M.J., Colligan, Frockt and Tasto (1979).
1974	Longitudinal study of coronary heart disease	Chadwick, Chesney, Black, Rosenman, and Sevelius (1979)
1974	Mass psychogenic illness	Colligan and Murphy (1979); Murphy and Colligan (1979); Colligan, Pennebaker and Murphy (1982)
1975	Job termination	Cobb and Kasl (1977)
1977	Postal workers	Smith, Hurrell and Murphy (1981); Hurrell (1985)
1977	1st NIOSH/UCLA conference held	National Institute for Occupational Safety and Health (1978)
1977	2nd Cornell conference	McLean, Black and Colligan (1978)
1978	Video display terminal operators	Smith, Cohen, Stammerjohn and Happ (1981)
1978	2nd NIOSH/UCLA conference	National Institute for Occupational Safety and Health (1980)
1979	Machine-pacing and stress	Murphy and Hurrell (1980); Salvendy and Smith (1981); Stammerjohn and Wilkes (1981); Wilkes, Stammerjohn and Lalich (1981)
1980	Demand/control model of strain	Karasek, Schwartz and Theorell (1982); Karasek, Theorell, Schwartz, Schnall, Pieper and Michela (1988)
1980	Office worker stress	Cohen (1984)
1980	Stress management training	Murphy (1983, 1984a, b, 1988, 1996)
1982	Follow-up studies on VDT operators	Sauter, Gottlieb, Jones, Dodson and Rohrer (1983); Sauter and Swanson (1996)
1984	Stress measurement methods	Hurrell and McLaney (1988)

Table 1. Continued.

Year	Activity	Citation
1985	Fatigue effects of work schedules	Rosa and Colligan (1988); Rosa, Colligan and Lewis (1989); Rosa (1991); Rosa and Colligan (1997); Rosa, Bonnet and Cole (1998); Rosa and Bonnet (1993); Schroeder, Rosa and Witt (1998)
1986	National strategy for prevention of work-related psychological disorders	National Institute for Occupational Safety and Health (1988); Sauter, Murphy and Hurrell (1990)
1987	Workshop on control and health	Sauter, Hurrell and Cooper (1989)
1989	Healthy work organizations	Sauter, Lim and Murphy (1996); Lim and Murphy (1997); Murphy and Lim (1997); Murphy and Cooper (2000)
1990	1st APA/NIOSH conference	Keita and Sauter (1992); Quick, Murphy and Hurrell (1992)
1991	Occupational HIV/AIDS	Gershon, Murphy, Felknor, Vesley and DeJoy (1995); DeJoy, Murphy and Gershon (1995)
1992	Stress in agricultural work	Kidd, Scharf and Veazie (1996); Scharf, Kidd, Cole, Bean, Chapman, Donham and Baker (1998)
1992	2nd APA/NIOSH conference	Keita and Hurrell (1994); Murphy, Hurrell, Sauter and Keita (1995); Sauter and Murphy (1995)
1992	Harassment and violence at work	Cole, Grubb, Sauter, Swanson and Lawless (1997)
1993	Letter of Agreement between NIOSH and Corning Inc.	Monroy, Jonas, Mathey and Murphy (1998)
1995	3rd APA/NIOSH conference	Gowing, Quick and Kraft (1998)
1995	Organizational downsizing, restructuring, and health	Murphy and Pepper (2002)
1996	National Occupational Research Agenda (NORA)	National Institute for Occupational Safety and Health (1996)
1996	Analysis of National Medical Expenditure Care Survey (NMES)	Grosch and Murphy (1998)
1997	Stress in construction work	Grubb and Swanson (1999); Goldenhar, Swanson, Hurrell, Ruder and Deddens (1998)
1998	4th APA/NIOSH conference	Galinsky, Swanson, Sauter, Hurrell and
1998	Organizational interventions to reduce stress in IRS call centers	Schleifer (2000)
2000	Health of aging workers	
2000	Quality of work life module for the 2002 General Social Survey	
2001	Depression, coronary heart disease and work	
2002	National Organizations Survey 2002	
2003	5th APA/NIOSH conference	

1970s: INITIAL JOB STRESS ACTIVITIES

One of the early tasks facing NIOSH's stress research program was characterizing the job stress concept. Job stress implied so many events and processes that it was a nebulous construct difficult to study in a scientific manner (Margolis & Kroes, 1974). As a first step, NIOSH set up a relationship with the Center for Occupational Mental Health, Cornell University Medical College. The collaboration was a natural one since the goal of the COMH, namely, a healthier relationship between employee and employer, fit nicely with the NIOSH mission. Moreover, the COMH had prior experience in the field of job stress, through their sponsorship of symposia (McLean, 1967, 1970) and publication of the quarterly journal *Occupational Mental Health*, which carried abstracts of relevant literature, original articles and commentary as well as news of activities in the field.

As part of the collaboration, NIOSH co-sponsored an Occupational Mental Health Conference in 1972 in White Plains, New York. The purpose of this endeavor was to bring together representatives of various disciplines to present their points of view so that the current thinking on the subject of job stress could be discerned (McLean, 1974). As a result of this seminal conference, a paradigm of job stress was adopted which would guide future NIOSH research. This paradigm defined job stress as the condition in which some factor, or combination of factors, at work interacts with the worker to disrupt psychological or physiological homeostasis (Margolis & Kroes, 1974).

The concept of factors interacting with the worker in this paradigm was deemed significant. Indeed, a broad and diverse literature was known to exist dealing with individual differences in physical and psychological state that can alter human response in a variety of situations. What was not completely clear was how much of this information was relevant to occupational situations. Thus, a literature review (Sleight & Cook, 1975) was undertaken that focused on: (a) questions of hypersusceptibility or predisposition of certain workers to job related illnesses and injuries; (b) selection criteria for placing workers in stressful or hazardous jobs; (c) needs for standards or guidelines to protect worker groups with special physical or psychological characteristics; and (d) research needs. The results of the review were significant in that they highlighted first, the paucity of empirical data linking job conditions, individual characteristics and health consequences and secondly, problems with existing research methodologies. These early endeavors provided NIOSH with a paradigm of job stress and information as to the kinds of methodologies that would be needed to examine it.

The 1972–1973 Quality of Employment Survey

The earliest NIOSH job stress study involved a cross-sectional interview survey. In an effort to add to the small body of literature linking psychological job factors to ill health, a number of questions were added by NIOSH to the triennial interview survey of workers conducted in 1972–1973 by the U.S. Department of Labor (Quinn & Shepard, 1974). The Quality of Employment Survey's general purpose was to sample representative workers' reactions to their jobs. The questions added by NIOSH examined six potential sources of stress at work and ten different mental and physical health problems in workers (Margolis, Kroes & Quinn, 1974). Sources of stress included role ambiguity, underutilization, overload, resource inadequacy, insecurity and non-participation. Indicators of strain included overall physical health, escapist drinking, depressed mood, loss of self-esteem, life and job satisfaction, motivation to work, frequency of suggestions to employer, intent to leave, and absenteeism.

Analyses of this data revealed that overall physical health was related to job stress, the latter operationally defined as a simple composite of six specific job stressors. These relationships were evident in spite of the fact that physical health status is clearly a function of many variables other than psychological job conditions (e.g. diet, exercise, genetic composition, exposure to illness, including toxic agents, and non-job related psychological factors). All six stressors in the survey, considered individually, played a role in worker physical and mental health. Although statistically significant, the degree of correlation was quite low in most instances ($r < 0.20$). One stressor, non-participation, was of special significance and correlated highest with the eight measures of strain. Moreover, responses to the job stressors and strain questions varied considerably across occupations but not always in a predictable fashion. For instance, professional and technical workers had the highest levels of job satisfaction but also the highest levels of depressed mood. Machine operators had the lowest scores for job satisfaction and perceived health. Laborers had the second worst job satisfaction scores but their perceived health was good and mental health scores were high. In general, white-collar workers showed much greater job satisfaction than blue-collar workers but had lower perceived health and more depressed mood.

Of special interest were worker ratings of importance. When asked to rate the importance of 25 aspects of work, the following list emerged in order of importance: interesting work, enough help and equipment to get the job done, enough information to get the job done, enough authority to get the job done, good pay, opportunity to develop special abilities, job security, and seeing the results of one's work.

Job Demands and Worker Health Study

The most ambitious undertaking was a study of job stress and strain among 2,000 workers in 23 occupations. This *Job Demands and Worker Health Study* (Caplan et al., 1975) also included a sub-sample of 390 workers who were subjected to clinical-biological tests to ascertain any physical bases for apparent stress states. Figure 1 shows the theoretical model that guided the study design and analysis. The model distinguishes between the objective and subjective environment, the former being independent of worker perceptions, and allows for moderator variables (the person and social support). In the model, the objective environment influences worker responses (affective, physiological, behavioral) and health-illness *directly* (the arching lines at the top of the figure) and *indirectly*, via the subjective environment. How the worker responds to the subjective work environment is conditioned or moderated by three sets of factors: the person, social support, and the degree of person-environment fit.

Text box 1 shows the main findings from the study as they appeared in the original NIOSH technical report (Caplan et al., 1975). The results showed clear occupational differences in stress and strain. For instance, low utilization of skills and abilities, lack of participation, low work complexity, and role ambiguity were major stressors for assembly line workers, fork-lift drivers, and machine operators, but were not stressors for professionals such as university professors, physicians, and white collar supervisors. Machine-paced workers had the highest scores for boredom and dissatisfaction with workload and had the highest scores for measures of strain. There were no significant relationships between physiological measures of strain (blood pressure and serum uric acid) and job stressors, although these analyses were limited to only a few occupations (administrators, scientists, air traffic controllers, electronic technicians, and supervisors). Personality variables were not directly related to measures of psychological (anxiety, depression), physiological (somatic complaints), or behavioral (smoking, caffeine consumption) strains.

The importance of the *Job Demands and Worker Health* study was four-fold. First, it produced data on levels of job stress and strain across multiple occupations and in so doing, helped NIOSH identify occupations and job stressors in need of additional study. Second, it set forth a model of stress and strain (Person-Environment fit) that NIOSH and others would utilize in many later studies. The P-E fit model suggested that the discrepancy between what a worker desires on a job (P) and what a worker has in a job (E) was the best predictor of strain. Third, the methods and findings from this study served to drive many future NIOSH studies of job stress. Indeed, it is impossible to

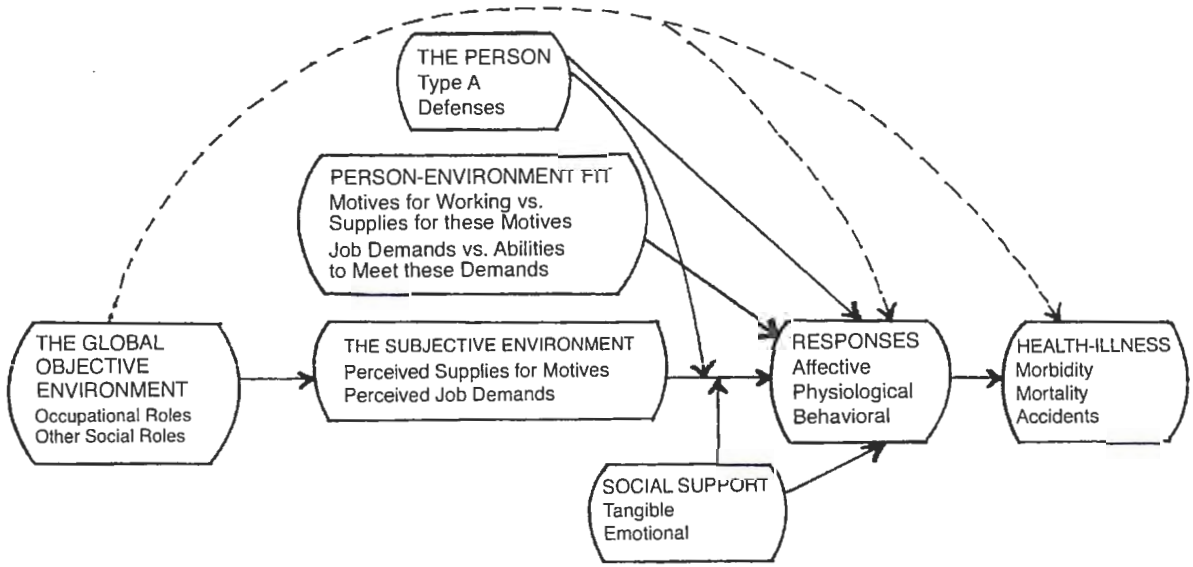

Fig. 1. Theoretical Model from Job Demands and Worker Health (1975) Study.

