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COMMENTARY

Women, Work, and Health

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The U.S. Bureau of National Affairs has conducted several surveys asking women to rate the seriousness of 11 hazards thought to affect female workers. In 1995 the women respondents ranked them in the following order: 1) stress, 2) repetitive motions, 3) AIDS, 4) violence, 5) VDTs, 6) indoor air pollution, 7) hepatitis, 8) injury on the job, 9) reproductive hazards, 10) tuberculosis, and 11) other infectious diseases. A parallel list of 11 hazards thought to affect male workers would look very different. The purpose of this paper is to explore why this is so and what it implies for the occupational health research agenda. Am. J. Ind. Med. 32:303–308, 1997. *© 1997 Wiley-Liss, Inc.*

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INTRODUCTION

At the present time in the United States, women represent roughly half the civilian workforce, about the same as their proportion in the general population (45% and 52%, respectively) [Quinn et al., 1995]. Although women workers contribute equally to the labor pool, they are not equally distributed across occupations and industries. Instead, there is a marked gender-based differentiation of work activities, with women concentrated in a small number of sectors. While the sectors that are considered women's work may vary from place to place, the segregation of employment by gender seems to be a universal phenomenon. Note that the hazards listed in the U.S. survey reflect the localization of female workers in two areas of employment: clerical work (stress, VDTs, repetitive motion, indoor air) and services (stress, hepatitis, AIDS, TB, other infectious diseases). With the exception of VDT use, and perhaps stress, many hazards that are common in female-dominated industries have not received much attention from occupational health researchers.

Because women engage in different work activities from men and potentially have different exposures and health risks, there need to be studies designed expressly for women workers. Such studies would, for one, investigate diseases unique to or more prevalent in women. Any effects of occupational agents on these endpoints will likely be missed by research designed from a male perspective, with its focus on male exposures and outcomes. In addition, occupational health research needs to consider potential gender differences in response to exposures common to both men and women. It is precisely because of differential response by gender that drug trials in the U.S. are now mandated to include female subjects. Whether in the general population or among workers, studies of the prototypical ''170 lb. white male'' cannot be counted on to produce results that hold true for everyone. Striking gender differences in morbidity and mortality, such as women's lower risk of heart disease and longer lifespan [Wingard, 1984], have already been recognized. Some underlying reasons why such gender differences may exist are listed in Table I.

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TABLE I. Some Possible Mechanisms for Differences in Women's Response to Exposure

- more body fat
- endocrine effects on hepatic activity
- endocrine effects on exogenous exposures
- differences in metabolizing enzymes
- distinct dietary patterns

In the future, the goal of occupational health research should be to study both female and male workers in sufficient numbers to determine whether gender influences the risk being estimated. Where indicated, studies would be designed to allow biological and social differences to be examined directly.

Since the field of occupational health arose and developed in relation to male employment sectors [Messing et al., 1993], how much attention have occupational exposures and diseases of women received up to now? A comprehensive, substantive summary of research to date is beyond the scope of this paper. Rather, our aim is to illustrate with examples the areas that have been pursued and the approaches that have been taken. Until recently, only two areas—cancer and reproduction—have received much attention. We begin with these.

OCCUPATION AND CANCER

A principal concern of occupational health research has been chemical and physical carcinogens, reflecting both the field's focus on traditionally male employment sectors and the maturity of cancer epidemiology relative to other areas. Before the recent emergence of the microelectronics industry as a predominantly female sector, women seldom worked in environments where chemicals, radiation, or physical agents were present. Wartime was an exception, and two cohorts of female workers that incurred unusual exposures in connection with production for the military were ultimately studied extensively, producing valuable new information.

The first cohort consists of the thousands of girls and young women who painted radium dials on military wrist watches during World War I, using their tongues to wet the tip of the paint brushes, unaware of the risk involved. Many radium dial workers exposed in this way went on to develop, first, the head and neck cancers and bone sarcomas characteristic of radium and, eventually, many other cancers as well [Stebbings et al., 1984]. Their experience may have been the first demonstration that radiation in an industrial setting could be carcinogenic [Clark, 1987]. Follow-up of these unfortunate young women has added to our knowledge of the range of radiogenic cancers and the nature of radiation dose–response relationships.

The second such cohort consisted of women workers exposed to asbestos in the manufacture of gas masks in Britain during World War II. In addition to lung cancer and mesothelioma, this group has also shown an increase in cancer of the ovary [Acheson et al., 1982], raising the possibility that ovarian cancer might also have an asbestos-related etiology. This is plausible biologically, since the surface of epithelial ovarian tumors consists of mesothelial tissue, as in the signature tumor. A possible association between asbestos and ovarian cancer raises interesting questions about vaginal transport of foreign material and whether more common fibers or particles, such as talc, could also be pathogenic to the ovary [Harlow et al., 1995].

