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TABLE OF CONTENTS

ABSTRACT

Background:
Breast cancer is the most commonly diagnosed cancer among women in Massachusetts (excluding non-melanoma skin cancers). The age-adjusted incidence rate increased by approximately 43% from 1982 to 1998. Although there are many well-established risk factors for breast cancer, they cannot explain most cases of breast cancer, and occupational exposures have not been fully explored.

Methods:
Subjects were identified through the Massachusetts Cancer Registry. The study group (N=44,363) was limited to cancer cases diagnosed between 1982 and 1992 (the years for which industry/occupation information was complete) among women at least eighteen years old with known occupations. A case-referent study design was utilized. Cases included all non-lymphoma breast cancer cases, and referents included all other known cancer cases. Two Mantel-Haenszel odds ratios (ORs) and their 95% confidence intervals were computed for selected occupations and occupational groups: one controlling for age, and the other controlling for age and restricting by socioeconomic status (SES), which was determined by the previously published Nam-Powers scores. Excess numbers of cases were calculated as an indicator of the public health importance of a given occupation or occupational group.

Results:
There were 15,549 cases and 28,814 referents. Cases were slightly younger and at a slightly higher SES than referents. Most ORs did not differ appreciably from one. In general, age-adjusted ORs greater than one were observed among women in higher SES occupations, whereas most of the decreased risks were associated with lower SES. Teachers, office workers and health care workers had the highest numbers of excess cases of breast cancer. Billing clerks (OR=2.46; $p<0.001$), radiologic technicians (OR=1.93; $p<0.05$), and pressing machine operators (OR=1.47; $p=0.07$) are examples of occupations with elevated risks of breast cancer.

Conclusions:
We found that breast cancer risk varied with reported occupation. SES, an indicator for several breast cancer risk factors, may account for some of the increased risk associated with occupation. Overall, the high-risk occupations were more likely to be sedentary in nature, supporting the association between low physical activity and breast cancer risk. Further etiologic studies are needed to verify the high risks of occupations that cannot be fully explained by SES or physical activity, as well as the high risks of occupations that are exceptions to the high SES/low physical activity rule. Regardless of etiology, common occupations with elevated incidence can be targeted for screening and education.

INTRODUCTION

Breast cancer is the most commonly diagnosed cancer among women in Massachusetts (excluding non-melanoma skin cancers), and recognized as a major public health issue in the Commonwealth. The age-adjusted breast cancer incidence rate among women in Massachusetts increased by approximately 43 percent from 90/100,000 in 1982 to 128.3/100,000 in 1998[1]. (Commonwealth of Massachusetts, 1997 and 2001) Although the increase in incidence appears to have slowed in recent years, the rate of breast cancer in Massachusetts is still higher than the national rate. (Howe *et al*., 2001; Commonwealth of Massachusetts, May 2001) Breast cancer is also of concern because it is the second-leading cause of cancer deaths among women in the Commonwealth. (Commonwealth of Massachusetts, 2002)

Many risk factors have been linked with breast cancer incidence. The most clearly established risk factor is age; the risk of breast cancer increases with age, doubling about every ten years until about age fifty, with a slower rate of increase thereafter. (McPherson *et al*., 2000) Other factors, such as reproductive factors, family history and genetic factors, certain lifestyle factors and socioeconomic status (SES) are also known to be associated with breast cancer. (Threlfall, 1985; Friedenreich *et al*., 2001; Coogan and Aschengrau, 1999; Van Loon *et al*., 1994) Well-established reproductive risk factors include nulliparity (i.e., having no children), delayed first childbirth, earlier menarche, and later menopause. (Kelsey *et al*., 1993; McPherson *et al*., 2000)

Family history of breast cancer and certain genetic mutations are also well-established risk factors for breast cancer, but these appear to account for only about five to ten percent of

[1] The incidence rate for 1999 was available, however it cannot be compared to previous years' incidence rates due to the utilization of different methods of age-adjustment.

