

**Extracts from
the Occupational Hazards
section of the
'Anthology on Women,
Health and Environment'

a WHO publication**

Foreword

The studies compiled here have been selected from a comprehensive anthology on women which originally concerns water, nutrition and agriculture, housing and shelter, domestic fuel shortage and indoor air pollution. The last section on occupational hazards is the focus here and only a fraction of the myriad hazards faced by women in their paid and unpaid work is addressed. Of those selected, some address actual or potential health effects arising directly from exposure to specific hazards (pesticides, neurotoxins, psychological and ergonomic stressors, cyanide); others stress the dearth of information on the health effects of work allocated to women. Conditions which may lead to permanent chronic ill-health in women are low social and economic status combined with poor environmental conditions which often include outdoor work.

Studies on psychosocial adverse and ergonomic factors in the workplace are completed by two more recent articles stating a number of facts. Their focus is not exclusively on women, but of a more general nature.

Articles include the following key points:

- ***Pesticide exposure and reproductive outcomes***: to investigate the reproductive risks and outcomes from exposure to toxic substances is methodologically difficult, but essential, given the rapidly increasing use of chemicals in industry and agriculture.
- ***Exposure to neurotoxins in the microelectronics industry***: behavioural problems in women traditionally attributed to mass hysteria may result from occupational exposure to neurotoxins.
- ***Psychological and ergonomic stressors in garment workers***: repetitive motions and fast work speed in factories or at home are increasingly linked to physical and psychological ailments. The study concludes that more pieceworkers are disabled than fixed wage workers, and repetitive strain injury is common among assembly line workers.
- ***Health consequences of 'maquiladora' work***: subjective and social factors appear to be an important determinant of women's health status in Mexico. This is a consideration often neglected in epidemiological studies.
- ***Repetitive strain injury and occupational tasks***: this disease is real and affects a large number of women. Changes in the work organisation can only temporarily alleviate painful symptoms. Therefore, work environments which provoke these, have to be identified before the disease develops.
- ***Silicosis in Swedish women***: silicosis in women, although rare in developed countries, is usually contracted in the pottery industry and tends to progress more rapidly in women than in men. Many women in developing countries are exposed to silica dust through pottery work or hand-grinding grain.
- ***Cassava processing and cyanide poisoning***: the importance of exposure monitoring and

protective measures is outlined for this agricultural process dangerous to women's health.

- ***Fetal protection policies:*** "fetal protection" policies often serve to protect the employer rather than the employee or the fetus.

Some facts on:

- ***Why consider psychosocial factors in the workplace?:*** this articles gives a general overview of the importance and the current understanding of the concept of stress. A multiple array of contributing factors is outlined, which points to the fact that mental stress is a concept which lacks clarity as to cause-effect relationships at this point.
- ***Musculo-skeletal disorders: Improving ergonomics at the workplace:*** this includes current definitions of some major musculo-skeletal disorders, an overview of the financial health implications, as well as practical tips for low-cost improvements.

Pesticides exposure and reproductive outcomes

Of the 350 million cut flowers imported every year into the United States, 90% are grown in Colombia. Although a relatively new industry, floriculture employs large numbers of Colombians. Floriculture workers risk exposure to 127 different kinds of pesticides. A study was undertaken among 8867 employees of 58 companies who had worked for at least six months in the flower growing industry to ascertain the occurrence of certain reproductive events among a population occupationally exposed to a heterogeneous group of pesticides, and to assess the possible association between adverse reproductive events and such exposure.

A questionnaire administered through an interviewer was used to obtain information on the occurrence of fetal loss, prematurity, congenital malformation, and cancer among the offspring of workers (female employees, or wives of male employees) in Bogota. "Exposed" pregnancies were defined as those occurring during the time the relevant parent worked in floriculture; "unexposed" pregnancies were those occurring before this time.

The following variables were used to assess different exposures: size of employing company, quantity of pesticides used, job category, and length of time worked in floriculture. Information on these variables was obtained during a survey on patterns of pesticide use conducted in each of the 58 companies. Jobs were classified on a 6-point scale from no exposure (administration) to high exposure (sorting and packing). In terms of time worked, 6-11 months was considered as low exposure, 12-36 months as medium exposure, and over 36 months as high exposure.

Of the 8867 workers, 33% were men and 67% women, with mean ages of 29.2 and 27.0 years respectively. Most of the workers had been educated to primary level. The mean length of time worked in floriculture was about three years. The total number of pregnancies included in the analysis was 13,984; 10,481 were pregnancies of female employees and 3,503 of wives of male workers.

Various adverse outcomes

The rates and odds ratios for the various adverse outcomes of pregnancies before and after exposure to pesticides in floriculture are shown in the table below. All rates, except for stillbirths, were higher for pregnancies occurring after exposure for both female workers and wives of male workers. This gave significantly higher odds ratios

for abortions, premature births, and malformed babies. No dose-response relationship with any of the variables used as indicators of degree of exposure was observed for either spontaneous abortion or prematurity; an inverse relationship was observed with the two variables which could be regarded as more objective (type of job and length of time worked in floriculture). The highest odds ratios were observed for the unexposed jobs — administration, and those with 6–11 months experience. These results are not surprising considering that exposure only during a short critical period is relevant in the induction of embryotoxic effects.

An increased risk among female workers and wives of male workers was observed in relation to congenital malformation, spontaneous abortion and prematurity in pregnancies after having worked in floriculture. Subsequent physical examination of the children showed though that about half the children reported as malformed by their parents were in fact normal, while about 10% of those reported as normal were malformed. All confirmed cases of cancer proved to have occurred before the parents began working in floriculture.

Regarding spontaneous abortion, the risk ratios may have been increased by recall bias rather than exposure to pesticides. While spontaneous abortion occurring early in pregnancy is an excellent indicator of embryotoxicity, it is very difficult to record accurately. It is highly probable that if a spontaneous abortion occurs very early in pregnancy, the woman will not recognize it as such, but perceive it as a delayed menstrual period. Alternatively, if identified correctly, it may be forgotten over time.

The rates obtained in this study indicated a significant under-reporting of spontaneous abortion, which was more pronounced when the information on a woman's reproductive history was given by her husband. Lack of perception of the event by husbands is an adequate explanation in the case of wives of male workers, as is early unrecognized spontaneous abortion in the case of the female employees. In this instance, an environmental embryotoxic agent could be suspected. However, the data in this study cannot support this explanation given that the problem of perception was the same for the pregnancies occurring before and after work in floriculture, and that the actual rates for spontaneous abortion from 1978–81 were shown to be very similar to those reported for other population groups.

Multiple exposures

Multiple exposures pose the problem of identifying the toxic chemical responsible, but also of interaction between chemicals and the resulting toxic effects. Given the assumptions made in this study to estimate exposure and the multiple nature of the exposure, a random misclassification of exposure may have played a role in underestimating the observed effects. It was not possible here to estimate the degree of such a bias or, if present, to correct it.

Occupational Hazards

Rates and odds ratios (OR) for various adverse pregnancy outcomes before and after work in floriculture (95% CI=95% confidence interval)

Pregnancy outcome	Female workers				Wives of male workers			
	Prevalence rates (%)		OR	95% CI	Prevalence rates (%)		OR	95% CI
Before exposure	After exposure	Before exposure			After exposure			
Induced abortion	1.46	2.84	1.98**	1.47-2.67	0.29	1.06	3.63**	1.51-8.70
Spontaneous abortion	3.55	7.50	2.20**	1.82-2.66	1.85	3.27	1.79**	1.16-2.77
Premature baby	6.20	10.95	1.86**	1.59-2.17	2.91	7.61	2.75**	2.01-3.76
Stillbirth	1.37	1.34	0.99	0.66-1.48	1.01	0.89	0.87	0.42-1.83
Malformed baby	3.78	5.00	1.34*	1.07-1.68	2.76	4.16	1.53*	1.04-2.25

* P=0.05-0.01; ** P<0.01

The overall results of no association or a moderate increase in risk for some adverse pregnancy outcomes, with the possibility that these are due to recall bias and/or misclassification of exposure, accord with the results reported previously for other populations. Although some studies in Seveso, Italy, and in Vietnam suggested an increase in spontaneous abortions after possible maternal exposure to phenoxy herbicides and dioxins, methodological problems relating to difficulties in assessing exposure, and in eliminating possible confounding and bias, prevented definitive conclusions. Similar limitations apply to studies on paternal exposure to these substances.

This and previous studies should be considered as preliminary approaches to a very complex problem which needs considerable further research. Further research is urgent for two reasons. First, the use of pesticides — especially in developing countries — is increasing rapidly and is often uncontrolled. Second, in this example, two-thirds of the workers questioned were women of reproductive age, indicating a large population at risk.

Summary of the work of:

Restrepo M et al. Prevalence of adverse reproductive outcomes in a population occupationally exposed to pesticides in Colombia. *Scandinavian journal of work, environment and health*, 1990, 16:232-238.