Apart from these unusual exposure cohorts, scant research has been conducted on the cancer risks of female workers. A 1994 conference entitled ''Women's Health: Occupation and Cancer'' compiled a summary of all occupational cancer studies published between 1971–1990 [Zahm et al., 1994]. Out of 1,233 total investigations, only 35% included any female subjects. Fewer still (14%) included analyses of women as a separate subgroup. Many factors are likely to have contributed to these statistics, including the small number of women in the workplaces studied and their concentration in jobs with lower levels of exposure. Because cancer is usually a disease with a long interval between exposure and diagnosis, there may not have been enough women employed for long enough to ensure adequate numbers of events for analysis. In recent years, many more women have entered traditionally male occupations and industries, partly as a result of federal legislation and affirmative action. We can, therefore, expect to see an increase in research on occupational cancer risk among women. In considering topics for future studies, investigators might consult a recently assembled cross-listing of the industries where women predominate and the hazards that are potentially present there [Stellman, 1994].

As in early occupational cancer studies of men, the methods used in early cancer research on women workers were quite crude, based on analyses of cancer rates by job title or industry rather than any direct measure of exposure. In contrast, the most promising cancer studies of women workers currently underway use exposure to a carcinogenic agent as the starting point, not unlike the studies of radium-dial workers and gas-mask workers discussed above. For example, the National Institute for Occupational Safety and Health (NIOSH) is utilizing a registry of polychlorinated biphenyl-exposed workers to follow up provocative reports linking breast cancer, a hormone-related tumor, to potentially estrogenic organochlorine compounds [Wolff et al., 1993; Houghton and Ritter, 1995; Ahlborg et al., 1995]. This is a good model of a woman's occupational health study, not only for its methodology involving use of an actual exposure registry but also because the study endpoint is a female cancer (largely) and the suspected mechanism of

action is hormonal. Studies in women will contribute information concerning the pathophysiology of various agents, including those with hormonal activity, and it bears noting that the knowledge gained is very likely to have relevance for male workers as well.

Recently, cancer incidence and mortality rates have begun to be explored in a variety of traditionally female occupations, including teaching, cosmetology, nursing, and agriculture [Swanson and Burns, 1995; Zahm et al., 1993]. One study of telephone operators, 97% of whom are women, observed a significant excess risk in younger women (under 50 years of age) for cancers of the connective tissue, colon, rectum, breast, uterus, ovary, and brain [Dosemeci and Blair, 1994]. The authors postulate that exposures stemming from the technological advances in telecommunications, including new instruments, machinery, and production procedures, may increase the risk of cancer, especially in premenopausal women. Unfortunately, interpretation of the results is limited by a lack of information on other known risk factors. This is a limitation inherent in occupational cancer studies that rely solely on available data [Santella et al., 1987].

Cancer among women in non-traditional sectors such as mining and rubber work is also beginning to be studied. Soviet women employed as miners during World War II show the same excess of stomach and lung cancer mortality as male miners [Bulbulyan et al., 1992]. Female farmers, rubber workers, and workers in transportation equipment manufacture and repair have shown significantly elevated rates of brain tumors, consistent with the reported excess of brain cancer among men in the same industries [Heineman et al., 1995]. Bladder cancer has also been associated with employment in the rubber industry. One of the few case-control studies with sufficient numbers of women workers for analysis [Silverman et al., 1990] showed similar patterns of bladder cancer risk by job title as had been found in men, and the authors estimate that 11% of bladder cancer diagnosed in white United States women is attributable to occupational exposures.

In contrast, a study of rubber workers in Moscow reports gender differences in cancer risk [Solionova and Sulevich, 1993]. While both males and females were at elevated risk for bladder cancer, the Standardized Incidence Ratios for all cancers, and for digestive and respiratory cancers in particular, were significantly elevated only in men. Women were found to be at increased risk for cancer of the ovary. Cancer incidence according to occupation showed that 63 of 71 (88.7%) women with cancer worked in production areas; 61 of 84 (72.6%) men with cancer had also worked in production. Thus, the same job sector (production) seemed to be hazardous for both men and women but in relation to different cancer sites. This could be explained by confounding factors which were not taken into account. Alternatively, it could mean that the exposures were different or that gender-specific vulnerabilities determined the site of carcinogenesis. The pattern of similarities and differences that will emerge from parallel studies in men and women will help to extend our understanding of both cancer etiology and pathogenesis.