breast cancer cases, disproportionately affecting younger women. (McPherson, 2000; Wiseman, 2000) Family history of ovarian cancer has been identified as a possible risk factor as well. (McPherson, 2000) Personal history of breast cancer or benign breast disease (e.g., severe atypical epithelial hyperplasia) is also a contributing factor. (McPherson, 2000) In addition, women with BRCA1 and BRCA2 mutations have been found to have an increased risk of breast cancer and ovarian cancer. (McPherson, 2000; Radice, 2002)

Lifestyle risk factors for breast cancer include lack of physical activity (Coogan and Aschengrau, 1999; Friedenreich *et al*., 2001), alcohol use (Singletary and Gapstur, 2001), postmenopausal obesity (Greenwald *et al*., 1997), ingestion of a high saturated fat/low fiber diet (Howe *et al*., 1990; Dos Santos Silva *et al*., 2002), and the intake of estrogen in the form of oral contraceptives and hormone replacement therapy (Wiseman, 2000; Colditz and Rosner, 2000; McPherson *et al*., 2000)—though the last two risk factors have not been without controversy. (Terry *et al*., 2001; Marchbanks *et al.*, 2002; Bush *et al.*, 2001)

Socioeconomic status (SES) has been shown to be associated with breast cancer; women with a higher SES have a greater risk of developing breast cancer than do women in lower SES groups. (Van Loon *et al*., 1994) SES is believed to be a surrogate for other breast cancer risk factors. For example, high SES is correlated with advanced education, which is associated with delayed childbirth. Moreover, high-paying jobs tend to be more sedentary, and physical inactivity has been associated with increased breast cancer risk. (Friedenreich *et al*., 2001; Coogan and Aschengrau, 1999)

Several environmental agents have been linked to breast cancer, including pesticides, polychlorinated biphenyls, electromagnetic fields (EMFs), and radiation. (Wolff, 1996; Laden

and Hunter, 1998; Welp *et al*., 1998) For example, organochlorine pesticides such as DDT were investigated in relation to breast cancer incidence, though the results are conflicting.

Since women now constitute a significant fraction of the workforce, studies examining potential occupational risk factors of breast cancer have become more relevant. (Goldberg and Labrèche, 1996) Goldberg and Labrèche reviewed 115 studies published in twenty major journals from 1971 through 1994 to identify occupations associated with increased breast cancer. Among those identified, white-collar managerial occupations and other related professionals, clerical and related jobs, teachers, scientists, nurses and other health professionals, and clergy were more consistently reported. Associations were also found with employment in the pharmaceutical industry, and among cosmetologists, beauticians, chemists, occupations with possible exposure to extremely low frequency EMFs, and occupations with potential exposure to organic solvents.

Although some studies question the association between occupational exposure to EMFs and breast cancer risk (McCurdy, 2001), the association between exposure to organic solvents and breast cancer risk appears stronger. Not only are there proven physiological mechanisms by which organic solvents may cause breast cancer, but the evidence supports the hypothesis that organic solvents may increase the risk of breast cancer. (Labrèche and Goldberg, 1997; Hansen, 1999)

Occupational exposure to ionizing radiation was found to be associated with increased risk for breast cancer among women. (Weiderpass *et al*., 1998) Using job title information from Finnish cancer registry data, Weiderpass *et al*. found that, for premenopausal breast cancer, medium or high levels of occupational exposure to ionizing radiation was associated with a standardized incidence ratio (SIR) of 1.3 (95% confidence interval (CI) 0.7-2.5; trend P = 0.03).

For postmenopausal breast cancer, they found an SIR of 1.2 (1.1-1.3) for low levels of ionizing radiation, and an SIR of 1.4 (1.1-1.8) for medium or high levels of ionizing radiation (trend P = 0.001). However, Boice *et al*. did not find a significant increase in breast cancer incidence among radiologic technicians (Boice *et al*., 1995), though their methodology has been questioned. (Swift *et al*., 1996)