Exposure to neurotoxins in the microelectronics industry

Women are employed in the majority of production and assembly jobs in the microelectronics industry. Organic solvents are used in many of the industry's production and assembly processes. Neurotoxic effects of organic solvent exposure include abnormalities and impairments in the behavioural area, notably mood change, irritability, anxiety, fatigue, depression, mood lability, defective impulse control, personality change, and development of psychosis. Emotional and personality changes are among the first symptoms reported by persons exposed to neurotoxins. In many cases, affective changes are present even when neuropsychological or neurologic effects cannot be detected.

Despite evidence that microelectronics work is ergonomically stressful and involves the handling of hazardous substances, the industry gives the impression of being well-organized and clean. This may provide some explanation as to why, for over 20 years, complaints from female workers have often been ascribed to problems of mass psychogenic illness.

Persistent long-term effects of solvent exposure are being reported with increasing frequency. One study found no evidence of recovery when retesting solvent-exposed patients 8 months after exposure had ceased. Another found that two years after removal from solvent exposure, subjects continued to report negative effects on their personal, social, and employment situations.

Effects on former workers

A study was carried out to evaluate the stability of affective and personality disturbance among former electronics workers over a two-year period. The Minnesota Multiphasic Personality Inventory (MMPI) — the most widely used standardized adult mood and personality measure — was used to evaluate 79 former microelectronics workers, all of whom had been awarded compensation for work-related injuries. Review of work medical records showed that they had complained frequently of

headaches, dizziness, respiratory distress and skin irritation, suggesting high exposure levels. Two years after the initial evaluation, a second MMPI was undertaken involving 63 of the original 79 workers. This sample consisted of 56 women and 7 men, who had worked in the plant for an average of 6.8 years, and had ceased working there an average of 5.7 years previously. Prior to employment, all the workers had been screened for good health and mental stability. Reference data were obtained by matching the former employees with current workers involved in a neurotoxic effects study in the same plant.

Work in the plant involved direct handling of organic solvents, without adequate ventilation and/or without respiratory protection. The solvents included fluorochlorohydrocarbons, chlorinated hydrocarbons, glycol ethers, isopropanol, acetone, toluene, ethyl alcohol and xylene, used in a variety of cleaning and degreasing operations. The former workers reported having handled these substances with bare hands and without protective equipment.

Analysis of the MMPI scores revealed that the workers manifested affective and personality disturbances that persisted over the two-year period between testings. The score elevations were remarkably stable over time, with slight but significant increases on the depression (D), psychasthenia (Pt) and schizophrenia (Sc) scales. These findings indicate that affective and personality disorders diagnosed 5–6 years after cessation of employment appear to be long-lasting disabling psychiatric conditions. As is the case with most retrospective studies, no pre-employment personality profiles were available. However, in pre-employment screening, each individual had been considered mentally stable.

The MMPI profiles of this group are remarkably similar to profiles reported by other investigators studying workers with a history of solvent exposure. The findings are also similar to studies of Vietnam combat veterans exposed to Agent Orange; with the exception of two categories, the veterans' MMPI scores were lower than those of the former microelectronics workers.

Previous studies of women microelectronics workers have tended to attribute the type of affective and personality disturbance observed in this study to mass hysteria. It has been assumed that an "hysterical" personality structure attributed to women workers was the source of these outbreaks. MMPI reports of hysteria and other work injuries show elevations on the hysteria (Hy), depression (D) and hypochondriasis (Hs) scales, whereas reports of organic solvent effects show elevations for psychasthenia (Pt) and schizophrenia (Sc), reflecting high anxiety and a psychotic process.

Mass psychogenic illness— hitherto defined as a women's illness

Investigation of the mass psychogenic literature shows that women comprise the majority of those afflicted, making up 82% of all reports of so-called hysteria. The

authors suggest that this is not a gender effect but a reflection of the percentage of women at risk in this industry. In this study, the low percentage of participating men corresponded to the gender distribution within the assembly plant. Although there were few men among the former workers tested, the scores of men and women were very similar, except for the men's higher scores on the hypochondriasis (Hs), depression (D) and hysteria (Hy) scales. This may be explained by the potentially higher exposure in men's jobs, which often involved cleaning large tanks of organic solvents or painting with oil-based paints, without protection.

It is also possible that psychological and psychosocial factors exacerbate or interact with the physical problems of disabled workers. Workers who become disabled frequently experience difficulty in adjusting to being non-working members of society and may suffer loss of status and diminished feelings of self-worth. These in turn may lead to family disruption. Loss of health benefits and access to medical treatment may also result. Assessment of the effects of neurotoxic exposure should include the levels of social support and treatment available to victims.

This study raises doubts concerning one traditional explanation of the behavioural symptoms observed among microelectronic workers, and suggests that these could be the result of overexposure to organic solvents in the workplace. The findings here suggest that work rather than gender may be the cause of the problem.

Summary of the work of:

Bowler RM et al. Stability of psychological impairment: two-year follow-up of former microelectronics workers' affective and personality disturbance. *Women and health*, 1992, 18(3):27-48.

Psychological and ergonomic stressors in garment workers

Women's jobs are often seen as low-risk in terms of severe work accidents and specific industrial diseases. Consequently, the health problems of women's work have not been adequately researched, with the exception of risks associated with pregnancy. However, adverse health effects are associated with female-dominated jobs, including those in the manufacturing and service industries, involving high time pressure. This study documents the psychological and ergonomic stressors which can, over time, lead to adverse health effects.

The work speed of many assembly lines and other jobs continues to be determined by machines. Previous studies have demonstrated that workers employed in jobs involving high time pressure experience an elevated frequency of physiological, musculoskeletal and psychological symptoms. Little is known about these symptoms or the more severe adverse health conditions that may ensue.

Garment workers represent a valuable study population as they fall into two natural categories – those operating on a piecework basis and those on hourly wages. The purpose of this study was to demonstrate that piecework involves more time pressure than hourly wage jobs, and that long-term employment in jobs involving high time pressure leads to a deterioration of health which manifests itself in greater reliance on medicine, increased anxiety and depression, and the development of permanent disability.

The study population comprised 800 women who had worked in unionized garment factories in Québec between 1976 and 1985. At the time of the study, each woman was between 45 and 70 years of age and had been employed as a sewing machine operator (either piecework rate or hourly wage) for at least five consecutive years at 1000 hours per year. Of the total sample, 267 were still employed. This population was thought to be fairly homogenous and likely to reflect the long-term effects of garment work. For some comparisons, an external population of 1300 women employed in clerical work, services, or manufacturing was used. Disability was defined as the presence of one or more disabling conditions for at least the twelve preceding months and categorized as: i) no disability; ii) slight restriction of non-work activities; iii) moderate restriction of major activity such as paid employment or housework; iv) severe restriction (unable to maintain major activity). Yearly data on job title, type of remuneration and number of hours worked were obtained from a labour organization for each worker, for the 1956 to 1985 period.

Results showed that when compared with the external population, garment workers were more often disabled than women in other occupations (see Figure). Garment workers currently employed had an increased prevalence of moderate and slight disability, while garment workers no longer employed had an increased prevalence of severe disability. Employed garment workers had higher levels of symptoms of anxiety and depression than workers in other types of employment.

Comparison of pieceworkers and hourly wage workers showed that the prevalence of severe disability among those no longer employed increased with the number of years the workers had spent in piecework jobs. In a separate analysis conducted for disability due to specific causes, the association with duration of employment in piecework appeared to be linked mainly to musculoskeletal problems, and to a lesser extent to cardiovascular problems, although the small numbers produced unstable effect estimates. Among workers currently employed, pieceworkers took medication for stomach problems in greater proportion than hourly wage workers.