TABLE II. Agents Considered Hazardous to the Fetus by Finnish Legislation[a]

Agents harmful during pregnancy:
Chemical:
Carcinogens
Anesthetic gases
Mercury and its compounds
Carbon monoxide
Lead
Cytostatic drugs
Organic solvents
Chemicals marked with:
R 45 (carcinogen)
R 46 (mutagen)
R 47 (teratogen)/R 61
Biological:
Viruses: hepatitis B, herpes, cytomegalo, varicella, rubella, HIV
Bacteria: listeria, toxoplasma
Physical:
Ionizing radiation, including radionuclides

[a]Adapted from Taskinen H (1992): Scand J Work Environ Health 18: Suppl 2:27–29.

OCCUPATION AND REPRODUCTION

While cancer risks have received some attention, the principal focus of occupational health research on women has been on whether work during pregnancy affects the fetus. In this body of research, the exposed woman is viewed as a vessel for future generations. Possible adverse effects on her own health are not considered. The large group of studies on occupation and reproduction are summarized in any number of good literature reviews [e.g., Figa-Talamanca and Hatch, 1994; Gold and Tomich, 1994], and their findings are reflected in the lists of reproductive hazards that several countries have developed for regulatory purposes. As a succinct and convenient reference to recognized fetal hazards in the workplace, we have reproduced here the list of agents regulated by Finland (see Table II).

A recent, positive development in women's occupational health research is the more balanced agenda that is being pursued in relation to video display terminals (VDTs). In the 1980s, clusters of miscarriage and birth defects were reported among VDT users. The reports attracted considerable attention because of the high prevalence of VDT use, and studies were mounted in a number of countries to determine whether exposure to VDTs during pregnancy was in fact a hazard. Results to date are, in the main, reassuring

[Lindbohm and Hietanen, 1995]. The new and notable development is that concurrent with these reproductive studies have been investigations into possible health effects of VDT use on the women workers themselves, including ocular damage and musculoskeletal disorders [Council on Scientific Affairs, 1987].

MUSCULOSKELETAL DISORDERS

Occupational musculoskeletal disorders are increasing dramatically. In the United States, more than 60% of new occupational illnesses reported to the Bureau of Labor Statistics were associated with work involving repetitive motion [Bureau of Labor Statistics, 1994]. Keyboard operators, garment workers, cash register operators, maids, and poultry processing plant workers all perform such tasks and all experience high rates of musculoskeletal disorders. These jobs are typically ''women's work,'' so the question has been raised whether there is a gender-specific susceptibility to the cumulative trauma disorders that can result from repetitive motions, or simply an excess of females in the high-risk occupations.

Whichever is the case, musculoskeletal disorders are widely reported to occur more frequently in women than in men. For example, the incidence of DeQuervain's tenosynovitis and trigger finger shows a female-to-male ratio of 2:1 to 3:1 [Kurppa et al., 1991]. Pain along the tendon insertions or along the path of the tendons, which may have associated local swelling at the site of the upper extremity pain, also appears to occur more frequently in women [Kurppa et al., 1991]. Tension neck syndrome has the highest prevalence rate of all of the shoulder–neck disorders. The odds ratio for tension neck syndrome among female office workers in the United States compared with male industrial workers is 5.9 [Hagberg and Wegman, 1987]. Carpal tunnel syndrome has also been widely reported to occur with greater frequency in women than men. However, in studies that have controlled for work exposures, no sex difference has been found [Silverstein et al., 1987; Franklin et al., 1991]. Thus, it appears that the female excess of musculoskeletal disorders could simply reflect the type of work women do—jobs that are traditionally held by women and their associated repetitive tasks.

JOB STRAIN AND HEART DISEASE

One of the early explanations for higher rates of coronary heart disease (CHD) in males was that men worked and women stayed home, where they were protected from the stresses and strains of the work world. Reasons for the higher risk of CHD in males have since been extensively studied, focusing first on so-called Type A behavior, particularly the component related to anger, and more recently on a job strain model based on high demands coupled with low control [Schnall et al., 1994]. The jury is still out on whether an association between CHD and job strain exists. What is of interest in the present context is that as women entered the workplace and began to be included in these studies, they appear to show the same risk for heart disease as men [Schnall et al., 1994; Reed et al., 1988]. There are, however, potential social as well as biological differences between men and women, and it may be important to consider women's multiple roles when assessing workplace hazards. A leading expert in the area of work stress and CHD has argued that women's domestic responsibilities, the so-called ''second shift,'' could prevent nighttime recovery from job-related increases in blood pressure, leading to potentially serious chronic elevations [Frankenhauser, 1989].