More recently, night shift work was associated with breast cancer risk. (Davis *et al*., 2001; Hansen, 2001) Exposure to artificial light at night due to a lighted bedroom or graveyard-shift work may increase the risk of breast cancer by suppressing the normal nocturnal production of melatonin by the pineal gland, which, in turn, could increase the release of estrogen by the ovaries, thereby increasing tumor promotion. Nurses who work on rotating night shifts at least three nights per month, in addition to days and evenings in that month, appear to have a moderately increased risk of breast cancer after extended periods of working rotating night shifts. (Schernhammer *et al*., 2001) Female flight attendants were also found to have a nearly twofold risk of breast cancer (Pukkala, 1995), and their disturbances in circadian rhythm (due to night work, shift work, and crossing time zones), as well as their exposure to radiation, have been well documented. (Mawson, 1998)

Although there are many contributing causes of breast cancer, the etiologic puzzle is far from complete. Studies have consistently shown that many breast cancer cases cannot be explained by established risk factors. (Seidman *et al*., 1982; Madigan *et al*., 1995; Wiseman, 2000) Even the well-established risk factors of later age at first birth, nulliparity, family history of breast cancer, higher SES, earlier age at menarche, and prior benign breast disease account for just approximately half of the breast cancer incidence. (Madigan *et al*., 1995) The potential links between occupational exposures in particular and breast cancer have not been fully explored.

The present surveillance study based on data collected and maintained by the Massachusetts Cancer Registry was undertaken to examine the potential associations between breast cancer incidence and occupation among women in Massachusetts. This study was also designed to identify high-risk occupational groups, which may be targeted for breast cancer screening, education, and other interventions, regardless of occupational etiology. This hypothesis-generating methodology is warranted because we are attempting to learn of new potential associations which may not otherwise be uncovered using more focused approaches. As such, this study is not designed to ascertain causality—that will be the task of future etiologic studies—but to generate hypotheses regarding high-risk occupations for further etiologic research and preventive intervention.

METHODS

Data

Subjects, all of whom resided in Massachusetts at the time of diagnosis, were identified through the Massachusetts Cancer Registry (MCR), which was established by state law in 1980, implemented in 1982, and has been maintained by the Massachusetts Department of Public Health (MDPH). The MCR is a statewide tumor reporting system requiring all acute care hospitals and licensed clinics in Massachusetts to report all newly diagnosed cases of malignant neoplasms (excluding basal and squamous cell skin carcinomas), within six months of diagnosis. Other reportable diagnoses include benign tumors of the central nervous system (CNS) and neoplasms of uncertain behavior. Although the MCR began collecting data on *in situ* neoplasms diagnosed as of January 1, 1992, *in situ* cases are not included in this report. This practice is consistent with the reporting procedures of both the MCR and the Surveillance, Epidemiology, and End Results (SEER) Program.

Completeness of reporting[2] to the MCR is high, with an estimated ninety percent of all reportable cases included in the MCR during the study period. (Commonwealth of Massachusetts, 1995) Cases that are not reported tend to be those diagnosed in outpatient facilities; melanoma, prostate cancer, leukemia and multiple myeloma tend to be underreported, compared to other types of cancer.

Required reporting variables include name, date of birth, street and town of residence, race, gender, current smoking status, primary site, histology, stage, method of confirmation, and usual occupation and industry. Stages for breast cancer cases were re-categorized by the MCR into the following summary stages: local, regional, distant, and unknown. Reporting facilities

[2] Completeness of reporting has increased; the most recent year of MCR data (1999) is above 95% complete.

assign primary site, histology primary site, and histology codes according to the International Classification of Diseases for Oncology (ICD-O).[3]

Usual occupation is defined as the "type of job the patient has held during most of his/her working life." Industry refers to the "type of business in which the patient works or worked." Although reporting facilities are directed to review the entire medical record for information on the patient's usual occupation and industry, these details are rarely found, and any occupational information, if available, is recorded. (Levy *et al*., 2001) Occupation and industry information for cases reported to the MCR between 1982 and 1992 were coded by National Institute for Occupational Safety and Health (NIOSH)-trained occupational coders at the MDPH, utilizing the 1980 United States Bureau of the Census System. A ten percent sample of adult cases with known occupation and/or industry, diagnosed in 1982 or 1983, was forwarded for external verification to NIOSH, which found less than a five percent coding error rate.