Mental workload and psychological stress

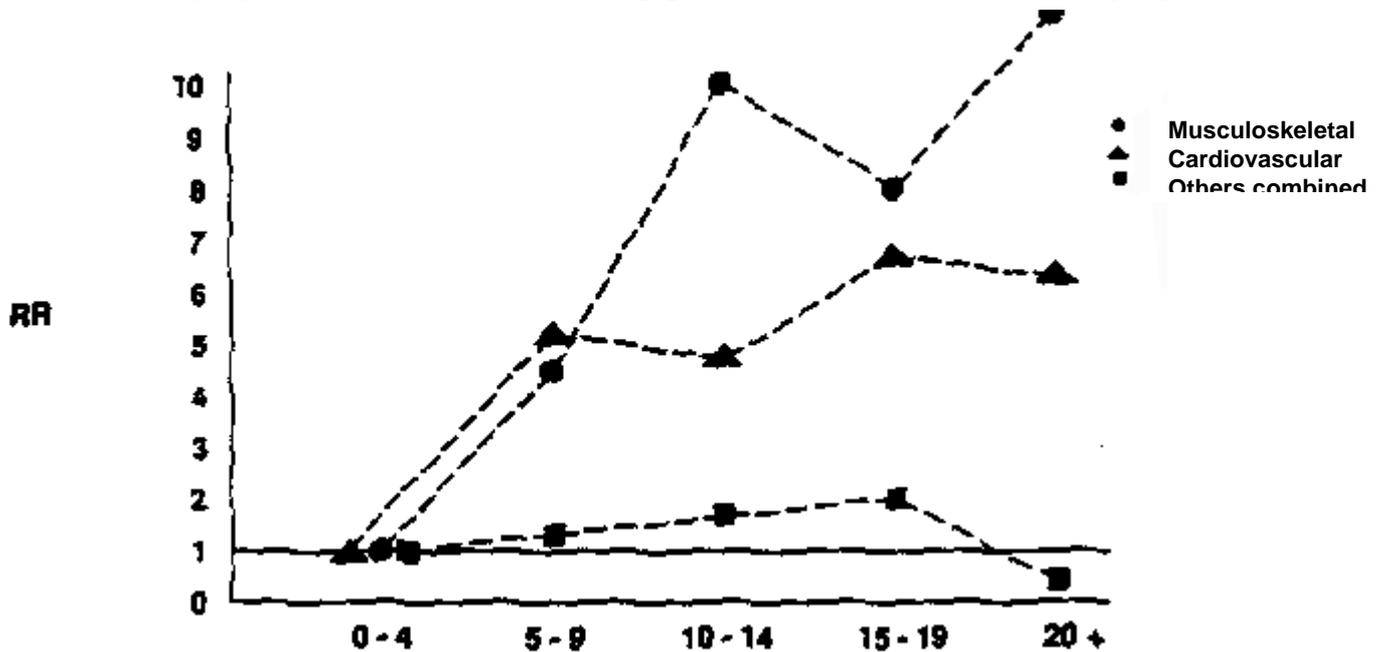
The level of psychological stress of pieceworkers is likely to be greater than that of hourly wage workers due to greater time pressure which directly increases their mental work load. The mental work-load associated with garment work is determined mainly by the complexity of the task and its speed. A high level of mental activity, visual attention and precision movement, in which eyes, hands and feet must be constantly coordinated, is required. Garment workers' task complexity tends to be identical for piecework and hourly wage work as the end result is the same, and equipment and indoor environment are similar. The main variation, therefore, relates to the time constraint under which pieceworkers operate.

An increased mental workload may represent a source of psychological stress. Under stress, complex adaptive mechanisms are activated and several parts of the endocrine system react simultaneously. Prolonged activation of the adaptive mechanisms are believed to be involved in the genesis of various chronic diseases (cardiovascular, gastrointestinal, musculoskeletal).

Regarding ergonomic stressors, the work of an operator in the garment industry necessitates a sitting position with the head bent forward, which must be sustained for long periods, coupled with repetitive movements of the upper limbs. Studies have shown that these characteristics are two of the six principal causes of absence from work due to back disorders. Also, repeated use of the same joints has been associated with the development of osteo-arthritis. It is possible that piecework acts directly on the biomechanical load by increasing the number of motions per unit of time, or by influencing the temporal distribution of work and rest. Evidence suggests that psychological tension associated with time pressure may play a direct role in the

development of musculoskeletal disorders, since muscle tension, measured by continuous electromyographic recording, increases with psychological tension.

Risk ratios^a for severe disability among specific causes by duration of employment in piecework among garment workers who left employment^b



a Adjusted by binomial regression for age, smoking type of task and total length of employment

b Quit during the 10 years preceding the interview

The results of this study indicated that moderate and slight disability, anxiety and depression, and the use of medication tend to reflect mild conditions, while severe disability involves health problems serious enough to prevent workers from remaining employed or doing housework. Short-term and non-disabling conditions identified by previous authors may therefore prove to have more important long-term sequelae than hitherto documented. These could be due either to the physiological reactions associated with psychological stress, or the enhancement of the ergonomic stressors involved in garment work. These findings are of interest given the large numbers of women employed in piece-work either at home or in factories in developing countries.

Summary of the work of:

Brisson C, Vézina M, Vinet A. Health problems of women employed in jobs involving psychological and ergonomic stressors: the case of garment workers in Quebec. *Women and health*, 1992, 18(3):49-65.

Health consequences of "maquiladora" work

Foreign-owned assembly plants in Mexico (maquiladoras) enable these industries to operate with low labour and operation costs, and to avoid stringent health and safety regulations enforced at home. The plants employ large numbers of predominantly young women (over 60% of the total maquiladora workforce). Adverse working conditions are frequently reported in the plants, including poor ventilation, few rest periods, excessive noise levels, unsafe machinery, long hours of microscopic assembly work, and exposure to toxic chemical and carcinogens. The work requires high production quotas and repetitive tasks which, coupled with lack of decision-making capacity and often poor supervisory relations, add to stressful work conditions. However, empirical data concerning the health issues are scarce.

High levels of stress among maquiladora workers have been associated with generic symptoms such as gastric disorders, menstrual problems, depression, and mass hysteria. Pulmonary and eye problems, dermatitis, hand injuries, and musculoskeletal disorders have been reported among textile and garment workers, while eye irritations, visual acuity loss, headaches, nervousness, allergies, and adverse pregnancy outcomes have been identified among electronic assembly plant workers. This evidence is, however, derived from studies with many methodological shortcomings and which did not control for multiple risk factors, including factors inherent to the living conditions in the urban shantytowns from which most of the female labour force is recruited.

A study was carried out to assess the health and lifestyle of women employed in electronic and garment assembly plants, comparing them with two reference groups: women employed in the service sector and women who were never part of the labour force. Thus the demographic, occupational, and psychosocial characteristics of maquiladora workers were compared with those of the two reference groups. The impact of maquiladora work on the health status and well-being of women was then examined, controlling for a number of social and occupational variables.

The total sample comprised 480 non-pregnant women between the ages of 16 and 28 years (mean age 21 years), divided into four groups: electronics workers, garment workers, service sector workers, and women with no work history. Over 70% were single and more than two-thirds were childless and lived with their families of origin. Housing conditions among all four groups were similar, although service sector workers were more likely to own a car and/or a telephone. Household incomes were lowest among housewives, followed by electronics workers. The number of years of

formal education was lower for maquiladora workers than for the two reference groups. On average, both electronics and garment workers worked 48 hours per week, and 6 hours longer than service sector workers. The mean hourly wage was US\$1.02 for electronics workers, US\$1.09 for garment workers, and US\$1.32 for women in services.

Identified sources of strain in maquiladora workers included few opportunities for skill development, and reduced autonomy in decision-making compared with service sector workers. Garment workers appeared to receive less support from colleagues and supervisors than other categories. Yet despite longer working hours at lower wages and with less freedom to make decisions, maquiladora workers reported job satisfaction levels equalling those of women in services. Although maquiladora workers received more benefits such as health insurance and performance incentives, these did not seem to be associated with job satisfaction. All four groups felt that the basic income of their household was too limited to satisfy basic needs, and levels of self-denigration were high, suggesting internalized strain related to low self-esteem. All groups perceived their health status to be fairly good, although women in garment plants were more likely to report lower health status than electronics workers.

Health outcomes better than anticipated

Given that women employed in electronics and garment maquiladoras are less well educated, earn less, work longer hours, and perceive themselves as having less control at work than service workers, worse health outcomes from these groups could have been expected. Evidence suggested, however, that they did not suffer more functional impediments than service workers or housewives. Neither did they experience more depression (all four groups had similar mean depression scores) and electronics workers reported nervousness significantly less frequently than service workers.

All four groups showed high stress scores on the control scale, indicating a low sense of control over their lives. The one factor which consistently "predicted" the four outcomes of health and wellbeing (functional impediment, nervousness, depression, and sense of control) was lack of financial resources. This was followed by work dissatisfaction, which predicted three health outcomes. Factors associated with family life and self-denigration were significant predictors of depression and sense of control. Demographic factors, such as education, number of children, and housing conditions, were important predictors of nervousness.

The main finding — that maquiladora workers did not suffer more depression or lack of control than other occupational groups — persisted in the multivariate analysis, which also confirmed that the two consistently strong and most significant predictors of health and wellbeing (negative attitude toward economic adversity, and dissatisfaction with work) were subjective indicators — negative attitude towards economic adversity, and dissatisfaction with work. The intensity of these two

subjective factors was directly associated with depression, nervousness, and lack of control over life.

It is possible, however, that more job dissatisfaction was not reported by maquiladora workers due to their young age, which dampens awareness of occupational stress. Or, particularly in the case of electronics workers, their jobs may reflect some degree of upward mobility as they are in the most modern and dynamic industrial sector, and the factories tend to be physically attractive places with cafeterias, air conditioning, heating, piped music, and other comforts unavailable in the shantytowns where most of the workers reside. This may explain the particularly favourable health outcomes of the electronics workers.

Subjective factors beyond the working environment were found to be of great relevance to the health and wellbeing of poor Mexican women. Issues of self-esteem and lack of personal control seem particularly important to health outcome. Future studies should take account of feelings, attitudes and beliefs in order to fully understand disease patterns. These subjective or social measures do not compete with conventional indicators, but rather complement them.