WORK-RELATED INJURY

Occupational injury is another health outcome that may be affected by a woman worker's domestic responsibilities. One recent study of female aerospace workers [Wohl et al., 1995] found that those with young children were at a two- to fivefold increased risk of on-the-job injury compared to women without young children, although it is unclear whether this reflects fatigue or a preoccupation with household responsibilities or some other unknown factor. A twofold excess of injuries has also been observed among female electric utility workers compared to their male co-workers, after adjusting for age, occupation, and job experience [Kelsh and Sahl, 1996]. In addition to male-oriented design of tools and work settings, the authors mention household responsibilities as one of several possible explanations for the sex difference. A higher injury rate has also been observed among female postal workers [Zwerling et al., 1993]. This phenomenon now needs to be investigated in settings where data can be obtained on social factors that may mediate such an association.

WORK IN THE HOME

Many women have never worked outside the home. Nonetheless, exposures related to the work women do inside the home may pose a health risk—e.g., cooking in conditions of poor ventilation [Liu et al., 1993] or using certain cleaning products. Environmental tobacco smoke is another issue. In addition, wives of male workers may be exposed to workplace hazards as a result of handling their husband's contaminated clothing. One case in point is the asbestos workers' wives who developed lung cancer or mesothelioma in this way [Anderson et al., 1979].

WOMEN'S OCCUPATIONAL HEALTH RESEARCH: SUMMARY AND RATIONALE FOR AN EXPANDED AGENDA

Despite the relatively brief span of time since the occupational health of women has been a concern, some important issues have already emerged.

First, in the areas of cancer, heart disease, and musculoskeletal disorders, the occupational risk factors that were identified in male workers appear to increase risk among women workers as well. This impression needs to be confirmed by a systematic cataloguing of the available evidence.

Second, women workers are mainly exposed to different hazards than men. Moreover, there are numerous workplaces dominated by women (hairdressing establishments are one example) where no industrial hygiene or other approach to determining exposure has been instituted. A quantitative exposure profile for women workers needs to be constructed.

Third, the importance of introducing data on women's social roles when assessing occupational risk factors now has some empirical support. In the main, however, there are still only theoretical grounds for arguing the significance of gender differences in biological response. Development of empirical data in this area will require that occupational health studies take steps to measure biological variables such as cancer susceptibility genes.

We have presented at least three arguments in favor of gender-based occupational health research. First is the suspicion that, on biological grounds, it could be misleading to extrapolate from results of all-male cohorts. Second is the fact that the health risks of jobs allocated to women have been neglected in the occupational health research agenda, and thus constitute an important gap in knowledge. Finally, conditions that affect only women have rarely been studied in relation to occupational factors. To illustrate what this may mean, consider the prevalence of chronic gynecological disorders among U.S. women (97.1 per 1,000) [Kjerulff et al., 1996]. Given the frequency of these disorders, any occupational exposures that increased a female worker's risk for, say, fibroids or endometriosis would be important to identify, particularly if the risk factor were modifiable.

A useful initial step toward parity for women workers would be agreement by professionals in the field to undertake a gender-based evaluation of occupational health research. NIOSH has recently set a new national occupational health research agenda with eight high-priority areas:

1. allergic and irritant dermatitis
2. asthma and COPD
3. fertility and pregnancy abnormalities
4. hearing loss
5. infectious diseases
6. low back disorders
7. musculoskeletal disorders
8. traumatic injuries

In addition to fertility and pregnancy abnormalities, at least three of these high-priority areas—infectious diseases, low back disorders, and upper extremity disorders—are directly relevant to the kind of work women do as health care and clerical workers. A research emphasis on such areas will be important in achieving meaningful improvements in the health, safety, and well-being of women workers.

An increased emphasis on occupational health in women is also likely to lead to the development and application of new research methods [Dumais, 1992], something which may ultimately benefit the field as a whole. As suggested above, studies of women workers will frequently need to incorporate data on social factors (e.g., household and child care responsibilities, amount of leisure time, hours of sleep) and on biological variables as well (e.g., body size, hormones, susceptibility genes). Women could, for example, be vulnerable to occupational exposures only or especially during specific stages of the menstrual cycle. Although the particulars will differ, the principles of improving the quality of research by incorporating social and biological variables apply equally to studies of male workers.

Before concluding, one important concern about the direction described here must be addressed: the fear that gender-based research, which separates women from men and looks for differences between them, will erode the gains women workers have made to date and invite further discrimination in the workplace. While this could be something of a risk, we are better prepared to deal with it now than in the past, when consciousness of these issues was less widespread and there were fewer women in the workforce. It should also be noted that the kind of research proposed here will serve to identify *both* similarities and differences between men and women. There is simply too much known already to return to a reliance on male cohorts, or even mixed cohorts, to estimate the health risks of women's work. Only when there are accurate estimates for women workers will we have a comprehensive profile of occupational health in this country.

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