Text Box 1. Main findings as presented in the *Job Demands and Worker Health* (1975) study.

Occupational Differences

(1) The occupations in this study differ considerably in age and length of service.

(2) University professors in administrative posts and family physicians score highest on a measure of the coronary-prone personality; tool and die makers are somewhat high on this measure.

(3) The number of hours worked per week is highest for family physicians and administrative professors (over 55 hours per week), followed by professors, blue collar supervisors, scientists, and police. At the low end, air traffic controllers (whose hours are regulated for reasons of safety), average 38 to 39 hours per week.

(4) The most unwanted overtime is put in by the administrative professors, blue collar supervisors, physicians, tool and die makers, and white collar supervisors.

(5) A measure of quantitative workload shows high scores for family physicians, administrative professors and train dispatchers.

(6) The greatest variation in workload occurs for air traffic controllers and train dispatchers; the least variation is found-in assemblers, especially on machine-paced lines.

(7) A demand for high concentration on the job is typical for air traffic controllers, train dispatchers, and family physicians; the lowest concentration is required on the machine-paced assembly line.

(8) Several job stresses (low utilization of one's abilities, low participation, low complexity of the work, poor person-environment fit on job complexity, poor fit on responsibility for persons, and poor fit in role ambiguity) tend to have similar levels in any given job. Occupations that are high on these stresses include assembly line workers, fork lift drivers, and machine tenders. The occupations that are low on these stresses are professors, family physicians, and other professions.

(9) The men in high stress jobs in 8 above also suffer from low social support, whereas the men in low stress jobs report high support from their supervisors and others at work.

(10) The occupations where the workers report both the most boredom and the greatest dissatisfaction with the workload are the assemblers and the relief men on the machine-paced assembly line. Our small sample of machine tenders is also high on these strains. The most satisfied with their jobs are university professors, family physicians, white-collar supervisors, police, and air traffic controllers at small sites.
(11) The results for anxiety, depression and irritation present a picture similar to the above results for job dissatisfactions. These psychological strains are highest among the machine tenders and the assemblers and relief men on the machine paced assembly line. The least such affective strain is found among physicians and continuous flow workers.
(12) Somatic complaints were most frequent in assemblers and relief men on machine-paced assembly lines. Such complaints were least common among university professors, family physicians, and scientists.
(13) Scientists had the lowest blood pressure of the seven occupations measured.
(14) The assemblers and relief workers on the machine-paced assembly lines have the highest stress and strain of any of the 23 occupations (see 6, 7, 8, 9, 10, 11, and 12 above).
(15) Air traffic controllers at large sites have been shown previously to have more psychosomatic disease than those at small sites. The findings of this study suggest that the former may have more disease because they have more job ambiguity, more conflicting demands in their work, and less social support from others at work.

Source:

Caplan, R. D., Cobb, S., French, J. R. P., Jr., Van Harrison, R., & Pinneau, S.R. (1975). *Job Demands and Worker Health*. DHEW (NIOSH) Publication No. 75-160. Washington, D.C.: U.S. Government Printing Office.

overstate the influence of the Job Demands study on later NIOSH research. For instance, the finding that machine-paced workers had the highest levels of job stress and strain led to a series of NIOSH-funded studies on the health consequences of machine-pacing (Multiple Position Letter Sorting Machine (MPLSM) operators, poultry inspection workers, and lab studies of pacing). Fourth, the measures of stress and strain in the Job Demands study would be utilized in countless other NIOSH studies, and some scales continue to be used today (e.g. quantitative workload, social support, role ambiguity, conflict, worker control, and somatic complaints).

Work in America (1973) Report

Shortly after the OSHAct was signed into law, a task force was established on December 29, 1971 by the U.S. Department of Health, Education and Welfare (DHEW) to examine "... health, education, and welfare problems from the perspective of one of our fundamental social institutions – work" (Work in America, 1973). The work was performed under contract with the W. E. Upjohn Institute for Employment Research and involved: (1) a review of the published literature; (2) preparation of 50 background papers by experts in business, academia, labor unions, and government; and (3) interviews with a large number of blue- and white-collar workers. The background papers and interviews provided the evidence upon which the report was based, and were published in a separate document (O'Toole, 1974)

The report confirmed the centrality of work to life, its contribution to identity and self-esteem, and its value in providing meaning and order to life. While offering no simple solutions to the problems highlighted in the report, the summary of the report indicated that "... in the institution of work, we believe we have found a point where considerable leverage could be exerted to improve the quality of life" (Work in America, 1973, p. xv).

Some of the conclusions reached by the task force were:

(1) Many workers, at all levels, feel locked-in to unchallenging jobs, with low mobility and few opportunities to grow in their jobs.
(2) Job satisfaction appears to be the best predictor of longevity, better than known medical or genetic factors
(3) Work redesign holds great promise for decreasing mental and physical health costs, increase productivity, and improve the quality of work life for many Americans while for the first time, giving voice to many workers in important decision-making processes (Work in America, 1973).

NIOSH FIVE-YEAR RESEARCH PLAN

The first long-term plan for NIOSH job stress research was developed in 1974 and spanned a five-year period. The plan, shown in Text Box 2, contained five general research topics and multiple studies within each topic.

Of special interest are two research ideas that were never implemented: a national study of job stress and health among 10–20,000 workers and studies of primary stress prevention techniques. The former was not implemented due to the high cost of conducting such a large national study. The latter studies of stress prevention and reduction were never initiated due to the difficulty in

Text Box 2. NIOSH 5-year plan for job stress research.

(A) JOB DEMANDS AND WORKER HEALTH

(1) Correlation of stress factors in 20 job types and evident psychological and physiological strain indications.
(2) Examination of morbidity data on all major occupations within one state (Tennessee) to uncover frequency of stress-related disorders characteristic of different jobs.
(3) National questionnaire survey of 10,000–20,000 U.S. workers to ascertain evidence of physical and emotional problems arising from job stress factors.
(4) Interview survey to determine mental health consequences of job stress in workers in Cincinnati establishments.

(B) JOB STRESS IN SPECIFIC OCCUPATIONS

(1) Determine psychological job stressors particular to police officers and associated mental health consequences.
(2) Determine psychological job stressors and associated mental health consequences in coal miners.
(3) Survey job stress factors evident in 2–4 of the highest ranked occupations in terms of the frequency of stress-related disorders (as identified in A-1 above).

(C) SELECT FACTORS IN JOB STRESS

(1) Study of job stress in the etiology of coronary heart disease.
(2) Shift work as a job stress factor, its consequences to physical and emotional health, and recommended guidelines for optimum shift routines re: worker adjustment.
(3) Study of a job stress factor (to be selected) for its health impact.

(D) DEVELOP AND TEST TECHNIQUES AND WORK PRACTICES FOR ALLEVIATING JOB STRESS OR ENHANCING WORKER ADJUSTMENT TO IT

(1) Evaluate stress reduction measures for police officers and formulate program packages for use.
(2) Define stress reduction measures in 2–4 high stress occupations and formulate program packages for use.

Text Box 2. Continued.

(E) EFFECTIVENESS OF SELECT APPROACHES TO STRESS-ALLEVIATION IN INDUSTRY

(1) Implications of job enrichment techniques for stress reduction
(2) Implications of the role of social support in reducing job stress.
(3) Utility of "troubled employee" programs for reducing job stress.
(4) Participatory management as a stress reduction activity.

Source: Abstracted from NIOSH internal memo: December 19, 1974.

securing access to organizations to implement job and organizational change programs. Aside from these two areas, the remainder of the five-year plan was implemented, as described below.

Implementing the Research Plan

One of the first elements of the 5-year plan that was implemented was an evaluation of mental health admission records to identify high stress jobs. The aim of the study was to equip health professionals with an empirical basis for identifying and selecting specific occupations for more in-depth research into the relationship between job stress and worker health. The data for this study were collected from the records of 22 of the 27 mental health centers operated by the State of Tennessee. The records of all first admissions to the 22 participating mental health centers from January 1972 through June 1974 constituted the sampling frame. The selection of cases for inclusion in the study was based on the following criteria: (1) the individual must have been a resident of Tennessee, in the primary working age group of 18–64; and (2) s/he must have been employed in one of the state's major occupations (1,000 or more workers) within two years prior to admission. Data were recorded for a total of 8,450 cases.

The results indicated a disproportionate incidence of mental health disorders among workers in health care professions; these professions comprised seven of the top-ranked occupations. Clouding the interpretation of this data was the high proportion of females in health care professions. Women in general, and health care workers in particular, are more likely to report mental health disorders relative to the general population and this factor, not excess job stress, could partially explain the obtained results (Colligan, Smith & Hurrell, 1977). While mental health admissions provide only a crude index of distress, and the direction of the causal arrow between occupation and admission rate is certainly tenuous, later studies supported the conclusion of excess mental health

problems and stress-related disorders among health care workers (e.g. Hoiberg, 1982).

Police Officers

Another element of the 5-year plan involved studies of two high stress occupations: police work and coal mining. NIOSH's first in-house job stress study was a semi-structured interview of 100 police officers in the City of Cincinnati (Kroes, Margolis & Hurrell, 1974). The 45-minute semi-structured interview contained information about the officer's background (e.g. age, work assignment) and perceptions of job stress. Interviews were carried out with officers from all three work shifts. A similar interview (Kroes, Hurrell & Margolis, 1974) was used to elicit job stress information from 30 police administrators.

The results revealed a large number of psychological job stressors perceived by police officers, especially role conflict and role ambiguity, both in the organization and with respect to community and societal expectations. The extent to which these problems generalized to other police departments, however, was unknown. This information, along with insights gained in a NIOSH sponsored symposium of stress in policing (Kroes & Hurrell, 1976), was used to develop a large cross-sectional survey study of stress and health in police work (Hurrell, Pate & Kliesmet, 1982). In this study, conducted in collaboration with the Police Foundation and the International Union of Police Officers, patrol officers in 28 police departments representing various geographic locations received self-report type questionnaires for rating job stressors and consequent health problems. The questionnaire contained a number of the scales developed by Caplan et al. (1975) as well as items aimed at job stressors that appeared to be unique to police officers. In all, more than 2,200 officers were surveyed. Those features receiving the higher stress ratings related primarily to organizational and management practices, notably lack of participation in job decisions, frustration with court leniency, and too much repetitiousness in work routines. Job future insecurity and role conflict showed the most significant associations with negative health and emotional states. It was concluded that stress among police officers involves needs for greater clarification of job roles and expectations, and the development of strategies for better coping with conflicts that relate to professional and familial responsibilities.