Summary of the work of:

Guendelman S, Jasis Silberg M. Health consequences of maquiladora work: women on the US-Mexican border. *American journal of public health*, 1993, 83(1)37-44.

Repetitive strain injury and occupational tasks

Repetitive strain injury (RSI) is the term commonly used to describe a set of musculoskeletal symptoms affecting large numbers of people, often women, in many countries. It occurs in workers who perform repetitive tasks over a prolonged period, most commonly in the hands, wrists, and arms, although other areas may be affected depending on the type of work performed. RSI causes considerable pain and discomfort in the affected areas, including loss of grip strength in the hand. Over time, disability can become so severe that temporary or permanent cessation of employment results.

When 12 women patients involved in highly repetitive occupational tasks were referred by their trade unions' solicitors for medical and legal adjudication on their cases, an opportunity arose to document symptoms and physical signs that could be of diagnostic value. An attempt was also made to clarify the natural history of the disorder and to estimate its prevalence in conveyor belt workers.

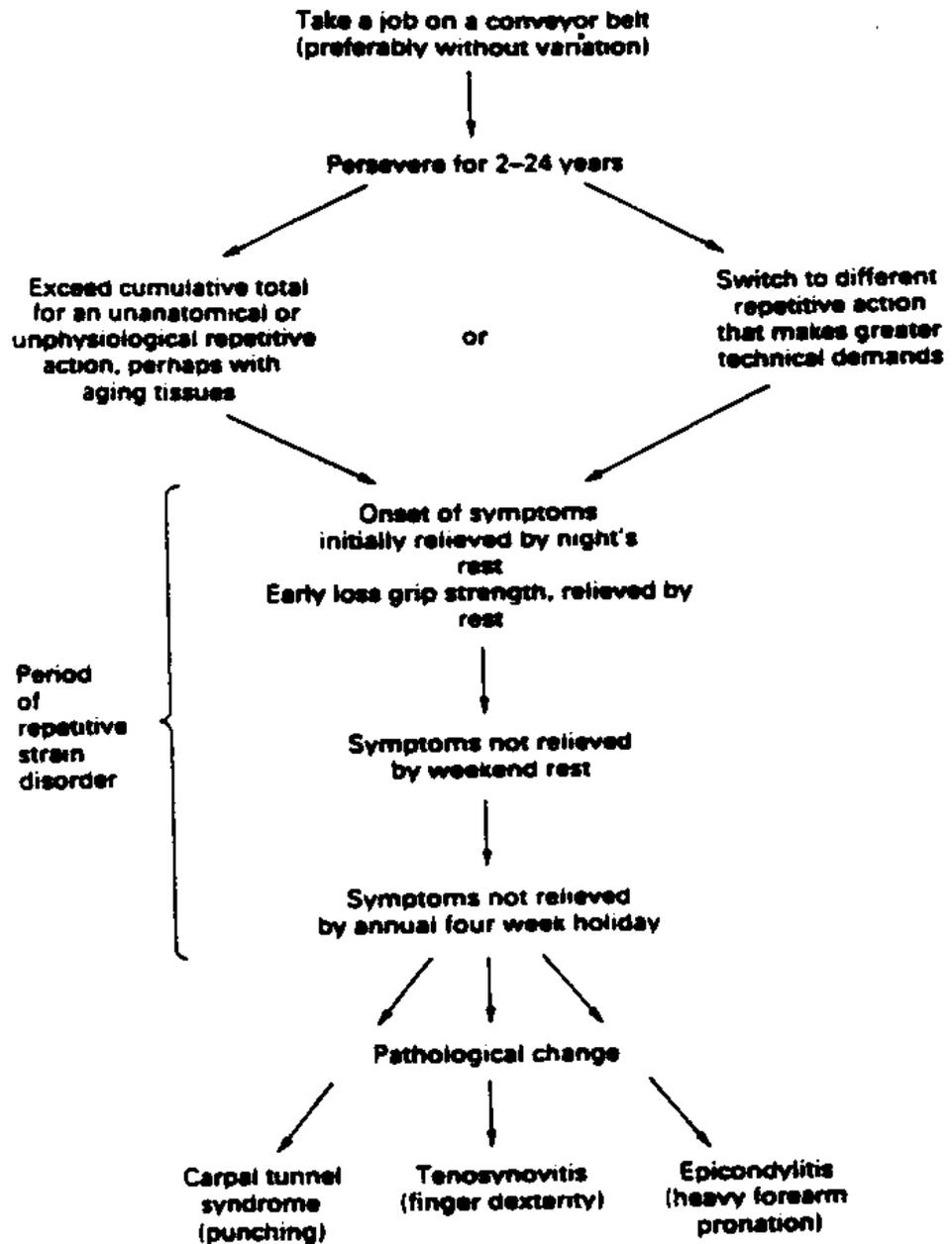
The mean age of the group was 48.2 years (range 25-60 years) and duration in employment ranged from six to 26 years. There was no consistent type of activity after which symptoms invariably occurred, although most women attributed the onset of symptoms to a change in technique or, more frequently, a move to a different conveyor line. Two women worked in an electrical factory, and 10 in the packing department of a biscuit factory. Six women had been operated on; in each of these cases, the particular pathology had always been preceded by a period of symptoms typical of those described in repetitive strain disorder.

In the biscuit factory, all staff worked an eight-hour shift, packing at a rate predetermined by management, with two 10-minute tea-breaks and one half-hour meal-break. Once present, symptoms were not relieved by the 10-minute or 30-minute breaks, although in the early stages a night's rest provided relief. After a period of three to four months, symptoms were not relieved by the weekend break from work. Ultimately, one or two years after the onset of symptoms, there was no relief following two or four weeks' vacation. This progressive resistance to relief by rest appeared characteristic.

The particular task performed by each worker was invariably correlated with the site of symptoms. Lifting heavy boxes caused shoulder symptoms, twisting heavy packs caused forearm symptoms, and repeated use of the fingers caused symptoms in wrists

and fingers. Specific pathologies later emerged: tendon inflammation for those using

Natural history of repetitive strain injury



fingers

or twisting the forearm, and frozen shoulder for those lifting the heaviest weights.

The work of the two women employed in the electrical accessories factory involved a repetitive punching action with a stapler. Both experienced the same preliminary

symptoms as the biscuit workers but these later developed into carpal tunnel syndrome. These women were ostensibly working at their own speed; however, they were paid a low basic wage with a high supplement for performance. In practice this meant that adequate wages could only be earned by maintaining a fast work speed.

Symptoms in all patients in the preliminary phase invariably included weakness and pain in the affected areas. Reduced grip strength was a consistent clinical finding once symptoms were present. Compared with a control group of women matched for age and without RSI symptoms, the grip strength in both hands of the study group was significantly weaker ($p < 0.001$). Even the two women with the fewest clinical signs showed the characteristic reduced grip strength that appeared consistently throughout the group. On this basis it was judged that most if not all the women suffered from repetitive strain injury. This allowed delineation of the natural history of the disease as shown in the figure.

Social and economic factors also contribute to the disease. The biscuit factory was a monopoly employer in an area where there was little other work for women. Their choice of employment was therefore restricted. Moreover, women worked exclusively on the conveyor belts, while men employed in the factory tended to perform only cleaning and maintenance tasks.

In an effort to assist women with painful symptoms, the factory management invariably moved them to a production line where the weights were lighter. Ergonomic comparison of the two tasks suggested that the speed of the packing cycle was faster on this line, however, and this move simply tended to transfer the strain from the forearm to the fingers.

It has been estimated that approximately 2% of the biscuit factory workers experienced symptoms of repetitive strain injury at any one time. However, accurate estimates are difficult to arrive at, given that the symptoms tend to fluctuate, and the tolerance of individuals differs. In the women studied here, the strong association between their occupational activities and the location of their symptoms tends to support a causal effect. Further well-designed studies are needed to identify which women are more likely to develop this painful and handicapping condition. These findings are representative of the situation of many women in occupations where repetitive tasks are carried out at a particularly fast or predetermined speed, outside the control of the worker. Several occupations covered in this *Anthology* meet these criteria. The diagnosis of this condition in a wide variety of occupations, countries and conditions would assist in negating claims that the symptoms of this disorder are imaginary, or a wilful attempt to acquire disability compensation.

Summary of the work of:

Bird HA., & Hill, J. Repetitive strain disorder: towards diagnostic criteria. *Annals of the Rheumatic Diseases*, 1992, 51:974-977.

Silicosis in Swedish women

Silicosis remains primarily a "male disease", and hence pneumoconiosis in women has received little attention in the literature. In Sweden, only about 1% of registered cases are women, employed mainly in potteries. Indeed, most silicosis in women, in Sweden and elsewhere, is contracted in the ceramic industry. Two earlier studies noted that the duration of exposure to pottery dust in the women studied was appreciably shorter than that of a comparable male group. Since the issue of greater sensitivity (or otherwise) of women to inhaled silica dust was not demonstrated in previous research, an analysis of silicotic women observed over a long period was considered useful in clarifying the incidence, course and evidence of progression of this disease. The effects on this small group may be relevant to many women in other parts of the world who are engaged in pottery work or employed in the ceramics industry.