Analysis

The study period was defined as 1982 through 1992, the only years for which coded industry and occupation information was available and complete[4]. The study group was limited to newly diagnosed cancer cases reported to the MCR among women at least eighteen years old at the time of diagnosis. Males were excluded from the study because male breast cancer is a rare condition, with only 1.2 cases/100,000 men in 1992 (Commonwealth of Massachusetts, 1995), and furthermore, male breast cancer may have a different etiology than female breast

[3] During the study period, several facilities assigned International Classification of Diseases-9th Revision (ICD-9) codes, which were converted to ICD-O codes by the MCR.

[4] At the time of the writing of this report, industry/occupation coding was completed for the 1993 and 1994 data, and the I/O coding of the 1995 and 1996 data was in progress.

cancer. (Rudan *et al*., 1995) This is also true for childhood cancers, which is why women younger than eighteen at diagnosis were excluded.

Women who had occupations coded as unknown, retired, housewife, student, volunteer, disabled, or never worked were excluded from the analyses. There were no exclusions based on industry information. Only employed women were included in the study, because we were trying to ascertain potential workplace exposures. There was too much diversity and uncertainty among unknown occupations, so it was necessary to exclude them. Exclusions based on occupation codes represented 69.3 percent of the potential subjects (after the pathological exclusion criteria, described below, were met). This large proportion was mainly attributed to women with unknown occupations (38.7 percent), retired women (30.1 percent), and housewives (26.9 percent). After all exclusions, the final study population size was 44,363 subjects, including cases and referents.

A case-referent design was utilized. Cases were all female breast cancer cases (ICD-O 1st edition: 174.0-174.9, ICD-O 2nd edition: C50.0-C50.9), excluding lymphomas (histology codes 9590-9980). Referents were comprised of all other cancer cases among women, except for those with unknown primary site (ICD-O 1st edition: 199.9, ICD-O 2nd edition: C80.9). Similar proportions of potential cases and referents were excluded from the study (57.3 and 61.6 percent, respectively). The slightly lower percentage of exclusions among cases could be attributed to their younger age at diagnosis (and thus their lower percentage of retired workers).

Women diagnosed with cancers other than breast cancer were chosen as the referent group due to the following considerations: (1) comparable information on the distribution of usual occupation was unavailable for the general population in Massachusetts (Smith *et al*., 1988); (2) they were likely to represent the population from which breast cancer cases arose; and

(3) the manner in which the information on usual occupations was collected was consistent between breast and other cancer groups. The odds ratio of breast cancer for an occupation thus obtained is an estimate of the risk for breast cancer of that occupation as compared to the risk of the referent population, i.e., non-breast cancer patients.

It is important to note that the referent group of our study may not necessarily represent the general population in terms of the distribution of occupations because many occupations are associated with increased or decreased cancer risks. (Goldberg and Labrèche, 1996) Accordingly, the odds ratio for an occupation (or occupational group) estimated in this study should be interpreted with caution. This study is likely to detect occupations that are associated specifically with risks of breast cancer. However, if an occupation is associated with an increased or decreased risk of both breast and non-breast cancers to the same extent, the odds ratio of that occupation will be close to one.

Mantel-Haenszel odds ratios and ninety-five percent confidence intervals (CIs) were calculated to measure associations between occupation and breast cancer. We studied occupations in two ways: individually and grouped. We set a minimum of twenty breast cancer cases for each occupation or occupational group so that our results would have enough power and would have value for screening purposes. Thus, ORs were computed for each individual occupation with at least twenty cases. In addition, occupational groups, made up of individual occupations regardless of size, were based on groupings utilized in previous studies (Davis and Martin, 1990; Coogan *et al*., 1996), and ORs were computed for them. Most of the occupational groups were derived directly from Bureau of Census groupings, while certain occupations with similar activities or exposures were grouped together. Major occupational groups, such as "Sales" were never used, because they were considered to be too broad to be meaningful. In

order to create the occupational group for nuns, the narratives for the occupations of religious workers and clergy were examined.