Coal Miners

A second high stress occupation examined by NIOSH was coal mining (Althouse & Hurrell, 1977). This study examined the impact of psychological stress and strain among working coal miners in order to determine whether features of those mines characteristically exhibiting higher rates of accidents affect the health

perceptions of their employees. It was designed to compare responses between workers in mines with exceptionally high accident rates to those working in mines with low accident rates. It was reasoned that systematic differences between miners working in high or low accident environments could be examined to develop information that might be applied to the promotion of worker well-being and positive health among underground miners.

Based on accident statistics for every underground coal-mine operating in the United States, candidate mines were selected from the upper and lower extremes of the continuum. Once a sample population of candidate mines had been generated, mines were selected on a matched-pair basis from nine different states. Each pair was matched as closely as possible on: (1) geographic location; (2) number of employed miners; (3) annual production figures; (4) seam height; (5) unionization; (6) "captive" vs. commercial operations; and (7) conventional vs. continuous methods of extraction. A total of 15 matched pairs were selected. At each mine site, questionnaires containing indicies of stress and strain similar to those used by Caplan et al. (1975) were distributed to volunteer study participants. In all, some 486 miners and mine foremen participated in the study.

No difference in stress level and associated strain was found between the miners drawn from the high and low accident mines and miners reported no greater prevalence of stressful conditions than blue collar workers in Caplan et al. (1975) sample. Contrasted with these blue-collar workers, however, miners reported significantly more psychological distress including symptoms of anxiety, depression, irritation and somatic problems. Job discontent was the best predictor of psychological distress experienced by miners. Indeed, dissatisfaction with work, rather than actual characteristics of work, was most directly consequential for the psychological distress of the miner (Althouse & Hurrell, 1977).

Studies of Specific Job Stressors

While the initial NIOSH job stress studies targeted high stress occupations, the focus quickly changed to examination of job stressors and health outcomes. The logic for this shift in focus was straightforward: with limited funds, NIOSH got a 'bigger bang for the buck' by focusing on job stressors instead of individual occupations. Two job stressors that were selected for initial study were shiftwork and machine-pacing.

Shiftwork

Using both a cross-sectional survey and a health records examination, NIOSH collaborated with the Stanford Research Institute to examine the health effects

of shiftwork (Tasto & Colligan, 1978). In this study, a questionnaire designed to elicit information concerning the incidence and prevalence of physical complaints and illness histories, eating patterns, sleep patterns, medication usage, life style and domestic patterns, and psychological profiles was distributed to 3,500 shift workers, composed of nurses and food processors, dividing the distribution equally among day, afternoon, right, and rotating shift categories. Data for a sample of about 1,200 nurses and a similar number of food processors were also collected by reviewing health and accident files.

Findings from the study confirmed European studies in that rotating shift workers, who not only work at unconventional hours but who move from shift to shift, reported more sleep disturbances, gastrointestinal complaints, chest pains; fatigue, nervousness, alcohol consumption, and use of stimulants. Examination of employee records indicated that rotating shift workers took more sick leave and far more serious reasons than fixed shift workers and had a higher accident rate (Tasto et al., 1978). Shift work appeared to pose a distinct health hazard for rotating shift workers. An adaptation index was also developed in conjunction with the analyses of questionnaire results and suggested among other things, that shift workers adapt best if they are satisfied with their shift schedule and satisfied with the type of work they are doing.

Machine-pacing

A second job stressor that attracted the attention of NIOSH was machine-paced work. Machine-paced work, almost from inception, has been a source of worker complaints. Such a work process can enhance productivity, but there is reason to suspect that it may have adverse effects on worker physical and mental health. Indeed, machine-paced assemblers in the Job Demands and Worker Health study (Caplan et al., 1975) reported more stress and strain than the 22 other occupations studied. At the request of the U.S. Department of Agriculture, NIOSH conducted a study of job stress in a nationally representative sample of self- and machine-paced poultry inspectors. The task of the inspector required high vigilance, and it consisted of the post-mortem inspection of poultry carcasses moving at a machine-paced rate of 15 to 23 carcasses per minute. Workers in 121 of the 240 poultry plants in the continental USA were surveyed with a questionnaire that contained elements of the Caplan et al. (1975) instrument. Results confirmed findings from the earlier *Job Demands* study in that machine-paced worker inspectors having most time in the inspection task reported higher levels of workload, underutilization of abilities, job dissatisfaction, and more health complaints than did those who spent only part of their day in this work (Wilkes, Stammerjohn & Lalich, 1981; Stammerjohn & Wilkes, 1981).

In order to identify the potential sources and consequences of stress in machine-paced work in a different kind of job, NIOSH conducted a large scale cross sectional survey of Multiple Position Letter Sorting Machine (MPLSM) operators in the U.S. postal service. The job of MPLSM operator was chosen for study because with over 29,000 operators, it represented one of the largest work groups in the United States engaged in machine-paced work. The task of the MPLSM operators, like that of the poultry inspector in the study cited above, involves high vigilance but unlike the poultry inspection task, the MPLSM task is highly cognitive in nature requiring rapid encoding, manipulation and decoding of visually presented information. Questionnaires were mailed to a nationally representative sample of 6,000 MPLSM operators and to 6,000 non-paced workers who performed the same task. The questionnaire included a number of core scales derived from the work of Caplan et al. (1975), a variety of items aimed at tapping the more cognitive kinds of demands encountered in machine-paced mail sorting, measures of non-work related stressors, social support and the Type A behavior pattern. The results indicated that the MPLSM operators reported higher levels of job demands, particularly in relation to high workload, work pressure, and concentration and memory demands and decreased job satisfaction. They also reported greater levels of health complaints, indicating visual arm/wrist/hand, and neck strains and mood disturbances including depression and anxiety (Smith, Hurrell & Murphy, 1981; Hurrell, 1985).

Studies of Stress Outcomes

Having funded studies of high stress occupations and then studies of high-risk job stressors, the next step was to address specific health outcomes in more detail. Two distinct outcomes were selected for initial study: coronary heart disease (CHD) and mass psychogenic illness (MPI).

Coronary Heart Disease

The first study was done by the Stanford Research Institute International who conducted a longitudinal study of job stressors and CHD risk factors (additional NIOSH funded studies on this topic are described in a later section). The subjects in the study were a sample of male, salaried employees of Lockheed Missiles and Space Company (LMSC), a large aerospace corporation in Sunnyvale, California. The principal subjects of the study ($n = 397$) were the focal subjects. As an initial step in the survey plan, data were also obtained relative to the working environment from associates of focal subjects, including up to five

persons named by each focal subject as being part of his close working group. The average Work Environment Scale (WES) scores from the close associates of each focal subject became part of the data file.

Among the focal subjects there were three experimental groups and one comparison group. The comparison group was drawn from a cross-section of salaried employees from Lockheed. The three experimental groups were drawn from among specially chosen categories of lower-level managers and supervisors in: (a) New Business project leaders; (b) Finance and Accounting managers; and (c) Product Assurance managers. A reduced set of focal subjects, 220 or about half the original number, was then selected to participate in the repeat examinations. Because five additional examinations were to be carried out on each of these subjects, it was felt that the smaller number of subjects would be sufficient to allow the detection of significant effects. The selection process was random, but weighted to bring all study groups to approximately the same size.

The total employee population was approximately 19,000, of which 15,700 or 83% were males. Of the males, about 11,500 or 74% were salaried. Of the salaried males, about 1,250 were lower-level managers and supervisors, and approximately 400 of these were in the target categories. The 253 subjects in the experimental groups constitute approximately 60% of the target population for the specialized samples. By ethnic origins the sample was 84% white, 6% Hispanic, 6% Asian-American, and 4% black. A broad range of data was collected from each participant, including demographics, job title, Work Environment Scale, Family Environment Scale, Type A behavior, other personality scales, workload, job satisfaction, life stress, psychological distress, blood pressure, physiological variables from blood and urine samples (lipids, catecholamines), CHD status, other medical history, and full set of weekly workload reports.

The results of the study did not support the concept of job stress and behavior as an extraordinary component of CHD risk, i.e. as a component much larger than conventional CHD risk factors. The data were consistent with the concept of job stress and behavior, in combination, as ordinary components of CHD risk, having effects that are comparable to the classic factors. For instance, there were a fairly large number of low-grade, but seemingly consistent, relationships between psychosocial variables defining job stress and behavior and physiological measurements known or believed to relate to CHD risk. Previously reported relationships between certain psychosocial variables (principally anxiety, neuroticism, and depression) and self-reports of CHD status, such as angina, were replicated in the study. However, the variables that had the strongest relationship to self-reported CHD status did not have the strongest relationships to physiological variables, again indicating the existence of multiple mechanisms and paths.

Mass Psychogenic Illness

In July 1974, a team of psychologists from NIOSH was asked to aid in the investigation of an illness outbreak in a garment manufacturing plant in the southwest. This unusual request for psychological evaluation came about after preliminary measurement of chemical agents in the workplace had failed to detect any significant levels of known toxicants. Within a period of a week, approximately 100 women in a plant population of 340 workers (325 women, 15 men) had expressed or displayed symptoms of nausea, dizziness, fainting, and burning sensations in the eyes and throat. A majority of the affected workers reported smelling a peculiar odor or gas in the work environment, which they felt produced their illness. Extensive environmental sampling by industrial hygienists and medical examinations, however, failed to identify the presence of any toxicants capable of producing the observed symptoms. It was felt that the illness might have involved psychogenic components (e.g. stress or anxiety).

The immediacy of the situation did not allow for the development of a systematic research protocol by NIOSH psychologists. Nevertheless, it was felt that sufficient information could be obtained through observation of the work environment and interviews with affected and non-affected workers to permit generalizations to other reported cases of this nature. However, a post-investigation literature review was extremely disappointing and revealed only two published cases of apparent mass psychogenic illness in American work settings (Stahl & Lebedun, 1974; Kerckhoff & Back, 1968). In these two case studies, as was also true of the NIOSH investigation, the spontaneity of the phenomenon and the absence of a guiding theoretical framework hampered the collection of systematic and comparable data. Consequently, understanding of contagious psychogenic illness was more impressionistic than empirical and limited by the scarcity of existing data.

It was apparent that a critical need existed for systematic research into the etiology and methods for remediation of mass psychogenic disturbance in industry. Therefore, in 1976, NIOSH initiated a programmatic effort to develop, field test, and refine a research protocol for investigating cases of this nature. This approach involved combining individual interviews with questionnaire data collected from a random sample of affected and non-affected workers at each worksite. In addition to sociodemographic (e.g. age, sex, level of education, marital and parental status, etc.) and epidemiological information (date and time of illness, symptomatology, location of workplace at time of onset), the questionnaire contained items designed to measure perceived job stress along a variety of dimensions (e.g. unwanted overtime, quantitative work overload, role ambiguity, lack of social support, boredom, etc.). Life stress experienced outside the job situation was measured via the Holmes-Rahe Social Readjustment Scale. Sociometric (e.g. friendship choices at work, most frequent

interpersonal contacts, etc.) and personality/psychodiagnostic (e.g. Eysenck Personality Inventory, MMPI Hysteria, Hypochondriasis and Depression Scales) measures were also included.