The study used data from the Swedish Pneumoconiosis Register for the period 1931–1980. The register comprises details of all cases of the disease reported to insurance authorities during this time. It contains 4,700 records; 53 are of women with silicosis, the last of which was reported in 1975. According to normal practice, three stages of the disease were distinguished: Stage 1, up to pinhead-sized opacities; Stage 2, up to pea-sized lesions; and Stage 3, coalescence of these lesions into massive shadows.

Of the 53 silicotic women in the register, 42 had contracted the disease while working in the ceramic industry. Four others had worked in iron ore mines, and five in small factories producing scouring powder which contained silica. To facilitate comparison with silicosis in men, a group was selected for whom essential uniformity of dust exposure could be assumed—the 38 women who had contracted silicosis while working in potteries. Their data were compared with 128 silicotic male pottery workers.

An important factor in assessing silicosis risk and the course of the disease is the length of time during which quartz-bearing dust has been inhaled before the disease is diagnosed. As a rule, the shorter this time is, the more intense the dust exposure has been, and the more severe the course of the disease. Conversely, if there has been a very long period of prediagnosis exposure to dust, the intensity of exposure has usually been less and a proportionately mild course of silicosis can be anticipated.

For the total group of 53 women, the prediagnosis duration of dust exposure fell from a previous mean level of about 20 years to about 13 years in the period 1961–1975. This decrease was attributable in part to the five cases of silicosis in workers who

manufactured scouring powder, and for whom silicosis was diagnosed after only 5–10 years of exposure. Among the women employed in pottery shops, the average duration of exposure to dust in the period 1931–1975 was significantly shorter than for men.

In examining progression of the disease, it was found that the tendency to advance from Stage 1 to Stage 2 or 3 was strong among the affected women, and was particularly marked after cessation of exposure. The disease progression for men performing similar work was considerably slower. The difference was most striking during the first 15 years of the study period.

Approximately half the total group of 53 women died during the study period; 45% of deaths were due solely to silicosis, while silicotuberculosis accounted for about 10%. Similar death rates and causes of death were found among both men and women pottery workers.

In terms of age, calendar time of diagnosis, initially detected stage of silicosis, and mortality from the disease, there were similarities between both sexes of pottery workers. Incidence of tuberculosis was somewhat higher among the men up to 1950, declining sharply thereafter as a result of the general use of anti-tubercular drugs. Average duration of exposure to the causal dust before detection of silicosis in these workers was significantly shorter among women than men.

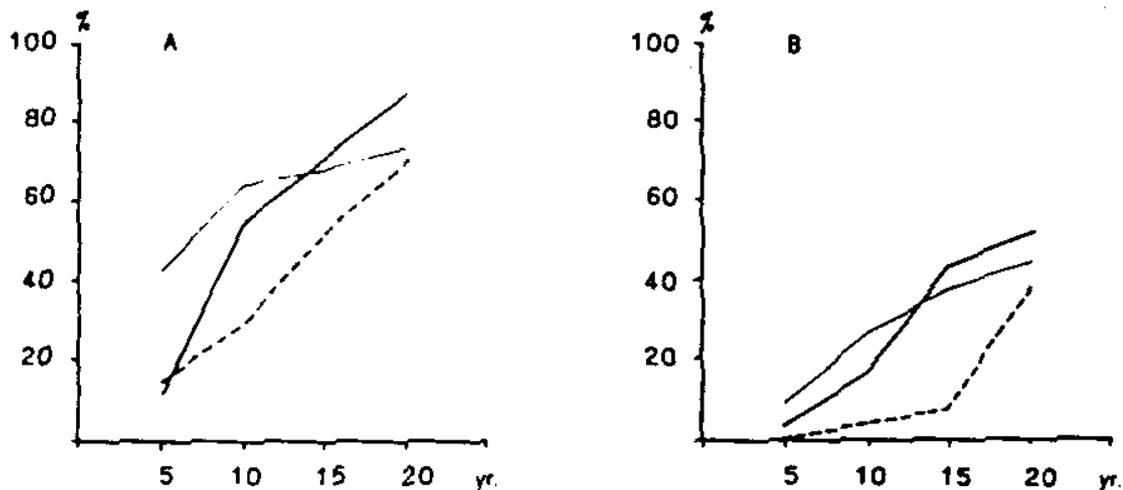
Comparison with male quartz workers

In accordance with the principle that short-term prediagnosis exposure is associated with greater intensity of dust and more serious symptoms, the progression of silicosis in female pottery workers in this study was more rapid and severe than in male potters.

The female group was therefore compared with male quartz workers — an industrial group usually regarded as at special risk because of its heavy exposure to quartz. After 15 years of observation slightly more progression of silicosis was seen in the female potter group than in the male quartz workers. This was despite an indication that the quartz content of airborne dust is much higher in cutting and processing quartz (74%) than in pottery work (15%). Small particles were more numerous in potteries—30% as compared with 24% in quartz works.

Silicosis contracted by women working in potteries has thus shown a more pronounced progression than silicosis in other Swedish occupational groups. Several explanations may be considered. Women could have been exposed to higher concentrations of dust than men at the same work sites, although no separate measurements of dust concentrations inhaled by men and women are available to support this assumption. Many of the silicotic women were employed as finishers of fired wares—dry work which generates large amounts of dust. It is therefore possible that they were exposed to more quartz in dust than the silicotic men, who worked mainly with moist materials, and that the dust inhaled by women had a somewhat higher content of small particles.

It is also possible that the men were on average in better physical condition than their female colleagues, who thus had to ventilate more for the same occupational performance, thereby receiving a higher dust load in the lungs. However, as the women's work was relatively light, this explanation does not seem adequate, although poorer physical condition may have been a contributory factor.



Cumulative percentage of known radiographic progression of silicosis after five-year intervals. Baseline starts at intersect of x and y axis and not at year 5. (Calculated according to technique that states cumulative percentage of progression, including progression in subjects who died during five-year interval and in nonattenders). Thick solid line indicates female pottery-forming shop workers; dashed line, male pottery-forming shop workers; and thin solid line, male quartz workers. A indicates progression from stage I to II or III; B, progression from stage I to III.

This study raises a number of significant issues despite the small numbers affected in Sweden. Many women in developing countries make their own pots or are engaged in ceramics work and pottery industries. The relationship to other contributions in this *Anthology* addressing illness from particle-laden dusts or smoke should also be noted. The designation of silicosis as a "male" disease, coupled with its long latency period, enhances the risks of its remaining undiagnosed and untreated in women. Similar issues are raised in the study on Hut Lung in South Africa, which addresses problems of pneumoconiosis in rural women. Women acquiring pneumoconiosis or silicosis in developing countries risk doing so in circumstances where the possibility of diagnosis and treatment are small.

Summary of the work of:

Gerhardsson L, Ahlmark A. Silicosis in women: experience from the Swedish pneumoconiosis register. *Journal occupational medicine*, 1985, 27(5):347-50.

Cassava processing and cyanide poisoning

Cassava is the third most important food crop in the tropical world, following rice and maize. Although it is low in protein, production is increasing because it grows well in poor soils and tolerates drought. But it has a major disadvantage in that its preparation as a food liberates hydrogen cyanide, a deadly poison. Careful preparation is therefore needed to initiate the various chemical interactions needed to eliminate this poison. Cassava is largely grown and processed by women.

Now the major food crop throughout tropical Africa, cassava is also widely grown in many Pacific countries. It is produced commercially in many countries, since it is easy to grow and reliable. In Nigeria, cassava is a major food staple and the production of processed cassava—known as gari—is carried out on a large scale. Like all traditional cassava processing, gari production is labour intensive. It is usually undertaken by a small group of people on behalf of a larger community, either at village level, or in large gari kitchens in towns, with many people working together in one unit. This tedious and potentially dangerous work is carried out mainly by women.

To make gari, women peel, wash and grate the tubers. Then they put the grated pulp in cloth bags and leave it to ferment for several days. If the bags are placed under weights or put in a press, water containing some of the hydrogen cyanide is squeezed out. After three days or so the pulp is removed and heated in shallow, open pans to expel residual water and cyanide. Finally, the relatively dry gari is stored, during which time any remaining cyanide disappears. Prepared in this way, or by an assortment of traditional methods in Latin America, Africa and the Pacific, cassava becomes quite safe to eat.