Two ORs were computed for each occupation and occupational group studied. The first controlled for age, using five-year age groups, except for the extremes of the age range (18-29, and 80 and older), which were each represented by a single stratum. The small numbers of cases in the youngest and oldest age groups warranted this categorization. A second OR was computed, controlling for age and restricting by socioeconomic status (SES).

SES was measured on a scale derived from occupations, based on the median education and income levels of occupations. (Nam and Terrie, 1982) This index, called the Nam-Powers Score, ranges from zero to one hundred, with each score indicating the approximate percentage of people in the experienced civilian labor force who are in occupations having combined average levels of education and income below that for the given occupation. For example, a Nam-Powers score of seventy-three for registered nurses indicates that seventy-three percent of the workforce are in occupations having combined average levels of education and income below that for registered nurses. Data from the 1980 U.S. Census form the basis of the rankings. Adjustment for SES was performed in order to account for the association between social class and important breast cancer risk factors such as parity, age at first pregnancy, and other reproductive health and lifestyle variables.

To account for SES, the occupations were grouped into quartiles (<32, 32-48, 49-72, >72) based on the distribution of Nam-Powers scores in the total study population. Quartile-specific, age-adjusted ORs were calculated. Calculation of an OR for a given occupation or occupational group was restricted to the SES group(s) represented by that occupation or

occupational group. When an occupational group contained occupations in different SES groups, it was compared to other occupations in the comparable SES groups.

Excess numbers of cases, or the numbers of cases above what was expected, were calculated as an indicator of the public health importance of a given occupation or occupational group in targeting for intervention, such as screening or education. They were calculated for occupations and occupational groups with elevated age-adjusted ORs, by multiplying the excess risk of breast cancer by the number of observed cases in a given occupation or occupational group: $\left(\frac{\text{age-adjusted OR} - 1}{\text{age-adjusted OR}}\right) x$ N cases . (Rothman and Greenland, 1998) From a public health perspective, it is important to consider not only the increased risk in a given occupation, but also the number of people affected in that occupation. This number theoretically represents the number of cases preventable by removing all risk associated with the occupation or occupational group in question. It is important to note that reporting on excess numbers of cases is simply a relative ranking of occupations and occupational groups most likely to be impacted by breast cancer, and *not* a causal list.

Analyses were performed using SAS software (SAS version 8.01, Cary, NC). In addition to controlling for age, we also evaluated whether occupational associations varied according to age, by testing for heterogeneity in odds ratios across age strata.

RESULTS

Descriptive

As previously noted, of the subjects included in the study, 15,549 were breast cancer cases, and 28,814 were non-breast cancer referents. The ratio of breast cancer cases to non-breast cancer referents was in line with the cancer distribution for females in the MCR overall during the study period. (Commonwealth of Massachusetts, 1995) The distribution of study subjects by demographic characteristics, smoking status, year of diagnosis, summary stage of breast cancer, and primary site for non-breast cancer cases is presented in Table 1. The study population was relatively homogeneous, consisting mainly of middle-aged, middle-class Caucasian females. The majority of both cases and referents were in the 40-69 year age range at diagnosis, however, breast cancer cases were, on average, slightly younger than the referents, with mean ages of 57.3 years and 59.6 years, respectively ($p<0.0001$). This is due to our exclusion of retired people for whom no occupational information was available, as well as housewives, who had a significantly higher mean age at diagnosis compared to known occupations. Cases and referents were comparable with respect to race, across the nine categories listed in Table 1.

The breast cancer cases had a mean Nam-Powers score (53.5) of more than three points higher than the referents (50.1) ($p<0.0001$). Although the proportion of cases and referents in the middle two SES groups was the same, a larger percentage of cases than referents fell in the highest SES group. This is consistent with previous findings that breast cancer is more common among higher SES women. Cases were also more likely than referents to have never smoked at the time of diagnosis. This may be explained by the inclusion of smoking-related cancers, such as lung cancer, in the referent group (lung cancer made up 18.6 percent of referents).

