

## INTRODUCTION

# Women's Health: Occupation, Cancer, and Reproduction

## A Conference Overview

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An international conference titled *Women's Health: Occupation, Cancer, and Reproduction* was held in Reykjavík, Iceland, May 14–15, 1998, to assess cancer and reproductive risks among working women, and to discuss methodological challenges in occupational studies of women. The conference, formally opened by Ólafur Ragnar Grímsson, President of Iceland, expanded on the themes of a conference, *Women's Health: Occupation and Cancer*, held in Baltimore, Maryland, USA, approximately 5 years earlier [Potter et al., 1994]. The aims of the Reykjavík conference were to present new information and to stimulate and enhance future research on cancer, including cancer risk among offspring, reproduction, exposure assessment, and other aspects of women's health and occupation. The keynote lectures and selected contributed papers are published in this issue of the American Journal of Industrial Medicine.

The conference was held at the initiative of the Medical Department of the Administration of Occupational Safety and Health in Iceland in close collaboration with the US National Cancer Institute and the International Agency for Research on Cancer. Other co-sponsors were the European Commission; National Institute of Environmental Health Sciences, USA; Office of Research on Women's Health, USA; National Institute for Occupational Safety and Health, USA; International Commission on Occupational Health; Scientific Committee on Reproductive Hazards in the Workplace; Nordic Institute for Advanced Training in Occupa-

tional Health; National Institute for Working Life, Sweden; Icelandic Ministry of Social Affairs; Icelandic Ministry of Health; Icelandic Director General of Health; Icelandic Cancer Society; City of Reykjavík; and the Association of Health Personnel, Iceland.

### CANCER

Occupational exposures are thought to account for about 5% of human cancer in developed countries [Harvard Report on Cancer Prevention, 1996], but this estimate was derived from research that focused almost entirely on men and on exposures sustained in the 1950s and 1960s [Zahm et al., 1994]. Since the 1950s, there have been dramatic changes in the employment patterns of women, which may have increased the role of occupational cancers among women. Many more women are in the workforce, the number of years spent working outside the home has increased, and more women are employed in jobs that may involve hazardous exposures. More thorough evaluation of cancer risk among working women and reassessment of the proportion of their cancer burden attributable to occupation is needed.

Aaron Blair, a keynote speaker from the National Cancer Institute, USA, reviewed previously reported associations between cancer and occupational exposures among women [Blair et al., 1999]. He noted that while it is reasonable to assume that substances that cause cancer among men will be carcinogenic in women, there are several reasons to study women specifically, and not rely only upon data on men. For example, breast and gynecologic cancers cannot be studied among men. Also, gender differences in exposures, metabolism, susceptibility, and interactions underscore the need for investigations specifically focused on

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women. Blair described methodologic issues related to study size, disease classification, exposure assessment, vital status determination, and confounding factors that pose challenges and may require innovative approaches in studies of occupational cancer among women.

Several of the conference presentations evaluated the role of occupational exposures in the development of breast cancer. Increased risk was reported among women exposed to organic solvents [Hansen, 1999; Weiderpass et al., 1999], as well as ionizing radiation, asbestos, and man-made vitreous fibers [Weiderpass et al., 1999]. The hypothesis that electromagnetic fields may increase the risk of breast cancer was supported by a study from Norway [Kliukiene et al., 1999], but not in a study from Sweden [Forssén et al., 1998]. Labrèche and Goldberg [1998] reported associations between breast cancer and service occupations, such as food and beverage preparation and serving, child care, dry-cleaning and pressing, janitors, and charworkers. Excess breast cancer was reported among health care workers in two reports based on death certificate data from the US [Burnett et al., 1999; Petralia et al., 1999]. A breast cancer cluster among nurses in Hungary led to an evaluation of risk associated with occupational exposure to ethylene oxide and environmental exposure to radioactivity in the local drinking water supply [Tompá et al., 1998]. A deficit of breast cancer was observed among female agricultural workers in two studies from Italy [Settimi et al., 1999; Sperati et al., 1999].

Vasama-Neuvonen et al. [1999] reported positive associations between ovarian cancer and occupational exposure to organic solvents, leather dust, asbestos, man-made vitreous fibers, and diesel and gasoline engine exhaust, as well as employment as a hairdresser. Ovarian cancer was linked to the printing industry, which involves exposure to solvents and dusts, in two reports [Vasama-Neuvonen et al., 1999; Bulbulyan et al., 1999], and the paper and pulp industry [Langseth and Andersen, 1999]. Nurses, physicians, pharmacists, and radiologic technologists had greater than expected mortality from ovarian cancer [Petralia et al., 1999], as did Italian women compensated for asbestosis [Germani et al., 1999].