The health risks related to cassava

Several problems remain, however. Firstly, in times of famine, starving consumers do not wait for the cassava to lose all its cyanide properties before eating it, and may suffer serious health problems as a result. Death is rare, but sublethal effects of cyanide inhalation are common. These include spastic paraparesis, a condition which afflicts the motor nervous system and leaves the victim permanently crippled. Problems of goitre, where this is endemic, may also be exacerbated. Secondly, the women in the gari kitchens or elsewhere who process the cassava may be exposed to

hydrogen cyanide fumes during their work and experience related health effects. Thirdly, farm animals may also suffer toxic effects if they are fed with cassava scraps and peelings.

Various solutions are being sought for these problems. For example, cassava varieties are being screened to identify those naturally low in cyanide content. Simple testing methods to determine cyanide content are also being developed. One difficulty in measuring and comparing the cyanide content of different cassava varieties is that this varies in different parts of the plant. Drought conditions tend to have the effect of increasing cyanide content, as do mechanical damage and pest attack. The effects of environmental factors may be so great that an inherently low cyanide variety grown under drought conditions may have a higher cyanide content than a high cyanide variety grown under favourable conditions. A range of varieties are therefore being grown in Nigeria to measure in detail the effects of various environmental factors.

Exposure monitoring and protective measures

To help protect the women in the gari industry, a simple means of monitoring their exposure to hydrogen cyanide fumes has been developed. This consists of a treated test-paper which is colourless, but which turns blue when exposed to hydrogen cyanide gas. It is proposed to introduce this for use by women and children gari workers so that they will realize when they are being exposed to dangerous fumes. The personal monitoring badges of radiation workers perform a similar function.

A typical gari preparation area consists of a large, open-sided shed, often poorly ventilated. Many women work in these sheds, often with children around them. Hydrogen cyanide is generated at various stages of preparation, particularly when the fermented gari is fried in open pans. Better ventilation systems for gari kitchens, and improved processing equipment to ensure that women and children are successfully isolated from the source of cyanide, are therefore required.

Given the ubiquity of cassava as a staple food, and women's responsibility for its processing on a domestic and commercial basis, the implications for women's health are important. Aside from the effects of eating toxic cassava, women are exposed to the air pollution connected with its processing. The potential synergistic effects with goitre (which afflicts mainly women) need further investigation. This is only one of many dangerous agricultural processes to which women are exposed.

Summary of the work of:

Ferrar P. Food laced with cyanide. *Partners in research for development* (Australia), 1992, 5: 29-33.

Fetal protection policies

In March 1991 the US Supreme Court ruled that personnel practices limiting the employment of fertile women in jobs posing reproductive health hazards constitute illegal sex discrimination. The ruling has important implications for public policy in other situations in which vulnerability to the health effects of toxic substances is associated with real or perceived biological differences between the sexes.

The fetal protection policy of Johnson Controls, the largest producer of batteries in the US, excluded women from jobs involving significant exposure to lead. As lead is a basic raw material in battery manufacture, this effectively excludes women from all production jobs. The only exceptions permitted were women whose sterility was medically documented. In 1984 the Union of Automobile Workers (UAW) sued Johnson Controls, arguing that the corporation's fetal protection policy constituted explicit gender-based discrimination, rather than a gender-neutral policy to protect fetuses that happened to exclude women rather than men. Initial hearings upheld the Johnson Controls policy, and the case came to the US Supreme Court.

This "gender-neutral with disparate impact upon women" argument had been successfully used by employers in past cases concerning fetal protection policies. The plaintiffs presented scientific evidence that lead harms male reproductive capacity, possibly produces defects in fetuses by damaging male germ cells, and produces non-reproductive health damage at low-exposure levels in both men and women. The plaintiffs examined the processes by which employers arrive at exclusionary hiring policies, contrasting the large number of jobs which actually pose fetal hazards (speculated at up to 20 million) with the relatively small number covered by fetal protection policies. If employers were as concerned for fetal safety as they claimed, why were gender-specific policies found only in male-dominated, high-wage industries and not in equally hazardous female-dominated-low-wage industries? Employers could easily, according to the plaintiffs, claim moral and ethical justifications for essentially economic, profit-oriented decisions.

A tool to maintain high wages for men?

Gender-specific fetal protection policies reflect a balancing of advantages and disadvantages for employers, but not for employees or society at large. The supply of male workers is a key factor. In industries where profit rates are high enough to permit high wages, and unions strong enough to obtain them, there is an ample supply of both

male and female job applicants. But implicit and explicit gender-based discrimination in these industries has historically reserved the jobs available in them for men. Where profits are too low to permit high wages and/or unions too weak to obtain them, applicants are often female workers who are excluded from the highly paid jobs in profitable, unionized industries.

It is possible that exclusionary policies are counterproductive even when evaluated solely in terms of fetal safety. Women excluded from male-dominated industries are virtually certain to earn lower wages and have less generous (if any) health insurance, both of which are linked to nutritional status, use of prenatal medical services, and other important determinants of fetal outcomes. The direct fetal risks from toxic substances may be even higher in some female-dominated industries, precisely because of the relative absence of labour unions and other economic incentives to improve working conditions. There was, the plaintiffs emphasized, no basis for treating health hazards to fetuses as socially more significant than health hazards to adult men and women.

The Supreme Court ruling in favour of the plaintiffs was unanimous. The Court noted evidence concerning the debilitating effects of lead exposure on the male reproductive system, but based its decision on the invalidity of policies ostensibly designed to protect the interests of female workers against their own volition. This anti-paternalistic approach essentially closed the door on fetal protection policies, leaving decisions about the welfare of future children to their parents, rather than to the employers who hire those parents.

Many toxic substances which harm the developing fetus in the workplace also harm the reproductive capacity of adult workers and impose non-reproductive health burdens on both men and women. For these substances, policies designed solely to protect the developing fetus not only impair the employment opportunities of female workers, but also leave male workers unprotected and limit the pressure to reduce exposures for all members of the population. However, the argument against fetal protection policies can be made solely on the basis of the damaging effects of labour restriction and segregation for women referred to above. Occupational segregation reinforces gender stereotypes that have traditionally restricted women's efforts to gain economic independence and take on prominent public roles.

Summary of the work of:

Robinson JC, Giacomini MK. A reallocation of rights in industries with reproductive health hazards. *Milbank quarterly*, 1992, 70(4):587-603.

WHY CONSIDER PSYCHOSOCIAL FACTORS IN THE WORKPLACE?

Hundreds of millions of people worldwide are exposed to job stress on a daily basis and suffer its health consequences. Millions develop symptoms of so-called “burnout” – a term to describe debilitating effects of a prolonged exposure to stress at work.

- More than 50% of workers in industrialized countries complain today about job stress and overwork.
- In the USA, problems at work seem to be more strongly associated with health complaints than any other life stressor, including financial or family problems. 68% of respondents to a survey confirmed that they had to work very fast and 60% never had enough time to finish their work.
- In Québec, long-term absences due to mental health problem jumped from 2% in 1980 to 33% in 1995.
- A survey of 630 trade union safety representatives in 1997 showed that 67% of respondents reported that their management had taken no action to reduce workplace stress.
- In Europe, stress appears to be one of the most important occupational diseases of the nineties. A European survey in 1995-96 found that more than 60% of workers experienced stress in their jobs for over 50% of the time.

Data related to work stress and its health consequences come mostly from developed countries and there is an urgent need to initiate systematic studies of occupational psychosocial factors in developing countries. In many of the developing countries, work-related stress, like many other occupational illnesses, remains underreported and underestimated because of the legal problem of compensation liability.

What is Stress at Work:

The Definition - The scientific literature on occupational stress points out three different but overlapping approaches to the definition and study of stress. The first approach conceptualizes occupational stress as an aversive or noxious characteristic of the work environment (engineering approach). The second approach defines occupational stress in terms of the common physiological effects of a wide range of aversive or noxious stimuli whereby stress is a physiological response to a threatening or damaging environment (physiological approach). And the third approach conceptualizes stress as the dynamic interaction between the person and their work environment (psychological approach). The psychological approach is largely consistent with the International Labour Offices’ definition of psycho-social hazards (ILO, 1986) and with the definition of well-being recommended by the World Health Organization (1986). They are also consistent with the developing literature on personal risk assessment. These consistencies and overlaps suggest an increasing coherence in current thinking within occupational health and safety.

The Functioning - Stress sets off an alarm in the brain, which responds by preparing the body for defensive action. The nervous system is aroused and hormones are released to sharpen the

senses, quicken the pulse, deepen respiration and tense the muscles. This response, sometimes called the “fight-or-flight” response, is *pre-programmed biologically*. It helps defend the individual against threatening situations. The response is similar in all people.

Short-lived or infrequent episodes of stress pose little risk. However, when stressful situations continue unresolved over a long period of time, the body is kept in a constant state of activation, which increases the rate of wear and tear to the body. Ultimately, fatigue and damage occur when the body’s immune system becomes seriously compromised. As a result, the risk of injury and disease increases many-fold.