Approximately ninety percent of referents with lung cancer and known smoking status were ever smokers (either former or current smokers), which was twice the proportion of breast cancer cases in that category (data not shown). When lung cancers were excluded from the referent group, cases and referents were similar with respect to smoking status.

The majority (approximately 58 percent) of breast cancer cases were staged as local, and nearly one-third of all cases were diagnosed at the regional stage. A small percentage of cases (5.5 percent) were staged as distant, and staging was not recorded in less than five percent of cases. Summary stage was not readily available for the non-breast cancer referents. Throughout the study period, the proportion of cases staged as local increased, while the proportion of cases staged as regional or distant decreased. This may be indicative of increased breast cancer screenings, which would result in earlier diagnoses. Breast cancer staging differed by SES, with higher SES cases tending to be diagnosed at an earlier stage than lower SES cases. Cases diagnosed at the local stage had a mean Nam-Powers score (53.5) of more than five points higher than those diagnosed at the distant stage (47.3) ($p<0.0001$). Therefore, the increasing proportion of cases staged as local throughout the study period may also be attributed in part to the increasing proportion of cases in higher SES occupations. This trend of increasing SES and earlier stage diagnosis[5] was also observed among referents. (Commonwealth of Massachusetts, 1997). The entire study population experienced a four-point increase in the mean Nam-Powers score during the study period, from 49.1 in 1982 to 53.1 in 1992.

The increase in the number of both cases and referents over the years during the study period can partially be attributed to more complete reporting, improved detection of cancers, and

[5] An evaluation of staging among all referent cancers was not possible in this study; however, a previous evaluation by the MCR of staging trends for several cancers among women showed a slight increase in early detection during the study period for cervical, ovarian, and uterine cancers. (Commonwealth of Massachusetts, 1997)

increased awareness over time. Although the first three years of the MCR data were notably more sparse, they are included in the analyses because there is little reason to believe that certain occupation-cancer combinations were disproportionately omitted from the MCR.

Case-referent study of breast cancer

Age-adjusted ORs for 109 individual occupations and 85 occupational groups are presented in Tables 2 and 3. To minimize the confounding effect of SES, age-adjusted ORs for occupations limited to the same SES level are also reported (as age-adjusted & SES-restricted ORs). Individual occupations (Table 2) are grouped by SES (four levels), and are listed in order of descending frequency of cases within each SES group. Occupational groups (Table 3) are arranged by major Bureau of Census occupational categories, with some groups comprised of occupations with similar potential for occupational exposures. Indentations represent further sub-groupings.

Most of the ORs calculated did not differ appreciably from one, indicating only slight elevations or reductions in relative risks for breast cancer by occupation. In general, it appeared that age-adjusted ORs greater than one were observed among women in higher SES occupations, while most age-adjusted ORs less than one were observed among women in lower SES occupations. In fact, the percentage of elevated age-adjusted ORs increased from 15 percent in the lowest SES group to 84 percent in the highest SES group, demonstrating the clear association between breast cancer risk and SES. Key findings and some notable exceptions to these general patterns are presented below.

The ten occupations and occupational groups with the highest relative risks of breast cancer, after controlling for age and restricting by SES, are presented in Table 4. In general,

most of the occupations are in the two highest SES groups, and most appear to be white-collar jobs that are sedentary in nature.

Compared to women in other occupations, proofreaders had the highest risk of breast cancer among all occupations and occupational groups studied (OR = 2.61; 95% CI = 1.37-4.99). Chemists (except biochemists) also had over a twofold risk of breast cancer (OR = 2.10; 95% CI = 1.07-4.11) compared to women in other occupations.

Billing clerks also had over a twofold risk of breast cancer (OR = 2.46; 95% CI = 1.45-4.16), and another three of the eleven types of clerks under study were among the ten occupations with the highest risks of breast cancer: traffic, shipping & receiving clerks, personnel clerks, and sales counter clerks. Four other clerking occupations and occupational groups (shown in Tables 2 and 3) were also associated with elevated odds ratios adjusted for age and restricted by SES. Thus, seven out of the eleven types of clerks had elevated risks of breast cancer.