Since the original investigation, NIOSH investigated eight outbreaks of mass psychogenic illness (MPI) in shoe factories, a warehouse, an aluminum lawn furniture assembly plant, a fish packing plant, and electronics assembly plants using the standard survey protocol described above. The eight incidents shared some important features that are noteworthy (Colligan, Pennebaker & Murphy, 1982). First, affected workers were predominately female (89%) although women were disproportionately represented in each of the workplace populations also. Second, the symptomatology across cases was remarkably similar. Headache was the most frequent symptom and lightheadedness, dizziness, sleepiness, and weakness were all in the top five most frequent symptoms in 75% of the studies. Third, in all cases, the onset of symptoms and their subsequent contagion was preceded by a triggering event (e.g. strange odor) that was viewed as causally related to the malady. Fourth, the work settings in which MPI occurred tended to involve boring, repetitive, rigidly-paced jobs with little opportunity for advancement. Moreover, in many cases, workers reported high work pressure, poor labor/management relations, and physical discomfort at work. Physical discomfort at work, which included worker ratings of noise levels, temperature, air quality, and lighting levels, consistently correlated highly with affected status. The finding that personality characteristics could not be conclusively linked with affected status suggested that MPI outbreaks involve normal individuals in stressful work environments (Colligan & Murphy, 1979).

While the data base on MPI outbreaks continued to grow (e.g. Boxer, Singal & Hartle, 1984), much remained unknown about this phenomenon and the appropriate remedial interventions. The spontaneous nature of the illness, which dictates a *post facto* investigation, severely limits the range of usable methodologies. Extent company records are usually of too poor quality and/or insufficiently detailed to pinpoint causes of the illness outbreaks. Aggregate analyses of MPI data, in which the organization, not the individual, becomes the unit of analysis (exemplified by Schmitt & Fitzgerald, 1982), may be the most fruitful course to pursue for increasing understanding of this phenomenon.

1977 Conference on Work and Stress

In 1977, NIOSH again co-sponsored a conference with the Center for Occupational Mental Health that was held in White Plains, New York in 1977 (McLean, Colligan & Black, 1978). The conference included presentations from 23 speakers that covered a broad range of topics including sources of occupational stress, prevention and remediation programs, and legislative efforts to

manage job stress. Indeed, the assemblage of speakers and the enduring relevance of the topics were so significant at this early stage of job stress research that the table of contents from the meeting is shown in Text Box 3.

At this conference, House and Wells presented early research suggesting that social support buffers the effects of job stress on some health conditions (neurosis and ulcers) more so than others (e.g. angina pectoris). Arthur Shostak highlighted job insecurity and job loss as major blue-collar stressors in the 1970s, and suggested that a revolution in managerial thinking was needed to bring about needed job redesign. Tores Theorell presented early evidence of a link between job stressors and myocardial infarction, citing workload and increased responsibility as major risk factors. Jerome Rosow pointed to significant changes in worker attitudes toward work, and noted that the quality of working life should be viewed broadly to encompass the organization of work, hierarchical structures, relationships with coworkers, organizational climate, participation in decision making, and opportunities for development and advancement. Bertil Gardell provided details of a legislative/regulatory approach to reducing psychosocial stressors at work in Scandinavian countries, and described the co-determination Act passed in 1977 and the work environment Act in 1978. The former gave trade unions the right to influence decisions at all levels in the organization, while the latter specified that working method be adapted to the worker, both a physiological and psychological point of view. Finally, Lennart Levi made clear that while it is common in discussions of job design to hear that the worker is adaptable, he/she is also deformable and working conditions should be redesigned so that they do not 'deform' the worker in terms of subjective well-being, behavior, and physiology.

It is important to remember that job stress was not a mainstream health and safety issue in the 1970s, nor was it a much-discussed topic in industrial/organizational psychology. Presentations of job stress studies at national scientific or trade group meetings were typically met with skepticism. Fundamental questions about its' legitimacy as a workplace issue and the quality of the underlying science (i.e. worker perceptions) were common, even routine. One major objection in the 1970s (and well into the 1980s) was that stress was not a work environment issue, but rather a worker problem, and hence solutions would require individual worker attention. The analogy to counseling for alcoholism was often made. It was not until a good deal more research was completed before these types of objections would become less common.

1980s: GROWTH AND EXPANSION

The 1980s saw an expansion in the scope of inquiry of NIOSH job stress research, as reflected by new research on job demands/worker decision latitude,

Text Box 3. Table of Contents from 1977 Cornell Conference on Occupational Stress.

III: THE ROLE OF THE ORGANIZATION IN STRESS/STRAIN MANAGEMENT

IV: LEGISLATIVE PROGRAMS FOR THE MANAGEMENT OF PSYCHOLOGICAL JOB STRESS

V: OCCUPATIONAL STRESS AND MENTAL ILLNESS: SOME PREVENTIVE AND REMEDIAL APPROACHES

Source: McLean, Black, G., & Colligan, M. (Eds). *Reducing Occupational Stress*. DHHS (NIOSH) Publication No. 78-140, Washington, D.C.: U.S. Government Printing Office.

stress management, video display terminal and office worker stress, and stress measurement methods. Moreover, NIOSH formally recognized psychological disorders as one of the top ten leading causes of work-related disease in its National Strategy for the Prevention of Work-related Disease (Millar, 1984; National Institute for Occupational Safety and Health, 1988). However, this expansion occurred in the absence of any budget increases; more projects were initiated but they were small relative to the size of projects in 1970s.

Demand/Control Model of Strain

NIOSH provided funding to test a new hypothesis that job strain (specifically coronary heart disease) was a function of the interaction of job demands and decision latitude. Karasek (1979) proposed that job strain resulted not from a single aspect of work but rather the joint effects of job demands and decision latitude (i.e. worker control). This research sought to harmonize two contradictory traditions in industrial/organizational research: one tradition focusing on job decision latitude and the other focusing on job demands or stressors (Karasek, 1979).

A model proposed by Karasek to predict stress-related consequences of job characteristics was tested in a NIOSH funded project using prevalence data on heart disease from the 1961 Health Examination Study (1961), the 1972 National Health Interview Survey, and the 1971–1974 National Health and Nutrition Examination Survey. Hypotheses about job characteristics were tested by assigning job scores to occupations using U.S. Quality of Employment data from 1969, 1972 and 1977. Multivariate analyses (controlled for known CHD risk factors such as age, education, marital status, and ethnicity) showed that high job demands were associated with excess prevalence of myocardial infarction, as was low decision latitude. However, the combination of high job demands and low job control (i.e. the 'high strain group" which comprised 15% of the sample) was not significant in the regression model. On the other hand, high strain jobs (those with high demands and low decision latitude) did have a higher prevalence of myocardial infarction across age groups, especially after age 35. Psychological job demands were most consistently linked to high blood pressure, especially diastolic blood pressure, as was job decision latitude. High strain jobs tended to have slightly higher blood pressures across age groups, except for the 65+ group that showed the opposite pattern (Karasek, Schwartz & Theorell, 1982; Karasek, Theorell, Schwartz, Schnall, Pieper & Michela, 1988).

A second grant awarded by NIOSH to Karasek examined the prospective development of CHD risk factors in relationship to job characteristics and occu-

pation using existing U.S. health databases. If job characteristics contribute to the ultimate development of CHD (as found in the first grant), they should affect the prospective development of conventionally measured CHD risk factors as well. However, almost no research has been undertaken in the prospective development of blood pressure, EKG, smoking, or Type A behavior linked to occupation or job characteristics. Such analyses would be of great potential value in occupational health research where the study of CHD risk factors could be accomplished with substantially smaller populations than are needed to study the prospective development of CHD itself. This study used a similar methodology to that employed in the first grant but was based on job title data available in the Western Collaborative Group Study, Exercise Heart, and Mr. Fit prospective databases, using adaptations of the existing job characteristics/occupation imputation methodology (Karasek, Theorell, Schwartz, Schnall, Pieper & Michela, 1988).

The NIOSH funding allowed these researchers to refine an occupational scoring system in which job characteristic scores were imputed to job titles and then to test associations between occupational scores and coronary heart disease. The findings reported in a 1982 grant report indicated the clear importance of decision latitude on myocardial infarction and of job demands on blood pressure, but tests of Demand × Control interaction terms were not always statistically significant (Karasek, Schwartz, Theorell, Pieper, Russell & Michela, 1982). Later research by other groups that tested Karasek's demand/control model would provide inconsistent results, some studies finding significant interactions while others did not find a significant interaction term. Still other NIOSH research partially supported a little tested aspect of the model; lower disability due to cardiovascular disease for 'active' jobs (Murphy, 1991). Active jobs represented the opposite of high strain jobs, that is, jobs with high demands but high decision latitude.

Of course, the lure of the demand/control hypothesis was its simplicity: workers will experience job strain whenever the demands of the work exceed their ability to control the demands. One advantage of Karasek's methodology was that issues of common method bias were avoided since the measures of job characteristics and health outcomes were not obtained from the same source. Rather, scores on job characteristics were imputed to occupations based on aggregated cores from selected items taken from the QES.

State of the Art Meeting on Worker Control and Health

As a follow-up to the demand/control research described above, NIOSH convened a special meeting of researchers to evaluate the state of knowledge on

worker control and health (Sauter, Hurrell & Cooper, 1989). The meeting reviewed findings from the fields of industrial/organizational psychology, epidemiology, and psychophysiology and was organized around three major topics: (1) evidence for the effects of control on worker health; (2) methodological and theoretical concerns; and (3) control problems and solutions in modern work. A few highlights of the meeting are worth noting. For instance, Karasek (1989) agreed with other speakers that while studies routinely find main effects for demands and control, many do not find that the demand/control interaction term is statistically significant. He suggested, however, that the practical implications for job design remain the same whether separate main effects for demands and control are found or demand/control interactions are observed. Ganster (1989) suggested that control was often treated as a uni-dimensional construct when in fact there are likely to be specific domains of control that require measurement, such as control over tasks, pacing, scheduling, physical environment, decision making, interpersonal interaction, and job mobility. The idea that control is multi-dimensional was incorporated into the design of the NIOSH Generic Job Stress Questionnaire (described later in this chapter). Finally, Kasl (1989) concluded that ". . . fundamental questions regarding conceptualization, measurement, and supportive evidence remain unanswered . . ." with respect to worker control and health.

Stress Management

An important element in the initial five-year plan was research on stress reduction and prevention. This became more critical as more information on job stress and health was produced by the early NIOSH studies. The first NIOSH study in this area focused on the merits of biofeedback and muscle relaxation for reducing stress symptoms among hospital nurses (Murphy, 1983). This was followed by a study of highway maintenance workers (Murphy, 1984). The latter group was selected for study because research in this area had concentrated on white- and pink-collar workers. In both studies, stress management training was associated with improvements on measures of psychological function such as anxiety and perceived coping skills, but inconsistent effects on measures of somatic complaints (e.g. headaches, shortness of breath). Stress management did not produce consistent improvements in job/organization-relevant outcomes, such as absenteeism or job satisfaction. This is not surprising since the interventions did not focus on changing job-related sources of stress. The effects of stress management on physiological outcomes like muscle tension levels and hand temperature were positive but very small in magnitude (Murphy, 1983, 1984). These results agreed with prior and later

studies showing that stress management training can improve individual-level measures of stress.

