Occupational Cancer Among Women: A Conference Overview

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Over the past several decades, women have become an increasingly important segment of the work force in the United States and worldwide. There are currently over 58 million women in the U.S. work force, accounting for 46% of the civilian workers.[1] With large numbers in the work force and entrance into occupations previously closed to them, women have been encountering long-term exposure to potentially toxic agents in the workplace, thereby increasing their chance of developing cancer. Nevertheless, only a limited number of studies have evaluated the effects of occupational exposures on the risk of cancer among working women.[2]

In recognition of the need to more adequately assess occupational cancer risks among women, the National Cancer Institute (NCI) of the National Institutes of Health (NIH) initiated a two-day international conference on "Women's Health: Occupation and Cancer" held in Baltimore, Maryland, on November 1–2, 1993. The cosponsors of the conference were the National Institute of Environmental Health Sciences (NIEHS), NIH; the Office of Research on Women's Health (ORWH), NIH; and the National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention. The collaboration of these organizations signifies the importance of women's health issues and the commitment of many groups to identifying and reducing cancer risks among working women.

The planning committee,* comprising representatives from the sponsoring organizations, developed a comprehensive program to encourage health professionals and scientists from around the world to attend the

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conference and exchange information on occupationally related cancer risks among women. The main objectives of the conference were:

1. To present new data on the occupational cancer risks among women
2. To clarify the methodological problems inherent in studying female workers and suggest ways to overcome such obstacles
3. To identify data resources that can be used to investigate occupational risk factors for cancer among women
4. To define research needs in the field of occupational cancer
5. To stimulate further research on the occupational determinants of cancer among women

To meet these objectives, the planning committee selected 11 invited papers, 20 contributed papers, and 28 posters to be presented at the conference. In addition, a panel of experts was invited to discuss research issues and recommendations for the future.[3]

Opening remarks from officials of the sponsoring agencies and institutes indicated strong support for research on women's health issues. Dr. Samuel Broder, director of the NCI, described recent NCI epidemiological studies which suggest that women and men may, in fact, react differently in certain workplace environments and stated, "Whether these findings represent differences in susceptibility, exposure level or other factors not yet known, they do underscore the need to evaluate men and women from a scholarly point of view, keeping an eye to both differences and similarities." Dr. Broder emphasized that in order to have the most complete picture, all factors that impinge on women in the work force must be evaluated, including known risk factors (eg, smoking, radon, occupational exposures to radiation), multiple types of jobs, fatigue, impact of poverty, competing risks, and competing responsibilities.

Dr. Vivian Pinn, director of the ORWH, stated that the "ORWH is well aware of the role of the workplace in the lives of so many women, and of the tremendous impact it has on their health, their well-being, and their families." She further commented on the fact that historically, the necessity of studying occupationally induced diseases in women often met with neglect, stiff opposition, or even suppression. Dr. Pinn underscored the important contribution to occupational health made by Dr. Alice Hamilton, an early feminist and pioneer in industrial medicine who wrote one of the first reviews on toxic hazards to women. The ORWH plans to use the recommendations from this conference to refine and expand the ORWH research agenda and priorities, to ensure that appropriate research is conducted on the effects of workplace hazards on women of all racial and ethnic groups and their families.

Dr. Terri Damstra described how the NIEHS has recently expanded its research efforts related to women's health issues. Ongoing research stresses interactions between environmental exposures (eg, occupation, diet, lifestyle), intrinsic susceptibility, and various time-related factors. An important area focuses on the function and health effects of environmental estrogens. Dr. Damstra recommended that women occupationally exposed to environmental estrogens be identified and studied for adverse health outcomes, including cancer.

NIOSH is refocusing its efforts in women's health into a more directed, deliberate, and comprehensive program, according to Acting Deputy Director Diane Porter. In addition to increasing its studies of occupational cancer research among women, NIOSH is also intensifying its efforts in surveillance of cancer and other health effects. Under the mandate of the Occupational Safety and Health Act of 1970, NIOSH is responsible for research in all aspects of occupational health among women, including violence, reproductive effects, stress, and musculoskeletal disorders. NIOSH also develops and recommends ways to redesign the workplace through engineering controls and ergonomic designs.