Radiologic technicians, an occupation whose breast cancer risk has previously been studied (Boice et al, 1995; Wang et al, 1990), had almost a twofold increased risk of breast cancer (OR = 1.93; 95% CI = 1.05-3.55). Two other medically related occupations (shown in Table 2) had moderately elevated breast cancer risks: dieticians (OR = 1.39; 95% CI = 0.96-2.01) and physicians (OR = 1.26; 95% CI = 0.93-1.71).

Eight of the nine types of managers or administrators (defined as Bureau of Census codes 003-017 and 019) in the study experienced an elevated risk of breast cancer (see Tables 2 and 3), and three of them were among the ten occupations with the highest relative risks of breast cancer: medicine and health managers, properties and real estate managers, and financial managers.

Pressing machine operators had a nearly fifty percent excess risk of breast cancer (OR = 1.47; 95% CI = 0.97-2.24). Of the twenty-four pressing machine operator cases for whom industry was known, eight worked in the dry cleaning industry, making it the most common industry for that occupation, while another seven pressing machine operators worked in the textile mill products manufacturing industry.

Table 5 lists the ten occupations and occupational groups with the lowest relative risks of breast cancer, after controlling for age and restricting by SES. In general, most of the occupations and occupational groups are in the two lowest SES groups, and most appear to be blue-collar jobs, with high physical activity.

Of all occupations and occupational groups analyzed in this study, shoe machine operators had the lowest risk of breast cancer, with slightly less than two-thirds the risk of breast cancer compared to other occupations in the same SES group (OR = 0.62; 95% CI = 0.44-0.87).

Printing machine operators and motor vehicle operators had the second and third lowest relative risks of breast cancer, respectively. Cases in the printing machine operators group (OR = 0.65; 95% CI = 0.39-1.09) were mainly printing press operators and typesetters. Among motor vehicle operators (OR = 0.67; 95% CI = 0.49-0.91), 35 cases held the occupation of bus driver, which had a breast cancer risk comparable to motor vehicle operators in general (see Table 2). Also among the five occupations and occupational groups with the lowest relative risks of breast cancer were the occupational groups of precision food production (OR = 0.71; 95% CI = 0.43-1.16), most of whom worked as bakers, and mail and message distributing occupations (OR = 0.72; 95% CI = 0.51-1.00), who were mainly mail clerks.

Designers also experienced a decreased relative risk of breast cancer (OR = 0.73; 95% CI = 0.55-0.96). The occupation of designers was quite heterogeneous; some specific occupations represented were florists, interior decorators, clothing designers, and graphic designers.

Two types of technologists and technicians had a moderately low risk of breast cancer: engineering and related technologists and technicians (OR = 0.73; 95% CI = 0.53-1.02), comprised mostly of electrical/electronic technicians and unclassifiable engineering technicians, and clinical laboratory technologists and technicians (OR = 0.79; 95% CI = 0.54-1.16).

Janitors and cleaners had approximately three-quarters the risk of breast cancer compared to occupations in the same SES group (OR = 0.74; 95% CI = 0.51-1.07). Of the individual occupations having at least a twenty-five percent decreased risk of breast cancer, waitresses (OR = 0.77; 95% CI = 0.66-0.91) had the most cases. Waitresses were the most common occupation in the food preparation and service group, which also had a decreased relative risk of breast cancer (see Table 3).

The diverse group of construction trades, except helpers and laborers, which consisted mostly of carpenters and painters, also experienced a decreased risk of breast cancer (OR = 0.77; 95% CI = 0.50-1.18).

Table 6 lists the occupations and occupational groups having at least twenty cases in excess of the number expected in the referent population. More than half (57 percent) of all breast cancer cases arose from three occupational groups: teachers, office workers, and health care workers. Although the relative risks of breast cancer for these occupational groups are only slightly to modestly elevated, they are still of considerable public health importance, due to the large number of women affected, and because they include the most common occupations for women in the Commonwealth and in the United States. In other words, a slight elevation in

breast cancer risk, extrapolated nationally to a large number of women, could have a significant impact.