One outcome of this work was the preparation of a manual on stress management training (Murphy & Schoenborn, 1989) that presented available evidence on training effectiveness, raised warnings to organizations about focusing exclusively on changing individual workers while ignoring the work environment, and presented a prototype for comprehensive workplace stress reduction programs. Another outcome was a series of articles that reviewed the literature on the efficacy of occupational stress management programs (Murphy, 1984a, 1996). These reviews indicated that, as applied in work settings, stress management more often than not was being offered in a preventive, as opposed to curative, context. That is, participants were not recruited because of evident stress problems or health risks, but rather such training was open to all workers. Accordingly, these programs have a more compelling association with health promotion than with stress reduction. The reviews also highlighted substantial knowledge gaps in stress management research and recommended a more comprehensive approach to controlling job stress, one that combines stress prevention (via job redesign and organizational change) with stress management training.

Video Display Terminals (VDT)

In 1978, NIOSH received a request from the Labor Occupational Health Program, University of California at Berkeley for assistance in a study of stress and strain among video display terminal (VDT) operators. NIOSH provided advice on a draft questionnaire instrument developed by the Newspaper Guild and made recommendations for improving the nature and scope of the survey instrument. Based on this advice, NIOSH was formally asked to assist in the investigation of psychosocial factors and musculoskeletal disorders among VDT users. This investigation revealed a much higher prevalence of musculoskeletal symptoms among clerical VDT users (e.g. 56% for neck-shoulder pain) than among work peers who did not use VDTs (19% for neck/shoulder pain). Increased psychosocial demands (greater work pressure, reduced autonomy, and lower supervisory support) were also seen among the VDT users, suggesting a possible etiologic role of these factors (Smith, Cohen, Stammejohn & Happ, 1981).

A NIOSH-supported follow-up study at the University of Wisconsin resulted in findings nearly identical to effects seen in the West Coast study (Sauter, Gottlieb, Jones, Dodson & Rohrer, 1983). In this cross-sectional study, VDT users again reported increased work pressure and reduced support and personal control in their jobs compared with workers who did not use VDTS. Adding

these factors (job control and social support) as predictor variables to regression models linking environmental factors to musculoskeletal outcomes substantially increased the explanatory power of these models. Three years later, NIOSH initiated a series of lab studies that sought to isolate stressful job and task characteristics of VDT operations. Although these studies did not detect changes in objectively measured visual function due to VDT use, subjective reports of visual and musculoskeletal complaints were more apparent in VDT operators. Other work in this area identified slow system response time as a source of stress for VDT operators (Schleifer & Amick, 1989) and examined the utility of end-tidal PCO_2 (peak concentration of carbon dioxide in a single exhaled breath) as a psycho-physiological indicator of stress in VDT work (Schleifer, 1994). In the presence of rapidly accumulating evidence that workplace psychosocial factors were instrumental in the development of musculoskeletal disorders in office and VDT work, NIOSH collaborated with Duke University in1993 to hold a state-of-the-art meeting that critically examined these factors and their influence (Moon & Sauter, 1996).

More recently, NIOSH has undertaken field interventions to evaluate the effectiveness of organizational interventions to reduce musculoskeletal disorders among VDT operators. In a controlled study of 100 data entry clerks at the Internal Revenue Service, reorganization of work schedules to provide more frequent rest breaks resulted in reduced discomfort in the neck, back, and upper extremity (Galinsky, Swanson, Sauter, Hurrell & Schleifer, 2000). It is noteworthy that these benefits occurred without any reductions in data-entry performance.

Stress Measurement Methodologies

The dominant methodology in job stress research had been a questionnaire survey approach in which workers were asked to rate job characteristics and also to provide information on the frequency of various health complaints. Problems with this methodology are well known, such as potential confounds between measures of stressors and strains (Kasl, 1978; Hurrell, Murphy, Sauter & Cooper, 1988). Perhaps the biggest problem was the absence of standardized scales to measure job characteristics, which prevented direct comparisons among studies but also prevented the development of a normative database.

The pressing need for a standardized set of reliable and valid scales to measure job stressors and strains across occupational settings prompted NIOSH to develop the Generic Job Stress Questionnaire (GJSQ). Working with outside experts (Dan Ganster and Neil Schmitt), NIOSH designed the GJSQ as a series of modules containing multi-item scales that addressed key features of the work environment and key health outcomes (Hurrell & McLaney, 1988). A general

model of job stress and health (described in the succeeding section) was used to guide development of the GJSQ. Three criteria were used to select items and scales from existing instruments: (1) evidence of reliability and validity; (2) absence of confounding of stressors and strains; and (3) extensive use of the items in prior research. If no adequate measures for a particular construct could be found, then new items were created.

Table 2. NIOSH Generic Job Stress Questionnaire.

	Scale name	No. of items	Reliability (α)
(1)	Physical Environment	18	0.84
(2)	Role Conflict	8	0.82
(3)	Role Ambiguity	6	0.84
(4)	Intra-group Conflict	8	0.86
(5)	Inter-group Conflict	8	0.85
(6)	Job Future Ambiguity	4	0.65
(8)	Task Control	8	0.85
(9)	Decision Control	4	0.74
(10)	Physical Environment Control	2	0.79
(11)	Resource Control	2	0.82
(12)	Alternate Employment Opportunities	3	0.80
(13)	Social Support from Supervisor	4	0.88
(14)	Social Support from Coworkers	4	0.84
(15)	Social Support from Family	4	0.85
(16)	Quantitative Workload	7	0.85
(17)	Variance in Workload	3	0.86
(18)	Responsibility for People	4	0.62
(19)	Skill Underutilization	3	0.73
(20)	Mental Demands	5	0.75
(21)	Non-work Activities	7	*
(22)	Type A personality	16	0.85
(23)	Self-Esteem	10	0.85
(24)	Somatic Complaints	17	0.87
(25)	Job Satisfaction	4	0.83
(26)	Depression	20	0.88
	TOTAL	179	

* Data not available for this scale.

The final instrument contained 179 questions that were distributed across 26 scales (see Table 2), not counting demographic questions. All of the work scales demonstrated internal consistency with the exception of Responsibility for People (alpha = 0.62). Many of the scales assessed features of the work environment taken from commonly used instruments (e.g. Caplan et al., 1975) but in some areas, new scales had to be developed. One example is the topic of worker control. Instead of measuring global or facet-free control, four distinct dimensions of control were assessed (task, decision, physical environment, and resources) and multiple questions were generated for each dimension or domain of control.

As mentioned above, the selection of constructs to measure in the GJSQ was guided in part by the NIOSH model of job stress and health (see Fig. 2). This model built on the earlier frameworks offered by Caplan et al. (1975), Cooper and Marshall (1976), and Levi (1971). The model views job stress as a situation in which a working condition (stressor) or combination of working conditions interact with individual worker characteristics and result in acute disruption of psychological or physiologic homeostasis. These acute reactions, if prolonged, lead to a variety of illnesses. Three sets of factors are shown in the model to influence the stressor-strain relationship: individual factors, non-work situations, and buffers. These three sets of factors can lead to differences in the way workers exposed to the same stressors perceive or react to them. It is noteworthy that most job stress research examine only the link between stressors and acute outcomes, and few studies have tested the full model. A full test of the model would require the collection of records data on health and disability in addition to questionnaire data on stressors, strain, and mediating factors.

Work Schedules and Fatigue

A trend toward increased scheduling of workdays longer than eight hours, often in combination with night or rotating shift work, raised concerns about the degree of stress and fatigue produced by these schedules. Consequently, NIOSH initiated a series of laboratory and field studies in 1983 to examine these effects. A portable fatigue test battery was designed to measure fatigue development and accumulation across 8- and 12-hour work shifts and compressed workweeks (Rosa & Colligan, 1988), coupled with questionnaire assessments of perceived stress, mood, fatigue and sleepiness. Initial studies found decreased reaction time and grammatical reasoning performance and increased subjective fatigue after seven months of 12-hour shifts as compared to the previous 8-hour shift schedule. Daily sleep logs indicated a 1-hour sleep debt by the end of the

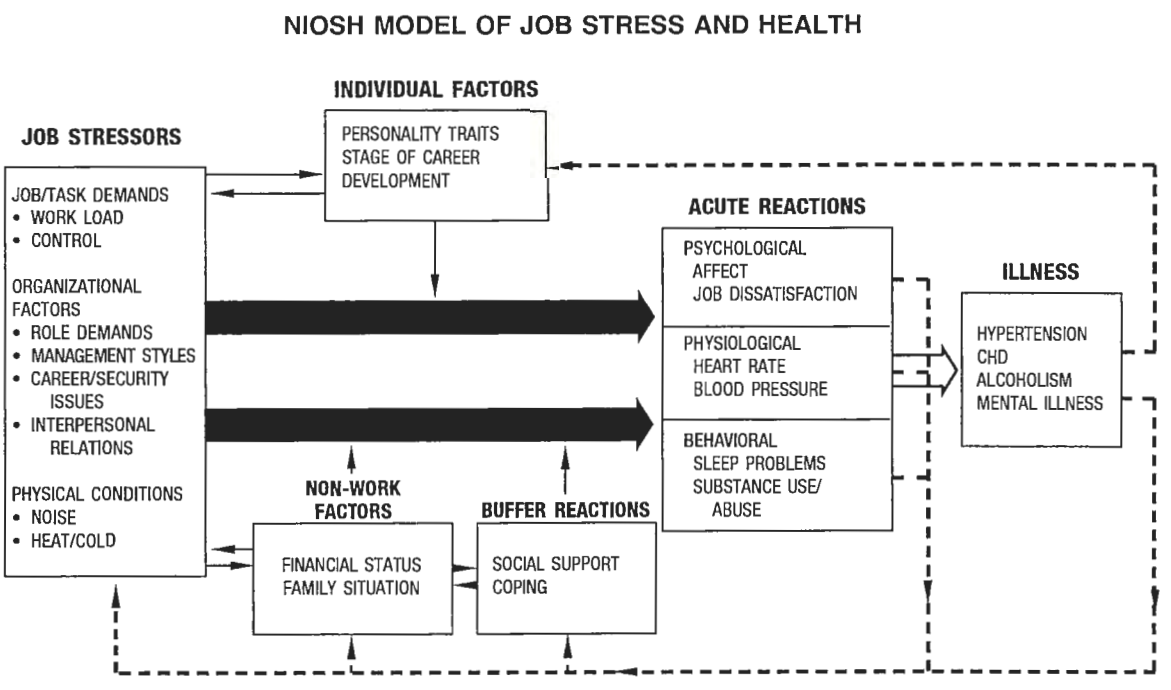

Fig. 2. NIOSH Model Used to Guide Job Stress Studies.

12-hour/3–4 day workweek. Performance did not deteriorate across the workweek, however, suggesting that the shorter workweek compensated somewhat for the longer work shift (Rosa, Colligan & Lewis, 1989). After 3.5 years on the 12-hour shift schedule, declines in alertness with time on-shift and reductions in total sleep time were still apparent, and few improvements were observed relative to the 7-month test phase (Rosa, 1991). In a second worksite study at a natural gas utility, there were significant decrements in reaction time performance and subjective alertness 10 months after the change to a 12-hour shift schedule. Reductions in sleep across the workweek were most apparent on 12-hour night shifts (Rosa & Bonnet, 1993). Accumulated fatigue across consecutive workdays exemplified by progressive increases in choice reaction time were apparent across a 5-day week of 8-hour shifts and a 4-day week of 10-hour shifts in air traffic control specialists (Schroeder, Rosa & Witt, 1998).