Occupational Cancer Risks

A major goal of the conference was to present new data on the occupational cancer risks among women. Occupational cohort studies based on employment records, union records, or disease compensation registries examined gender differences in cancer risk among benzene-exposed workers in China,[4] cable manufacturing plant workers during World War II,[5] chrysotile textile workers,[6] dry-cleaning workers exposed to perchloroethylene and Stoddard solvent,[7] and waiters and waitresses in Norway.[8] Some interesting new leads surfaced from these and other studies presented, including increased risks of esophageal, bladder, intestinal, and pancreatic cancer among dry-cleaning workers;[7] lung cancer among women in the fur hat industry compensated for mercury poisoning[9]; lung cancer among motor vehicle assembly workers;[10] pancreatic cancer among motor vehicle assembly workers in paint, plastic, and trim departments;[10] and brain cancer among rubber workers and among grain farmers in Shanghai, China.[11]

The relationship between occupation and cancer was explored in several case-control studies where potential confounding effects of established risk factors could be taken into account. Elevated risks were reported for invasive cervical cancer among service workers (maids and cleaners),[12] breast cancer among nursing aides/orderlies,[13] thyroid cancer among dentists/dental assistants,[14] salivary gland cancer among women employed in hairdressing shops, esophageal cancer among restaurant employees, and bladder cancer among computer manufacturing workers.[15]

Several presentations focused on cancer risk and employment in the health care industry, one of the biggest employers of women in the United States. U.S. nurses appeared to be at high risk for leukemia and possibly bladder cancer, especially younger women who are more likely to be exposed to antineoplastic drugs.[16] Among nurses who served in Vietnam, excess pancreatic cancer was observed.[17] An increased risk of breast cancer was reported among nurses in Iceland[18] but not in Washington state[13] or among over 13,000 U.S. nurses identified from the American Cancer Society survey.[16] In a large

cohort of U.S. radiation technologists, breast cancer was not associated overall or with performing any specific radiation procedure.[19]

Methodological Issues

Difficulties in detecting and interpreting occupational associations with cancer risk among women were highlighted in a number of the presentations. Many studies lack detailed work records and information on lifestyle factors (eg, smoking, alcohol, diet), hormonal and reproductive risk factors, socioeconomic status, or other occupational and environmental exposures related to disease outcome that might confound observed associations.

For most studies, the evaluation and quantification of workplace exposures were extremely limited because of the lack of information on job tasks, exposure measurements, or concomitant exposures on the job or at home. Relying on job titles is a crude approach that can result in misclassification of exposure status, dilute risk estimates, and diminish opportunities to identify excess risks. Men and women with the same job title often have quite different duties and therefore different exposures. Studies based on death certificates and medical records have an additional limitation in that a large proportion of women have designated housewife as their usual occupation, despite having worked outside the home.

Most studies of occupation and cancer among women include only a small number of women employed in any single occupation or industry category. The use of job-exposure matrices and other forms of exposure assessment to combine similarly exposed subjects can be used to partially overcome this limitation and can improve the power to detect risks. Only two case-control studies (an interview study of ovarian cancer[20] and a death certificate-based study of breast cancer[21]) presented at the conference included an exposure assessment component. Clearly, studies of occupational cancer among women must be conducted with sophisticated exposure assessment methods that are now often used in studies of men.

Several investigators described difficulties in determining the current vital status of women who worked decades ago. Missing Social Security numbers and changes in surnames were key factors for the high rates of loss to follow-up for female workers. Methods and resources to improve follow-up are needed.