Occupational exposures were found to be responsible for a sizable fraction of lung cancer among non-smoking women in Europe [Boffetta et al., 1999]. A German study reported elevated risk of lung cancer associated with numerous industries such as the chemical, oil, pottery, glass, vehicle manufacturing, paper, printing, cleaning service, as well as selected occupations, such as assemblers, metal workers, stock clerks, hairdressers, and restaurant workers [Jahn et al., 1999]. Agricultural workers in Italy had an elevated risk of lung cancer in one study [Settimi et al., 1999], but a decreased risk in another [Sperati et al., 1999]. Agricultural exposure was not found to increase risk of glioma in Nebraska women [Heineman et al., 1998]. Women exposed to silica [Fillmore et al., 1999] or asbestos [Ger-

mani et al., 1999] had an elevated risk of lung cancer in addition to non-malignant respiratory diseases. Mesothelioma was elevated among women in the asbestos-cement industry in Poland [Szeszenia-Dabrowska et al., 1998]. Women in the nickel alloy industry did not have any excess of lung cancer or other malignancies [Arena et al., 1999].

Leukemia and other lymphatic and hematopoietic malignancies are commonly linked to occupational exposures. At this conference, increased risks of these malignancies were reported among female agricultural workers [Sperati et al., 1999], clinical laboratory workers [Burnett et al., 1999; Petralia et al., 1999], nurses and pharmacists [Petralia et al., 1999], and hairdressers, textile workers, teachers, and housewives [Miligi et al., 1999].

Data on other malignancies were reported in one or two studies each. Renal cell carcinoma was associated with exposure to organic solvents and chlorinated aliphatic hydrocarbons, particularly trichloroethylene, among women, but not men, in a case-control study from Minnesota [Dosemeci et al., 1999]. The gender differences may be chance findings based on small numbers or may be due to differences between men and women in body fat content, metabolic activity, rate of elimination from the body, or level of exposure, even within the same job title. The risk of esophageal cancer was elevated among women with possible silica exposure in the US [Fillmore et al., 1999] and among women in the printing industry in Russia [Bulbulyan et al., 1999]. Moderate excess of cancers of the central nervous system was found among US women potentially exposed to methylene chloride, insecticides, fungicides, electromagnetic fields, and contact with the public [Cocco et al., 1999]. Lead exposure was linked to an elevated risk of meningioma [Cocco et al., 1999]. Brain cancer was also elevated among women employed in the pulp and paper industry in Poland [Szeszenia-Dabrowska et al., 1998] and stomach cancer was related to occupational activities, occupational exposure, and various life-style factors [Tobiasz-Adamczyk et al., 1998].

Papers on methodologic issues related to occupational cancer among women included evaluations of the healthy worker effect and of the potential confounding effect of smoking in occupational studies. There was no general healthy worker effect for cancer incidence among Swedish women [Gridley et al., 1999]. Cancer risks were highest among full-time workers, younger workers, urban workers, and workers with the highest socioeconomic status, based on the women's job title. A study on gender differences among man-made vitreous fiber workers showed that men exhibited a stronger healthy hire effect and time-since-hire effect, while women had a much stronger survivor effect than men [Lea et al., 1998]. Smoking did not appear to be a major confounder in occupational studies of bladder cancer [t Mannelje et al., 1999a]. Differences in the proportion of sinonasal cancer attributable to smoking and occupation

varied between men and women as a result of the gender differences in the prevalence of these exposures [t Mannetje et al., 1999b].

## REPRODUCTION

Marja-Liisa Lindbohm from the Finnish Institute of Occupational Health presented recent developments and methodologic issues in her keynote address on women's reproductive health and occupation [Lindbohm, 1999]. Traditionally, research evaluated pregnancy outcome. Recently, research has focused on fertility, including time to pregnancy. These outcomes are considered more sensitive indicators of reproductive health and may help identify more exposures with adverse effects. Future research will probably incorporate hormonal indicators of early pregnancy loss and menstrual cycle characteristics. Exposures of interest have expanded from the chemical and physical agents traditionally studied to include other agents such as psychosocial stress. Lindbohm emphasized the importance of exposure assessment along with validation of exposures and outcomes.