The interaction of time of day and accumulated fatigue from hours of work was examined in a later laboratory study in which subjects were instructed to perform a manual work simulation at three repetition rates and to stop the work trial when they reached a given level of perceived muscular fatigue. The data showed that muscular fatigue increased during 12-hour shifts and fatigue increased more quickly across the night shifts compared to day shifts. Subjects were willing to work longer at slower repetition rates early in the shift but this difference among workloads was appreciably smaller by the end of the shift, especially night shift. The results indicated that extra hours of work added to the early-morning downturn in circadian arousal produced the greatest fatigue (Rosa, Bonnet, & Cole, 1998). A summary of the stress, fatigue, and performance effects of shift work was prepared by NIOSH and is available at: (*http://www.cdc.gov/niosh/pdfs/97–145.pdf*).

Top Ten Leading Causes of Work-Related Disease

In 1982, a list of leading work-related diseases and injuries was developed by the scientific leadership of NIOSH. Three criteria were used to select conditions or disorders for inclusion in the list: (a) the frequency of the condition; (b) the severity of the condition in the individual case; and (c) the "preventability" of the condition. NIOSH leadership identified 10 disorders that met these criteria and psychological disorders was one of them. The "top ten" list was intended to encourage deliberation and debate, to assist in setting national health priorities, and to disseminate the concerns of the NIOSH leadership and the focus of the institute (Millar, 1984).

In 1985 and 1986, symposia were held to establish national prevention strategies for the leading work-related diseases and injuries. Psychological disorders

were addressed at the 1986 symposium held in Cincinnati, Ohio. Over 50 professionals from industry, business, trade unions, voluntary organizations, academia, and the professions attended the symposium. For each disorder, a team of internal and external experts was empanelled to prepare a national prevention strategy that described the scope of the problem, its work-relatedness, and recommendations for prevention and future research. The psychological disorders strategy document addressed four major areas: job design, surveillance, education and training, and mental health services (National Institute for Occupational Safety and Health, 1988). An expanded version of the psychological disorders national strategy later was published in the *American Psychologist* (Sauter, Murphy & Hurrell, 1990). The strategy examined current knowledge and practices and suggested initiatives for industry, labor, government, and academia to help promote the psychological health of workers. Key steps included measures to improve working conditions and employee mental health services, as well as research and surveillance to advance understanding of the problem. Within NIOSH, the strategy document was used to guide the research program and new projects were required to show relevance to research gaps identified in the strategy document.

In 1989, the American Psychological Association (APA), in collaboration with NIOSH, developed the APA/NIOSH Work and Well-Being Project, which used the NIOSH (1988) psychological disorders prevention document as its point of departure. This collaboration resulted in a national conference that was convened in November, 1990 (discussed later in this chapter).

Outside of NIOSH, the Institute of Medicine, National Academy of Sciences commissioned a special study of stress and human health. Panels were set up to address various aspects of stress and health, and one of those panels dealt with stress in organizational settings (Elliott & Eisdorfer, 1982). The panel reviewed the literature, presented a summary of the findings, and listed research needs including recommended interventions. Examples of recommendations were efforts to increase worker control of work arrangements, increasing worker participation in decision-making, avoiding monotonous machine-paced work, avoiding work overload, and facilitating communication among workers.

1990s: TO BE OR NOT TO BE

The 1990s are notable on several counts but the most memorable was the possibility that the NIOSH would be eliminated completely. Senate hearings held in the mid-1990s considered cutting 30% of the Occupational Safety and Health Administration budget and eliminating NIOSH and the Mine Safety and Health Administration as a federal agencies. In the end, this didn't occur

but the threat of elimination certainly brought the issue of job stress close to NIOSH researchers! Ironically, funding for work organization and job stress research actually increased in the 1990s and this increase has continued in 2000. As the reader will see below, since the late 1990s, the number and scope of NIOSH job stress research projects rose dramatically in response to increased funding and support.

From a research perspective, the 1990s began with three new thrusts to the NIOSH job stress program. First, major funding initiatives were introduced throughout NIOSH and would become a stable part of the NIOSH funding mechanism in future years. Second, NIOSH would establish a long-term partnership with the American Psychological Association (APA) to sponsor international conferences on work, stress and health and to encourage more psychologists to pursue careers in occupational safety and health. Third, NIOSH developed a National Occupational Research Agenda to guide internal research and extramural funding and to provide general guidance for OS&H research.

Initiative-Driven Research

In 1990, the first targeted funding initiative appeared within NIOSH, earmarking special funds for HIV/AIDS research. In later years, initiatives dealing with Agriculture and Construction would appear and drive new project development. Still later, funding initiatives based on NORA would become more prominent. A few initiative-driven research efforts are described below.

HIV/AIDS Initiative

Although HIV/AIDS is not usually viewed from a job stress perspective, it was easily blended into the job stress research program from a safety management perspective. For instance, recommended work practices (e.g. not recapping used needles) to prevent occupational exposure to HIV/AIDS were incorporated into the OSHA blood-borne rule in 1992. Despite the wide dissemination of these recommendations, a substantial number of occupational exposures to contaminated blood and body fluids continue to occur, especially through needlestick injuries and cuts by sharp objects. Broadly speaking, failure to follow recommended work practices in any work environment is a safety issue, and a number of individual and organizational factors have been associated with the safety at work (e.g. Cohen, 1977; Zohar, 1980). These include strong management commitment to safety, provision of performance feedback to employees, humanistic management style, high worker involvement in safety, and good hygiene practices.

NIOSH adopted this safety perspective and awarded a cooperative agreement to Johns Hopkins School of Medicine to design a questionnaire study that assessed individual, job and organizational factors that influenced worker adherence to Universal Precautions (UP). Survey data were obtained from over 1,700 workers at three hospitals across the USA. Hierarchical regression analyses revealed that demographic factors and worker personal characteristics were not good predictors of adherence to UP. On the other hand, job/task factors, notably worker perceptions of job hindrances, were the best predictors of adherence to UP. Job hindrances included perceptions that job duties interfered with practicing UP, failure to follow UP because "patients needs come first," and perceptions that UP prevented workers from doing their job to the best of their abilities. Organization-level factors, such as management commitment to safety and performance feedback were good predictors of worker adherence to UP. In order to improve worker adherence to UP, it was suggested that organizations: (1) evaluate jobs/tasks to identify and then reduce hindrances to compliance; (2) insure top management commitment to safety; and (3) encourage managers to provide feedback and reinforcement to employees on their safety performance (Gershon, Murphy, Felknor, Vesley & DeJoy, 1995; DeJoy, Murphy & Gershon, 1995).

Agriculture Initiative

This initiative funded a wide range of projects dealing with health and safety issues in agricultural occupations. In the area of job stress, new research was funded that examined job stressors and health and safety consequences among farmers and farm families. NIOSH funded cooperative agreements to conduct in-depth interview and questionnaire studies of farm families. Intramural studies of farmer stress, health and safety were also designed (Kidd, Scharf & Veazie, 1996) and identified workload, hours of work, physical environment, mental demands, and work-family spillover as major job stressors in farming. Economic conditions, weather, lack of resources, and farm hazards also contributed to farmer stress levels. A structural model was developed that linked farm family stress and injury and provided ideas for future research. These findings led to additional and continuing research on health and safety interventions for farm families (Scharf, Kidd, Cole, Bean, Chapman, Donham & Baker, 1998).

Construction Initiative

Two new studies funded under this initiative examined job stress and strain among female construction workers. The first study involved interviews with tradeswomen and discovered that, compared to their male counterparts, tradeswomen felt that they were offered fewer opportunities to learn and use

new skills, they had to overcompensate to 'prove their worth' to male co-workers, and that they felt a responsibility for the safety of others at work. A follow-up telephone survey of 211 female construction workers found that skill underutilization, responsibility for the safety of others, sexual harassment, and gender-based discrimination were related to lower psychological health (Goldenhar, Swanson, Hurrell, Ruder & Deddens, 1998). A second study used a qualitative methodology to obtain information from construction owners and workers on work organization risk factors for health and safety (Grubb & Swanson, 1999). Hours of work and job demands were major risk factors for company owners, but not for contractors or line-workers. Poor safety climate emerged as a major risk factor that may have been due to the lack of formal safety training provided to workers. Safety regulations were viewed as "getting in the way" of doing the job and, from the owners point of view, not worth the monetary investment required. Front-line workers viewed safety as a matter of "common sense"; one learns what is not safe from the mistakes (i.e. accidents) of others.

NIOSH/APA Partnership

In 1990, NIOSH and the American Psychological Association (APA) began a partnership to address the concerns set forth in the National Strategy for the Prevention of Work-Related Psychological Disorders that was described earlier in this chapter (Sauter, Murphy & Hurrell, 1990). The partnership initially resulted in the joint sponsorship of a national conference on work and health in 1990 to present new research in the area of job stress and psychological disorders. Many topic areas for the planned conference were abstracted from the National Strategy document. The conference, entitled *Work and Well-Being: An Agenda for the 1990s*, brought together over 300 experts from the fields of psychology, occupational medicine, epidemiology, public health, and business. Participants included researchers, policy analysts, managers, and medical and human resource specialists representing industry, labor, government, and academia.

The conference had two major phases. The first phase involved the finalization of an action plan to protect the psychological health of workers. This plan was based upon more general formulations contained in the NIOSH National Strategy for Prevention of Work-Related Psychological Disorders. The NIOSH strategy emphasized the need to improve working conditions, to improve education and health service delivery pertinent to work-related psychological disorders, and to improve the surveillance of work-related psychological disorders and risk factors. Information dissemination, research, training, and policy

development cross-cut each of these areas. The 1990 conference was followed by conferences in 1992, 1995, and 1998, each one being larger than the prior one. Proceedings from most of these conferences were published in a series of APA books (Gowing, Quick & Kraft, 1998; Keita & Sauter, 1992; Murphy, Hurrell, Sauter & Keita, 1995; Quick, Murphy & Hurrell, 1992; Sauter & Murphy, 1995).

Occupational Health Psychology

The second major outcome of the APA/NIOSH partnership was the development of a new discipline of study, occupational health psychology (OHP), which concerns the application of psychology to improving the quality of work life, and to protecting and promoting the safety, health and well-being of workers. The logic for this new discipline was that work organization and associated health and safety risks often fall into gaps between occupational health and psychology. The APA-NIOSH effort to promote the area of OHP, particularly to implement university programs and training in OHP, represents the first formal attempt by the psychology community to bring the expertise and resources of psychologists to the occupational safety and health field (Sauter, Hurrell, Fox, Tetrick & Barling, 1999).

In 1992, NIOSH entered into a cooperative agreement with the APA to develop university programs addressing these OHP training needs. To help ensure the quickest impact, OHP training under the APA-NIOSH cooperative agreement was supported initially at the postdoctoral level only and targeted principally to industrial/organizational psychologists for immediate application in teaching or professional practice in an organizational context. In the period 1994–1998, three university programs (Wayne State Department of Psychology, Duke University Medical Center, and the Johns Hopkins School of Public Health) served as training sites under the APA-NIOSH cooperative agreement. Program elements essential for selection as an OHP training site included: (a) faculty expertise in relevant areas such as work organization and health, job stress, etc.; (b) interdepartmental linkages which expose behavioral scientists to topics and methods in occupational safety and health, public health, epidemiology, labor studies, etc.; and (c) opportunities for projects, practical or internships with industry and labor organizations. Training sites were encouraged to develop a core OHP curriculum addressing the following topics:

- Organizational risk factors (management practices, job content, work roles and responsibilities, social/supervisory environment, etc.) for occupational stress, injury, and illness.

- Health aspects of stressful work, including physical and psychological health, and social and economic costs.
- Organizational interventions (e.g. work redesign) and programs (e.g. EAPS) for reduction of occupational stress, illness and injury.
- Research methods and practices in public/occupational health and epidemiology.