Data Resources

The conference was successful in identifying a number of data resources that can serve as simple and economical tools for generating or testing the hypotheses of occupationally related cancers. Since 1984, the NCI, NIOSH, and the National Center for Health Statistics (NCHS) have supported the coding of the occupational titles and industry information from death certificates in 24 states.[22] This death certificate database, the National Occupational Mortality Surveillance (NOMS) system, was the source of many conference presentations and posters. Some intriguing associations were reported, including increased risks for multiple myeloma among waitresses, hospital maids, and elementary school teachers;[23] for cancers of rectum, connective tissue, breast, corpus uteri, ovary, and brain among telephone industry workers;[24] for lymphatic cancer among drywallers;[25] and for non-Hodgkin's lymphoma among wallpaper hangers.[25]

In Denmark, Sweden, and other Scandinavian countries, the presence of both occupational and health registers with personal identification numbers has greatly facilitated research on occupational health. In these countries, computerized programs have been developed that link national cancer registry data with census and pension data. Linkage studies produced some interesting findings, including excess risks of hematopoietic and lymphoproliferative cancer among women in agriculture and the textile industry in Sweden,[26] liver cancer among Danish dry-cleaning workers,[27] and bladder cancer among Danish hairdressers.[27] Both Canada[28] and Italy[29] have implemented computer-linked surveillance systems for investigating work-related diseases, which have also produced some interesting leads for occupationally related cancer. Excesses of stomach cancer were reported in Canada among cooks and breast cancer in printing/publishing and in electrical equipment manufacturing industries,[28] whereas in Italy, an increased risk of ovarian cancer was noted among metal and clothing workers.[29]

Recent Opportunities and Recommendations

The inclusion of women is an important but typically overlooked component in occupational cancer research. A broad-based, multifaceted approach is urgently needed to improve this situation. High-priority areas for investigation include female-dominated industries such as health care, textile, and service and others where potential carcinogenic exposures are prevalent. Initial emphasis should be placed on the unique opportunities for additional and more complete analysis of data from studies that included both genders but have reported only on men so far. These data sets might provide some new clues to occupational cancer risks that could be pursued by more definitive epidemiological investigations.

Prospective cohort studies with periodic detailed exposure assessment should be considered for certain occupational groups and would meet the needs of the future, particularly in terms of exposure standard-setting. Recently initiated prospective occupational cohort studies include the NCI/NIEHS/EPA Agricultural Health Study[30] and the International Agency for Research on Cancer study of laboratory workers.[31] Whenever feasible, completed retrospective cohort studies should be extended and converted into prospective cohort studies.

Quantification of exposure to carcinogens is critical to the design, analysis, and interpretation of occupational cancer studies. Input from industrial hygienists in the design, exposure assessment, and analysis of occupational data is essential. New techniques for exposure assessment should be developed and incorporated into the next generation of studies of

occupational cancer among women. Data on concomitant exposure to other hazards and lifestyle factors, genetic-environmental interactions, socioeconomic status, and social and physical demands need to be obtained and evaluated in conjunction with exposure and occupational analyses on cancer risk.

More extensive data are needed on the physiological differences between men, non-pregnant women, and pregnant women that influence toxicokinetics (eg, body composition and surface areas, metabolism, and structure and function of organ systems). Animal studies, which can complement epidemiological studies, are ideal for identifying gender differences in cancer risk, since both sexes are studied under identical environmental conditions. Recently, rapid advances in molecular biology and genetics have made it possible to begin to identify and measure the critical events in multistage carcinogenesis.

Data resources should be improved to facilitate the study of occupational risks among women by including information on previous surnames and tobacco use and more extensive information on occupation. In addition, alternatives to the use of hospital records as the source of occupational information in cancer registries need to be considered to improve the value of registries in occupational cancer research. In Scandinavian countries, cancer registries do not collect occupational information, but are able to obtain the data by linkages with other relevant databases. Finally, education and awareness programs on the OSHA guidelines for exposures to hazards, such as pharmaceuticals and other chemicals in the health care setting, should be established to help minimize the exposure of women to these agents.

There was universal agreement among participants at this conference that there is a critical need to stimulate further research on occupational cancer among women. The information gained from such studies should increase our knowledge about environmental carcinogens and cancer etiology in general, and will ultimately benefit all workers and the general population.

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