The conference presentations assessed several reproductive outcomes, including time to pregnancy [Taskinen et al., 1999; Sallmén et al., 1998], spontaneous abortion [Sallmén et al., 1998], pre-term birth [Saurel-Cubizolles et al., 1998], and small size-for-gestational-age (SGA) [Seidler et al., 1999; Eriksson et al., 1998], plus methodologic research on the concordance between spouses on variables related to reproduction [Petrelli et al., 1998], such as date of marriage, children's birth dates, pregnancy planning, and time to pregnancy. Delayed time to pregnancy was observed among Finnish female wood workers exposed to formaldehyde [Taskinen et al., 1999] and among Finnish women exposed to organic solvents [Sallmén et al., 1998]. Both maternal and paternal exposure to organic solvents were associated with spontaneous abortions [Sallmén et al., 1998]. A multicenter case-control study in 16 European countries found a small but significant elevation in risk of pre-term birth among employed women with long working hours, long hours of working in a standing position, and a high level of job dissatisfaction [Saurel-Cubizolles et al., 1998].

Risk factors for SGA were evaluated in a few studies. A cohort study from Germany revealed an increased risk of SGA births related to organic solvent exposure [Seidler et al., 1999]. A slight increase in risk of having an SGA baby was observed among female hairdressers in a Swedish study [Eriksson et al., 1998], and heavy physical work was an independent risk factor of SGA in a Polish study [Hanke et al., 1999].

## ADMINISTRATIVE DATABASES

Karen Dunnell from the Office for National Statistics in the UK was invited to speak on the uses of administrative

databases to evaluate aspects of women's life and work in relation to health [Dunnell et al., 1999]. She demonstrated the value of assembling data from censuses, surveys, vital registrations, and health service records to describe inequalities in health between different groups. Data on economic activity, education, socioeconomic status, and family status were selected to show how these factors related to health indicators and outcomes. Problems with measuring the social class of women were discussed, and the use of deprivation indices illustrated. The importance of linking data in an efficient, but secure, way was discussed.

Cancer surveillance databases from the Nordic countries [Andersen et al., 1998], the UK [Simpson et al., 1999], Italy [Pirastu et al., 1999], and the US [Robinson et al., 1999] were presented. Differences in data availability in each country affect study design solutions. In the Nordic countries and Italy, population data on incidence or mortality were available, and standardized incidence or mortality ratios could be calculated, while only proportionate mortality ratio data are available from the US. The three European presentations used the same occupational classification scheme, making some comparisons across countries possible. The US study presented data on selected occupations with high proportions of women. Although administrative databases rarely have information on potential confounders, they provide valuable information on the distribution of cancer or other outcomes by occupation, and can serve as important sources for hypothesis generation.

## WOMEN'S HEALTH IN DEVELOPING COUNTRIES

Women's occupational health in developing countries was eloquently described by the fourth invited speaker, Rene H. Loewenson from Zimbabwe [Loewenson, 1999]. She described globalization and its implications for development and for the work and health of women. Quoting the International Labor Organization, she said that women are "half the world's population, receive one tenth of the world's income, account for two-thirds of the world's working hours, and own only one hundredth of the world's property." Despite optimistic assertions of an end to poverty in the 21<sup>st</sup> century, poverty and inequality have in fact increased in many parts of the world in the 1990s. Many women in developing countries have a heavy work burden in low-paying jobs that are held in low esteem. The problems many women face are poorly recognized, poorly studied, and poorly regulated.

## FUTURE DIRECTIONS

This conference demonstrated that the field of research on occupational health among women has advanced. There has been a transition from data generated in secondary

analyses from studies launched primarily for the study of men to data generated by studies designed and conducted specifically to address occupational risks among women. The topics of interest expanded in this conference to include reproduction, with future expansion expected to the fast-developing fields of ergonomics, psychosocial factors, and other areas. Research in developing countries should also be an area of emphasis in the future.

The quality of the research is improving. For example, at the 1993 Baltimore conference, analyses based on general occupational titles or industry groups predominated. Only about 15% of the presentations investigated the effects of specific exposures. At the conference in Iceland, over 60%, or four times as great a proportion as in Baltimore, investigated specific exposures through job-exposure matrices or other information about exposures.

Further methodologic improvements are needed. Larger studies are essential. Most studies are plagued by small numbers of exposed cases. Exposure assessment tools must be developed that consider possible gender differences in tasks, hygiene, and other exposure determinants. Data on potential confounders must be sought, or work done to explore the possible magnitude of their effect on risk estimates. For example, we need efforts to quantify the possible effects of reproductive patterns on occupational cancer risk estimates similar to the efforts that have been made to quantify the possible effects of smoking when smoking data are unavailable.

We believe this conference contributes to the knowledge of occupational health among women, and hope that these proceedings will stimulate the development and testing of new hypotheses in methodologically sound studies. Our desire is for our research to lead to safe and healthful working conditions for every working man and woman.

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