In 1998, training under the APA-NIOSH cooperative agreement was redirected to the graduate level in support of new course work, minor or major degree programs, or certificates in OHP in departments of psychology. Based on the same criteria for selection of postdoctoral training sites, three new universities (Kansas State University, University of Minnesota, and Bowling Green State University) were competitively selected as inaugural recipients of funding for support of graduate-level training in OHP, Subsequently, Bowling Green State University established a graduate minor in OHP as part of their existing industrial/organizational and clinical psychology programs, and Kansas State University developed a "concentration of courses and practica in OHP that would be offered to students in multiple psychology graduate programs, such as organizational psychology and human factors. Other universities funded from 1998–2001 were University of Minnesota, Clemson University, Tulane University, University of Houston, Portland State University, University of California-Los Angeles, Colorado State University, University of South Florida, and University of Texas at Austin (for details on the OHP program, see the NIOSH web page *http://www.cdc.gov/niosh/ohp.html*).

One of the most visible accomplishments of the APA/NIOSH partnership was the launching of the *Journal of Occupational Health Psychology* in 1996 as an APA publication. The journal addresses psychosocial factors related to the prevention of occupational health and safety problems and solicits research, theory, and public policy articles bearing upon occupational health psychology. The premier issue in January 1996 contained four state of the art reviews and five original research articles (*http://www.cdc.gov/niosh/ohp.html#johp*).

Downsizing and Health

Following the dissolution of the Soviet Union and the end of the nuclear arms race, the U.S. Department of Energy (DOE) and the nuclear defense industry embarked on a process of changing the agency's mission and determining appropriate staffing levels reflecting this change. Anticipating future layoffs, an approach was outlined in 1993 to plan and implement workforce layoffs consistently across the nuclear weapons industry. In 1995, Boston University School

of Public Health was awarded a contract to examine the health and safety effects of downsizing in five selected DOE facilities across the U.S. The study used focus groups, a questionnaire survey, and measures of the downsizing rate aggregate measures of sick time usage and accidents. The survey was sent to a random selection of 10,646 workers at the five sites, and 55% of those responded to the survey ($N = 5,889$ respondents).

Compared to national norms, workers at four of the five DOE study sites had better physical health scores. This finding is consistent with many prior reports indicating that working populations generally are healthier than national samples of U.S. adults. However, the opposite was found for mental health and perceived stress, where scores for each DOE site were worse than the national norms (i.e. lower mental health and higher stress). Multi-level hierarchical regression analyses were conducted to examine relationships between downsizing factors and worker health and well-being. Workers who felt that the downsizing process was fair, and that communication was open and honest, reported fewer medical symptoms (e.g. headaches, shortness of breath), fewer symptoms of downsizing survivor syndrome and more job security. Workers who were more directly involved with the downsizing process (i.e. delivered layoff notices) reported more medical symptoms. Finally, workers in jobs with high workload demands but with low decision-making authority reported higher levels of perceived stress and more job insecurity, more symptoms of survivor syndrome, and lower morale. It was suggested that the organizations: (1) implement processes and policies that emphasize fair procedures, and open, timely, and honest communication to employees in all work units; (2) assess workload demands following significant changes to a work unit or department; and (3) implement regular surveys of the organization, with particular attention to communication, workload, and management relations with the DOE (Murphy & Pepper, 2002).

National Occupational Research Agenda (NORA)

In 1996, NIOSH unveiled the National Occupational Research Agenda (NORA), a framework to guide occupational safety and health research into the next decade. NORA represented collaboration between NIOSH and 500 organizations and individuals and produced a list of 21 priority research areas, one of which was work organization (National Institute for Occupational Safety and Health, 1996). Work organization refers to the way work processes are structured and managed, and it deals with subjects such as the following: the scheduling of work (such as work-rest schedules, hours of work and shift work), job design (such as complexity of tasks, skill and effort required, and degree

of worker control), interpersonal aspects of work (such as relationships with supervisors and coworkers), career concerns (such as job security and growth opportunities), management style (such as participatory management practices and teamwork), and organizational characteristics (such as climate, culture, and communications).

Many of these elements are sometimes referred to as "psychosocial factors" and have long been recognized as risk factors for job stress and psychological strain. But recent studies suggest that work organization may have a broad influence on worker safety and health and may contribute to occupational injury, work-related musculoskeletal disorders, cardiovascular disease, and other occupational health concerns such as indoor air quality complaints. For example, work organization factors such as monotonous work/time pressure, and limited worker control have been linked to upper-extremity musculoskeletal disorders in a number of studies. Similarly, it is widely believed that the combination of low worker control and high job demands is a risk factor for cardiovascular disease. However, the manner in which work organization factors affect these types of health problems is not well understood.

Work organization is influenced by factors such as economic conditions, technologic change, demographic trends, and changing corporate and employment practices. Information and service industries are replacing manufacturing jobs. The workforce is aging rapidly and becoming increasingly diverse. Reengineering and downsizing continue unabated, and temporary or part-time jobs are increasingly common. These trends may adversely affect work organization and may result, for example, in increased workload demands, longer and more varied work shifts, and job insecurity. However, the actual effects of these trends on the conditions of work and on the well-being of workers have received little study.

Today's rapidly changing economy, with widespread corporate and government restructuring, has thrown the once low-profile issues of work organization into high relief, and has raised a host of research questions in need of additional study. For instance, if a factory or service operates around the dock to maximize productivity or attend to customer needs, what strategies will both assure productivity and prevent the adverse effects of night or extended shifts on injury rates or sleep disorders? What management approaches translate employer and employee concern about safety into actions that effectively prevent injury? How do 12-hour work shifts or "de-skilling" of certain jobs affect rates of sick leave, employee turnover, workers' compensation, and health care costs? How can such costs be avoided?

Definitive research is needed to clarify the relationship between psychosocial stressors associated with work organization and safety and health concerns

ranging from substance abuse to musculoskeletal disorders. Also, a wide range of research is needed to identify successful interventions and models of work organization that promote safety and health and that meet current and future demands for increasing productivity.

Healthy Work Organizations

One of the goals of NORA was to develop partnerships with outside groups in the conduct of safety and health research. In the area of job stress, one such partnership is noteworthy. In 1993, NIOSH entered into an agreement with Corning Inc. to study job stress and stress prevention. No funds were exchanged; rather, NIOSH provided technical assistance to Corning, Inc. in the assessment of work stress while Corning Inc. allowed NIOSH to analyze its employee opinion survey data. The Corning employee survey data was anonymous and did not allow tracking of employee responses over time. However, access to the survey data provided NIOSH with an opportunity to develop and test a model of healthy work organizations (Sauter, Lim & Murphy, 1996).

The employee survey contained three major categories of questions relating to macro-organizational characteristics of work: management practices (e.g. leadership, strategic planning, employee performance rewards, career development), organizational culture/climate (e.g. innovation, empowerment, diversity, inter-group cooperation), core values (e.g. individual worker, total quality, leadership, integrity). Additionally, the survey was used to obtain data on perceived organizational performance (e.g. overall organizational effectiveness, work group performance, personal effectiveness) and on worker well-being (e.g. job satisfaction, stress, turnover intentions).

Multivariate, multiple regression analyses were performed to identify those organizational characteristics associated with both performance and health outcomes (Lim & Murphy, 1996). Three separate multivariate regressions were performed, one for each of the three categories of organizational characteristics (management practices, culture/climate, and values). Thus, regression analysis was multivariate with respect to the health and productivity outcomes, but not in terms of the organizational characteristics. The results identified specific factors from each of the three categories of organizational characteristics that were linked to the performance and health indicators. Management practices associated with both organizational effectiveness and perceived stress were continuous improvement at work (i.e. TQM), career development, fair pay/rewards, human resource planning, and strategic planning. The culture/climate factors associated with these two organizational health indicators were conflict resolution, diversity, and sense of belonging. Finally, the core values

associated with these two organizational health indicators were commitment to technology, employee growth/development, and valuing the individual (Lim & Murphy, 1997).

These findings provide provisional support for an organizational health model that proposes that management practices create the culture and climate, which influence performance and employee satisfaction (see Fig. 3). The NIOSH healthy work organization model, along with some alternative models, is being tested via a cooperative agreement with the University of Minnesota, Carlson School of Business.

The research on healthy work organizations reflected a shift in focus away from a strictly pathogenic model of the work experience and towards a salutogenic model. The pathogenic models focuses on job stress, poor mental and physical health, and reduced performance as main measures. A salutogenic or health promoting model adds measures of worker growth and development, satisfaction, high performance, and teamwork and considers the organizational culture and climate as key influences (Murphy, 2000).

2000 AND BEYOND: SOMETHING OLD, SOMETHING NEW

NIOSH research in the current decade is just beginning but several trends are noteworthy. First, earlier work continues on several fronts. For instance, the NIOSH/APA collaboration continues with respect to the Occupational Health Psychology Fellowship Program (*http://www.cdc.gov/niosh/ohp.html*). Moreover, another international meeting on work stress and health is planned for 2003 in Toronto, Canada, with NIOSH co-sponsorship. And research on characteristics of healthy work organizations continues and a grant was awarded to the U. of Georgia to develop and test models of healthy work. Also, a book on international studies of healthy work organizations was co-edited by NIOSH to highlight ongoing efforts to design healthy work organizations (Murphy & Cooper, 2000). New work involves the preparation of a national research agenda for the field of work organization, new funding for a national quality of work life survey, a national survey of organizations, a large contract study of women, work and depression, and studies on the health of aging workers.

Work Organization Research Agenda

In one of its most ambitious efforts, NIOSH worked with representatives from industry, labor, academia, and government to formulate a national research agenda for work organization research (*http://www.cdc.gov/niosh/02-116pd.html*). The

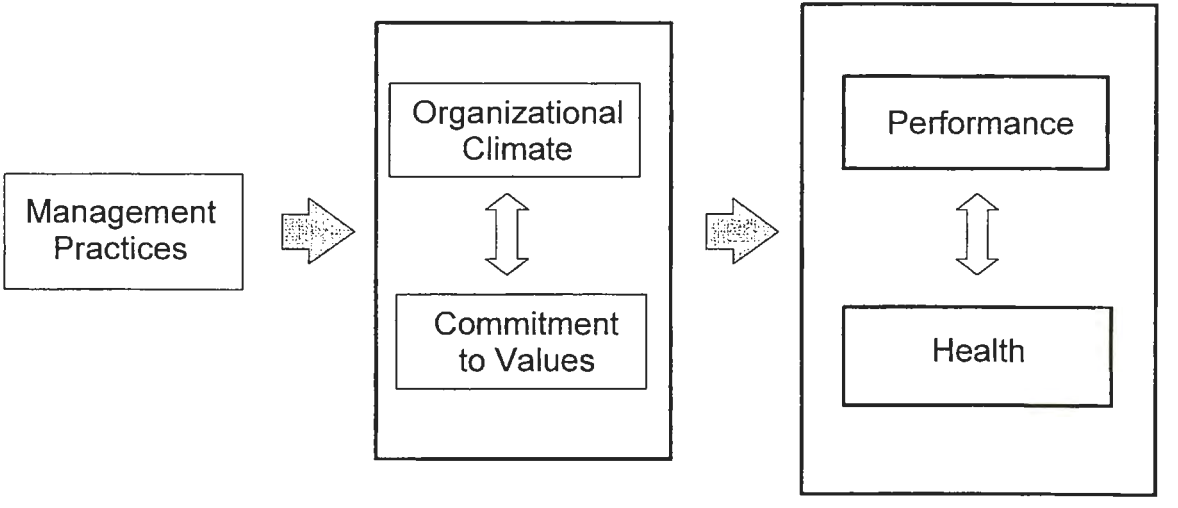

Fig. 3. NIOSH Provisional Model of Healthy Work Organizations.

agenda acknowledges that sweeping changes have occurred in the way jobs are designed and performed, in management and production methods, and in the human resource policies that accompany those changes. The changes include globalization, restructuring, flexible employment, longer hours of work, technological innovation, shifts in workforce demographics, and many other dynamics pertaining to work organization. The agenda recognized that such changes could have broad implications for worker health and safety, but they have occurred so quickly that they have outpaced scientists' ability to understand those implications. Consequently, researchers and others currently have only limited information for assessing the impacts.