Causes of Work-Related Stress: According to the National Institute for Occupational Safety and Health in the USA – one of WHO’s Collaborating Centres in occupational health -- such working conditions may include a multitude of responsible factors:

- *Improper design of tasks*, which implies heavy workload, infrequent rest breaks, long working hours and shift work, hectic and routine tasks that have no inherent meaning, not utilizing workers’ skills and there being little sense of control.
- *Management style* that is not transparent precludes participation of workers in decision-making and results in poor organization of work and lack of family-friendly policies in the company.
- *Career-related anxieties* that include, among other factors, job insecurity, lack of opportunity for advancement or promotion, little recognition, as well as rapid changes for which workers are unprepared.
- *Strained interpersonal relations* that are usually a sign of a poor social environment, lack of support, communication and help from supervisors and co-workers.
- *Conflicting and uncertain work roles*: too much responsibility, “too many hats to wear” – whereby individuals’ need for role clarity varies.
- *Unpleasant or dangerous work environment* such as overcrowding, excessive noise and air pollution, or ergonomically inferior designed work places resulting in health problems.

In addition, individual differences need consideration - what is stressful for one person is not necessarily stressful for someone else.

It is improbable that assessments of stress levels would determine with high confidence that stress symptoms are caused by certain stressors (which implies a clear cause-effect relationship), that exposure to these stressor already elicit symptoms, that they contribute to these symptoms, or that they accelerate, aggravate, or trigger them. “On the other hand, it becomes equally clear that they may contribute to a wider variety of morbidity and mortality, a much wider spectrum than is usually realised” (European Commission). It must be recognised that stress is a set of potentially pathogenic (disease-inducing) mechanisms which may result in disease and/or death.

The Role of Organizational and Managerial Characteristics: Some employers and managers believe that stressful working conditions are a necessary evil. They assume that to remain

productive and competitive in today's world, their companies must increase pressure on workers and set aside health considerations. However, according to data from the US Bureau of Labor Statistics, workers who must take time off because of stress, anxiety or a related disorder, will be off the job for an average of 20 days at a time.

On the other hand, research has identified a number of organizational and managerial characteristics associated with both healthy (adequate stress level) working environments and high levels of productivity and job satisfaction. These include:

- An organizational culture that values the individual worker.
- Recognition of employees for good performance.
- Opportunity for career development.
- Management policies and actions that are consistent with organizational values.
- Work load adapted to the person.
- Satisfactory level of participation in decision-making.
- Adequate social support system.
- Significant work content.

Stress and Health Implications: Gastric problems, headaches, mood and sleep disturbances, depression and upset relationships with family and friends are among the first symptoms of stress. At the same time, the worker becomes more vulnerable to infectious diseases. There are also the typical 'escape behaviours', when the persons under constant stress make use of all kinds of pills (such as pain killers, sleeping pills and other prescription medicines, some of which are very dangerous for self medication), tobacco, alcohol and illicit drugs. People become used to their consumption as they belong to the habit-forming behaviours. If they are not used, anxiety increases which further increases the stress level. This can eventually also lead to other negative consequences such as increased absenteeism and decreased efficiency.

There is enough evidence to suggest that prolonged exposure to job stress is associated with several types of chronic conditions, including *cardiovascular diseases*, *musculoskeletal* and *psychological disorders*.

- *Cardiovascular Disease:* Many studies suggest that psychologically demanding jobs that allow employees little control over the work process, as well as prolonged job insecurity, increase the risk of cardiovascular disease, particularly hypertension.
- *Musculo-skeletal Disorders:* There is evidence that job stress increases the risk of back and upper-extremity musculoskeletal disorders.
- *Psychological Disorders:* Prevalence of mental health problems, such as depression and burnout, is associated with job stress levels. Economic and lifestyle differences between occupations and individuals may also contribute. There is, therefore, a need to identify those individuals prone for mental disorders within those individuals who are highly-stressed.
- *Work-related Injuries:* There is growing concern that stressful working conditions interfere with safe work practices, thus contributing to the currently estimated global total of 250 million accidents at work each year, with around 300 000 fatalities.

- *Suicide, Cancer and Ulcers*: Some studies suggest an association between stressful working conditions and these health problems. However, more research is needed to draw firm conclusions.

In the USA, health care expenditures are nearly 50% greater for workers who report high levels of stress at work. By 1995, nearly one-half of the states in the USA accepted worker compensation claims for emotional disorders and disability due to stress on the job. It has to be noted, however, that courts were reluctant to uphold claims for what could be considered normal working conditions or just hard work.

- *Burnout*: Prolonged exposure to stress at work may lead to a psychological condition of burnout. Burnout is described as a three-dimensional syndrome, which is characterized by energy depletion (a feeling of being drained and having nothing more to give), reduced productivity and increased detachment from one's job and other meaningful relationships (cynicism). Burnout has most debilitating effects on the health of the working populations, bringing about apathy, callousness, despair and ill health. The increasing prevalence of burnout has become a matter of serious concern in many developed countries. However, unorganized workforces, which are the norm in developing countries, face the highest amount of stress due to permanent job insecurity.

Stress Management and Prevention: Two approaches are used today to offset the adverse impact of job stress on the worker's health, production output and company efficiency.

1. *Stress management* focuses on individual workers and ways to help them cope with demanding conditions. Stress management programmes teach workers about the nature and sources of stress, the effects of stress on health and personal skills to reduce stress. Such programmes may rapidly reduce stress symptoms in an individual, such as anxiety and sleep disturbance. They are also inexpensive and easy to implement. However, such programmes have a major disadvantage. Concentrating on the worker, they often ignore important root causes of stress, which are determined by the working environment. That is why the beneficial effects on stress symptoms are often short lived.

- Nearly one-half of large companies in the USA provide some type of stress management training for their workforce.

2. *Stress prevention* is the most direct way to reduce stress at work. This approach involves the identification of work stressors and the development of strategies to reduce or eliminate them. However, managers are sometimes uncomfortable with this approach because it can involve changes in work routines or production schedules, or even changes in the organizational structure.

A *combination* of stress management and stress prevention programmes is the most effective approach for preventing stress at work. Several studies have been conducted in the USA on the effects of stress prevention and management programmes in the hospital settings. Programme activities included (1) employee and management education on job stress, (2) changes in

hospital policies and procedures to reduce organizational sources of stress, and (3) establishment of employee assistance programmes.

- In one study, the frequency of medication errors declined by 50% after stress prevention and management activities were implemented in a 700-bed hospital. In a second study, there was a 70% reduction in malpractice claims in 22 hospitals. In contrast, there was no reduction in claims in a matched group of 22 hospitals that did not implement stress prevention and management activities.
- Another study showed that health professionals working in clearly defined teams reported lower levels of psychological strain, greater job satisfaction and greater organisational commitment than those who did not work in a team.

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MUSCULO-SKELETAL DISORDERS: IMPROVING ERGONOMICS AT THE WORKPLACE

WHAT IS ERGONOMICS?

The term ergonomics (or human factors) is based on the Greek terms 'ergon' (work), and 'nomos' (law) to denote the science of work. Ergonomics promotes a holistic approach in which considerations of physical, cognitive, social, organizational, environmental and other relevant factors are taken into account. The use of ergonomic principles results in individuals' comfort, health, safety and efficiency.

THE ROOTS OF THE PROBLEM

The most common work-related health problems of the global workforce are due to :

- a) strain experienced through physical tasks that require high levels of force and of repetition, and strain experienced through static and constrained working postures,
- b) poorly-designed workplaces (inadequate seating arrangements, high noise levels, poorly-designed equipment, inappropriate lighting), and
- c) effects of extreme ambient temperature, intense thermal radiation and inappropriate ventilation.

Injuries and illnesses range from eye strain and headaches to musculo-skeletal ailments such as back, neck and shoulder pain.

SOME FACTS AND NUMBERS

- In 1997, approximately 30 percent of the workforce in developed countries and between 50 and 70 percent in developing countries were either exposed to a heavy physical workload, such as lifting and moving of heavy items (especially miners, farmers, lumberjacks, fishermen, construction workers, storage workers, healthcare personnel, railroad and maritime workers), or ergonomically poor working conditions including repetitive manual tasks (in industrial and service occupations). These working conditions can lead to injuries and musculo-skeletal disorders.
- The occurrence of these disorders has not disappeared despite the development of new technologies that let machines and computers take over some of the previously manual work. Now new groups of people contract musculo-skeletal disorders.
- A European survey on working conditions took place in 1996 and collated the views of 15,500 employees from all over Europe. The working population of the European Union (15 Member States) is 147 million of whom 83 percent are employees and 17 percent self-employed. Findings highlight how musculo-skeletal disorders are among the rising occupational disorders in the EU, alongside occupational stress and occupational hazards such as pollution and noise. They point out the need for a more

holistic and multi-disciplinary approach to tackle health and safety issues and the need to mainstream these issues in organizational structures and development.