Sauter, Brightwell, Colligan et al. (2002) proposed an ambitious plan to stimulate needed research to fill those gaps, including:

(1) Efforts to design and implement programs and systems for collecting data to better understand how the organization of work is changing.
(2) Increased study of potential safety and health risks associated with the changing organization of work.
(3) Increased research on interventions, examining ways to reorganize work to protect worker safety and health.
(4) Improvement of resources and training for researchers to help advance studies of work organization and occupational health and safety.

National Quality of Work Life Survey

It has been almost 30 years since NIOSH added questions on job stress to the 1972–1973 Quality of Employment Surveys, and 25 years since the last QES was administered. In light of the dramatic changes in the workplace since 1977, a nationally representative survey of the quality of work life (QWL) is long overdue. Organizational practices have changed dramatically in the past 15 years. To compete more effectively, many companies have restructured themselves and downsized their workforces, increased their reliance on non-traditional employment practices that depend on temporary workers and contractor-supplied labor, and adopted more flexible and lean production technologies. Women are disproportionately represented in jobs with restricted benefits and reduced flexibility, and they account for almost all of the growth in working hours. African-American women are twice as likely to be employed in temporary jobs than in traditional work arrangements, and (longer-tenured) older workers are at increased risk of displacement with greater earnings losses.

These changes have outpaced our understanding of their effects on worker safety and health and highlight the need for a national data collection effort to track major trends in organizational practices such as lean production and flexible manufacturing. Such a system also needs to acknowledge the changing workforce, which is increasingly populated by women, ethnic minorities, and older workers.

At the time of this writing (Spring 2002), information on the quality of work life are being collected by the National Opinion Research Center (NORC) from about 2,000 workers as part of the 2002 General Social Survey. The General Social Survey (GSS) is a biannual, personal interview survey of U.S. households conducted by NORC and partially funded by the National Science Foundation (NSF). The first survey took place in 1972 and since then more than 37,000 respondents have answered more than 3,500 different questions. The GSS contains a standard core of demographic and attitudinal variables, plus certain topics of special interest called "topical modules." Also, the GSS is part of the International Social Survey Program (ISSP), a continuing program of cross-national collaboration on surveys covering topics important for social science research. Over thirty countries are members of the ISSP.

A quality of work life (QWL) topic module was developed by NIOSH with advice from a multi-disciplinary panel that included industrial psychologists, sociologists, representatives from business, unions, and other federal agencies. A small group process was used to: (1) identify the key constructs that should be measured; (2) identify individual items to measure each construct; and (3) prioritize the items and constructs. The task turned out to be a classic good news, bad news scenario. The good news was that for the first time in 30 years, we could develop items for a national survey of workers. The bad news was that the items we selected had to fit into a 20-minute interview module. It was estimated that 60–80 questions could be administered in 20-minutes, depending on item wording and response scales used. By comparison, the 1977 QES contained over 300 items.

We began by identifying those items and constructs in the QES that were important and timely in the modern workplace. We were surprised at how many constructs from the QES were still relevant today (e.g. work-family issues, job security, hours of work). To this list was added new constructs that were not measured in the 1977 QES but were important and timely. Then we grouped the entire list of constructs into five broad categories: Job design/task characteristics, employee development/job future, organizational climate, individual/non-work factors, and outcomes. The distribution of items/constructs within each category was inspected to ensure adequate representation of each category. Next, multi-item scales (at least three items each) were created and then each participant rated

the importance of each construct for inclusion in the module (a high, medium and low rating).

The module that resulted from this process was 120 items, fully 40 items more than our estimated maximum allotment. The size of the module was reduced first by retaining constructs, but dropping items within constructs. This produced a 90-item survey that was pre-tested in July 2001. The pre-test revealed that we needed to drop an additional 12 items from the module. As before, we decided to achieve the reduction by droppings items within constructs, not by dropping constructs. The final module consisted of 76 questions, half of which were taken directly from the 1977 QES. Topic areas covered by the module are shown in Table 3.

Table 3. List of Categories and Constructs Measured in the NIOSH Quality of Work Life Module to the 2002 General Social Survey.

Category name (No. of items)			
Job level (41 items)		*Culture/climate (11 items)*	
Workload	3	Safety climate	3
Autonomy	2	Discrimination	3
Pay/pay equity	3	Harassment	2
Skill utilization	2	Respect	1
Participation	2	Trust	1
Job future	2	Mgt. relationship	1
Repetitive work	2		
Resource adequacy	2	*Health outcomes (9 items)*	
Reward/recognition	2	Physical health	5
Skill utilization	2	Mental health	3
Supervisory behavior	2	Injuries	1
Coworker relations	2		
Promotions	2	*Other outcomes (6 items)*	
Variety	2	Performance	2
Occupation	2	Satisfaction	2
Job tenure	1	Intent to leave	1
Training	1	Job commitment	1
Layoffs	1		
Teamwork	1	*Hours of work (6 items)*	
Role clarity	1	Work at home	2
Role conflict	1	Overtime	2
Staffing	1		
Safety and health	1	*Flexibility*	*1*
Other/misc.	1	*Work/family*	*(4 items)*
		Supervision	*(3 items)*
		Benefits	*(1 items)*
		Union	*(1 items)*
		TOTAL =	76 Items

National Organizations Survey

To complement the QWL module, NIOSH is co-sponsoring a 3rd wave of the National Organizations Survey (NOS) that was first administered in 1991 (Kalleberg, Knoke, Marsden & Spaeth, 1996). The newest wave of the survey will be linked to the QWL module in that the sampling frame for the NOS will be based on the distribution of organizations represented in the 2002 GSS. The NOS will collect data on work practices and organizational programs and policies that the QWL module could not address (for reasons of limited size) and will be administered in the October-December 2002. In addition, NIOSH will add a special module to the NOS to gather data on the incidence of workplace violence and the presence and utility of violence intervention strategies. At the time of this writing, items for the NIOSH-sponsored modules for the NOS are being developed.

Depression, Cardiovascular Disease, and Work

A 5-year, prospective study has been funded to examine the relationship between depression, cardiovascular disease and work. The first component of the study examines the relationship between non-traditional work organization stressors (e.g. work-family conflicts, harassment, discrimination), traditional work organization stressors (e.g. job demands, control), and depression. Telephone survey data on non-traditional and traditional work organization stressors and depression will be collected from approximately 2,000 women and men working in administrative support positions (e.g. accounting, bookkeeping, clerical). Subjects will be drawn from 20 companies within two industries expected to vary with regard to work organization stressors (particularly non-traditional) and organizational policies, practices and programs. Data on absenteeism, disability and productivity will also be collected from personnel records. A Human Resources representative from each company will also provide information about specific HR policies and programs within their companies. It is hypothesized that workplace policies which prohibit discriminatory practices, and programs which promote career progression and work-family balance may attenuate the effects of work organization stressors on depression, especially among women workers.

A second effort investigates the prospective relationships between work organization (including job stressors) and depression among 10,000 men and 10,000 women. Job stressors will be assessed annually using both subjective and objective methods over a 5-year period. A questionnaire will be used that incorporates the NIOSH Generic Job Stress Questionnaire. This instrument

captures a wide range of job stressors as well as factors (e.g. self-esteem, social support) thought to moderate or mediate the relationship between job stressors and their health consequences. The Center for Epidemiologic Studies Depression Scale (CES-D) will serve as the principal index of depression. An observational approach to assessing job stressors will also be employed which involve the use of a checklist and trained observers. An attempt will also be made to document all relevant information regarding objective stressor indicators (e.g. production quotas, staffing ratios, work pace rates). Two sources of stress (perceived discrimination and family-related demands) that are in part external to the work environment will also be assessed in this study.

Health of Aging Workers

Analyses of data from the Bureau of Labor Statistics, the Health and Retirement Survey, and the National Health Interview Survey are being performed to identify occupations/industries with the largest number of older workers during the next decade and the health conditions/risks that workers face as they grow older. An effort will be made to determine at what age health conditions or disabilities begin to change, with particular attention to those which appear to be further accelerated by work, or where the workplace might offer an opportunity to reduce rates of disease. In addition, NIOSH funded an occupational supplement to a four-year, multi-site study being conducted by the National Institute on Aging (NIA). The supplement will collect detailed occupation/industry information, work history and exposure to a variety of job stressors. In a related effort, physiological measures (e.g. changes in cortisol level) will be collected for subjects participating in a simulated work task at one of the NIA study sites.

SUMMARY

We've learned a great deal about job stress and health since the NIOSH stress research program was established in 1972. We learned that job stress was not merely a "fad" in the 1970s but has endured as a significant workplace concern. We learned that management and labor groups viewed stress from quite different perspectives; the former saw job stress as a personal problem while the latter viewed it as exclusively a workplace issue. We learned that while the research community had difficulty defining stress, workers rarely lacked for a definition and were adept at providing one if asked. We learned that job stress, unlike other workplace hazards (e.g. neurotoxic agents and ergonomic hazards), respects no occupational boundaries and so the potential for exposure to this class of health risks is ubiquitous. Finally, we learned that certain job

conditions and work routines consistently produce health consequences (e.g. work overload, machine-pacing, rotating shift work, job insecurity, lack of control) but for other stressors (e.g. responsibility, cognitive demands), the relationship with health status is less consistent and probably moderated by individual and/or social factors or possibly by unmeasured work factors (e.g. organizational culture or climate).

On the other hand, there is a lot we haven't figured out about job stress and health relationships. For instance, we don't know much about the influence of worker self-selection and occupational 'drift' on job stress, in part because most studies have employed a cross-sectional design. We don't know enough about the contribution of objective job features vs. subjective perceptions in job stress and how these factors interact with organizational culture and climate to influence worker health and safety. Finally, although NIOSH routinely advocates job and organizational change interventions to reduce stress at work, we don't know with reasonable certainty which organizational change interventions will produce significant reductions in worker stress symptoms (see reviews by Parkes & Sparks, 1998; Van der Klink, Blonk, Schene & van Dijk, 2001), or if the reductions are larger than those seen after stress management training (Murphy, 1996). This latter point is especially challenging; either our job stress/health models are missing some important causal connections, or the link between job stressors and health is smaller than we thought, or the influence of non-work factors is larger than we thought. Much additional research is necessary to clarify job stress/health relationships.

The mission of NIOSH is to ensure safe and healthful working conditions for America's workers. The job stress research program has contributed to that mission by: (1) funding studies to identify job characteristics and working conditions that contribute to mental and physical health consequences for workers; (2) designing and testing interventions to prevent, reduce and manage stress at work; (3) disseminating the results of job stress studies to a wide audience; and (4) promoting job stress research in the private sector via grants, contracts and the sponsorship of national and international conferences.

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