- Musculo-skeletal disorders result in a high loss of productivity and increased health and social costs every year. In total, 1.8 million US workers and employees annually suffer musculo-skeletal disorders.
- One of the oldest and best recognized occupational health problems in the world is back injuries. Back strain due to over-extension represents one of the largest segments of employee injuries in the American workplace. Only the common cold accounts for more lost days of work. Back strain involves damage to the muscles, ligaments, and/or tendons and occurs when the ligaments or tendons are over-stretched or muscles are overused. This may occur in almost one of every two people sometime during their lifetimes. Once the back is damaged, it is more susceptible to repeated injury.
- Each year musculo-skeletal disorders of the lower back and upper extremities affect about 1 million workers and cost the American nation between US\$ 45 billion and US\$ 54 billion in compensation expenditures, lost wages, and decreased productivity.
- With over a third of a million sufferers in Great Britain, taking 10 million days off from work a year, Government statistics show that musculo-skeletal disorders (mostly repetitive strain injuries which occur when stress or strain is put repeatedly on a certain part of the body and back strain) are the second most common work-related diseases. The cost of this epidemic is now over £ 2 billion a year.
- The 1998 Trades Union Congress survey of trade union safety representatives from 500 workplaces across the UK shows that employers are not recording the number of sufferers or the amount of days lost due to repetitive strain injuries and back strain, nor are they providing treatment for sufferers. The survey found that only 17 percent of businesses had calculated the costs of back strain and that despite cost effectiveness of interventions such as physiotherapy or rehabilitation, under a third of employers provided these measures to their employees.
- In many developed countries these disorders have proven to be the main cause of both short-term and permanent work disability. In general, very little credit is given to the stress component as a risk factor, although recent research suggests that efforts targeting musculo-skeletal disability prevention should focus on reduction of such stress.
- An Indian study showed, for example, that the prevalence of musculo-skeletal disorders of back and lower extremities was comparatively much lower in workers with habitual oriental squatting or cross-legged sitting.

Repetitive Strain Injuries: Work-related musculo-skeletal disorders include repetitive strain injuries. Repetitive strain injuries may cause damage to nerves, muscles, tendons and other soft body tissue. They may take years to develop, and tend to strike individuals in the prime of their careers. Extreme cases can result in permanent disability and the inability to perform one's job.

A recent study of 200 computer professionals in Hyderabad, India, stated that a large number of repetitive strain injury cases developed in a relatively short duration of one and half years.

Carpal Tunnel Syndrome: One of the most frequently reported repetitive strain injuries is carpal tunnel syndrome. This occurs when the median nerve (a major nerve in the wrist) is inflamed by excessive pressure exerted by irritated tendons. The primary cause of tendon irritation is repeated finger motions and/or bent wrists.

Symptoms can include :

- numbness, pain and/or tingling in the thumb and the first three fingers
- a burning feeling in the hands or forearms
- reduced strength in the hand, and
- discomfort in arms, shoulder or neck.

Carpal tunnel syndrome may limit the range of motion and/or reduce the ability to grip objects.

- According to US statistics, 25 is only the median number of workdays per annum an employee affected by carpal tunnel syndrome misses.
- 42 percent of these cases result in more than 30 days of absence from work.

Working women: This group of employees has been found to experience an especially high number of the musculo-skeletal diseases that are the most severe and the most costly, such as carpal tunnel syndrome and tendinitis.

- Women suffer 62 percent of the work-related cases of tendinitis and
- 70 percent of carpal tunnel syndrome cases.

Reasons may be that a large number of women work in jobs which require heavy lifting (for example lifting nursing home patients), highly repetitive motion (such as in factory and computer work), awkward postures (for example, sewing clothing), and other physical stresses, in addition to balancing work and family demands.

- Swedish statistics show that 58 percent of men and 54 percent of women use computers at work. Of all reported injuries regarding musculo-skeletal diseases in Sweden, work with computer or mouse was reported as the cause of the problems among 13 percent of the women and 4 percent of the men in 1998, compared with 5 percent and 1 percent, respectively, in 1992.

HEALTH AND FINANCIAL IMPLICATIONS

Work-related problems due to poor ergonomic conditions, if not prevented or treated in time, result in a deteriorated health status and unnecessary suffering for the individual concerned, as well as in increased costs for the person affected, the employer and eventually for the economy. Adopting basic ergonomic principles may result in the following:

Decreases in:	Increases in:
1. accidents and errors	1. production output
2. injuries & occupational	2. quality work
3. absenteeism	3. spare capacity to deal with emergencies
4. turnover	
5. medical and insurance costs	
6. lawsuits and related costs	

The adoption of an ergonomic program in the workplace has a proven track record. A Swedish project, implemented from 1991 to the end of 1992, obtained results which proved how beneficial an ergonomic program can be. Results indicated:

- *reduction in sick leave from 44.1 to 10.1 days per employee per annum*
- *savings to the employer and social insurance system amounting to US\$57,000*
- *rise in productivity by 150 personnel days, and*
- *increased job satisfaction.*

Low-cost improvements can make a considerable impact on employees' health and company effectiveness.

SOME IDEAS FOR LOW-COST IMPROVEMENTS

Small and cost-effective changes can have a significant and beneficial health impact. This is even more so the case for workers in developing countries as their health can be improved at a much lower cost than in developed countries. For example, in India many of the improved workplace and tool designs, such as training for manual material handling, use of ergonomically-designed work aids like protective gloves in a shoe factory, were found to be quite useful in alleviating the problems.

Some other low-cost improvements which could be undertaken might be:

- adjusting the height for working surfaces
- adding a platform
- providing footrests
- providing ergonomic stools or chairs
- changing the size of grips or knobs
- providing the right tool for the job
- providing mechanical lifting equipment
- repositioning tools or equipment
- finding ways to relieve awkward wrist positions
- padding hand tools and work surfaces
- reducing vibration from hand tools.

It is, however, critical to acknowledge environmental differences, cultural variations and idiosyncrasies within each worksite which require carefully-planned changes.

- **USA:** According to the US Occupational Safety & Health Administration (OSHA), an average annual cost to an employer for altering a workplace so that it will not cause work-related musculo-skeletal disorders is US\$ 150.

Low-cost ergonomic solutions were undertaken in small- and medium-sized enterprises in Thailand. Of about sixty improvements achieved, 35 percent did not cost anything. 37 percent cost less than US\$ 20 and only 10 percent cost over US\$ 80. The low cost of the improvements provides evidence that they were attainable through the use of local skills and materials

Commitment, involvement and awareness: A number of steps towards controlling the occupational risk factors related to inadequate ergonomic working conditions in small-scale industries are necessary to ensure that ergonomic hazards are identified and controlled. These include management commitment, employee involvement, job hazard analysis, training and education, and medical management.

Commitment by management and employee involvement are important for the success of an ergonomics programme. Management has to support the programme in terms of commitment and resources, and employees should establish procedures for accurate reporting of signs and symptoms of health problems, and make recommendations and decisions for corrective action. Participation by employees supports risk control through encouraging their 'ownership' of safety and health policies. This includes raising individuals' awareness of potential health problems in the workplace, and training them accordingly at an early stage may avoid later complications and irreparable health conditions. This is especially important as physical pain can often manifest itself during the night when links to working conditions are not necessarily evident. In addition, managers need to be sensitive to the need for improvement and be capable of taking action when they perceive problems.

Another important component of any ergonomics programme is the gathering of information to determine the scope and characteristics of the hazards contributing to musculo-skeletal disorders. This is easiest for jobs which already show evidence of problems. Recently, scientists from the University of Surrey, UK, have developed a promising assessment tool for studying ways to evaluate the risk of musculo-skeletal disorders. However, it may benefit from further development to increasingly improve its reliability.

Lastly, the prevention of impairment and disability through early detection of injuries, prompt treatment, and timely recovery for the employee should be ensured by a medical management programme.

Useful references:

Evaluating changes in exposure to risk for musculo-skeletal disorders - a practical tool, CRR 251/1999 ISBN 0-7176-1722-X, price £25.00, available from HSE Books, PO Box 1999, Sudbury, Suffolk, CO10 2WA, UK

Ergonomics Checkpoints, Practical and easy-to-implement solutions for improving safety, health and working conditions, ILO, Geneva, Switzerland, ISBN 92-2-109442-1

Downloadable NIOSH Publications from: <http://www.cdc.gov/niosh/homepage.html>

- Waters TR, Putz-Anderson V, and Garg A. Applications Manual for the Revised NIOSH Lifting Equation. NIOSH Publication Number 94-110.
- Musculoskeletal Disorders and Workplace Factors, A critical review of epidemiologic evidence for work relatedness. NIOSH Publication Number 97-141.
- National Occupational Research Agenda for Musculoskeletal Disorders: Research topics for the next decade. NIOSH Publication Number 2001-117.
- Simple Solutions: Ergonomics for farm workers. NIOSH Publication Number 2001-111
- Elements of Ergonomics Programs: A primer based on workplace evaluations of musculoskeletal disorders. NIOSH Publication 97-117

European OSHA press release: European campaign aims to lift the burden of work-related musculoskeletal disorder, http://agency.osha.eu.int/news/press_releases/000211/