Teachers had only a modestly elevated risk of breast cancer. However, due to the large number of teachers diagnosed with breast cancer, this occupational group had more excess cases (N = 315) than any other occupational group, as shown in Table 6. Different types of teachers (e.g., elementary school, postsecondary, etc.) experienced similar relative risks of breast cancer, and so were examined as one group.

The two distinct subgroups of office workers also had more than one hundred excess cases of breast cancer. Although executive, administrative, and managerial office workers had fewer cases of breast cancer than administrative support workers did, they had more excess cases due to their higher age-adjusted odds ratios.

Registered nurses and physicians were the two types of health care workers with at least twenty excess cases of breast cancer. Although registered nurses' risk of breast cancer was barely above the null, their large number of breast cancer cases resulted in a high number of excess cases. Physicians experienced the opposite set of conditions, with a very small number of cases but a larger relative risk of breast cancer. As more women become physicians, the public health impact of breast cancer in this group will become larger. Nuns, real estate sales occupations, and librarians also had more than twenty excess cases of breast cancer. It is notable that only half of the occupations and occupational groups listed in Table 6 experienced a twenty-five percent or greater excess in the age-adjusted relative risk of breast cancer.

DISCUSSION

In this case-referent study utilizing Massachusetts Cancer Registry data, we found that breast cancer risk varied with reported occupation. Most of the occupations and occupational groups with elevated risks of breast cancer belong to higher SES groups, and tended to be sedentary in nature, while most of those occupations associated with decreased risks of breast cancer are in lower SES groups, and tended to be labor-intensive. This finding is consistent with the previous reports on the association between breast cancer and SES. (Van Loon *et al*., 1995) Since SES is closely associated with occupation, and is also an independent risk factor for breast cancer, SES confounds the association between occupations and breast cancer incidence. To minimize the confounding effects of SES, cases and referents were compared within the same SES groups as classified by their occupations. (Nam and Terrie 1982) In most cases, as expected, the magnitude of age-adjusted ORs for occupations shifted toward the null when the effect of SES was controlled for. This demonstrates the validity of using Nam-Powers scores to attempt to control for SES. In fact, the Nam-Powers scores may not only account for SES, but for parity and age at first birth as well. Women with a high Nam-Powers score (and thus a high SES) are more likely to be characterized by nulliparity, low parity, or delayed childbirth, than women with a low Nam-Powers score. (Baldwin and Nord, 1984; Bloom and Trussell, 1984; Dos Santos Silva and Beral, 1997)

This study identified numerous occupations and occupational groups having decreased or increased risk of breast cancer even after accounting for SES. The occupational risk not fully explained by SES may be associated with certain characteristics related to that occupation. For

example, the decreased risk of breast cancer for postal clerks[6] in the highest SES group may possibly be explained by their high physical activity on the job. Likewise, the remarkably increased risk for billing clerks and proofreaders in the lower SES groups may be partially explained by their lack of physical activity on the job. However, it is not certain whether the lack of physical activity in these jobs could explain the excessive risk entirely. We examined whether the excess risk of breast cancer observed among billing clerks working in hospitals could be attributed to carcinogens, a potential exposure among other health professionals as well. However, since only a few of them were employed in hospitals, hospital exposures are unlikely to have much effect on the risk. Furthermore, the other hospital-based occupations (except for physicians) did not have as high a risk of breast cancer. If billing clerks' high risk of breast cancer is not due to their occupational hazard, it may be due to the variation by chance in multiple comparisons, or by some other unknown factors.

Although the risk of breast cancer was often higher among the occupations with lower physical activity and in higher SES groups, several occupations are worth noting as exceptions to this general rule. Pressing machine operators may be exposed to dry cleaning agents; at least one of these agents, perchloroethylene, is known to be carcinogenic. (Ruder *et al*., 2001) Barbers, hairdressers and cosmetologists may be exposed to various chemical agents, including hair dye, which has been suspected as being associated with both breast cancer and bladder cancer. (Koenig *et al*., 1991; Skov and Lynge, 1994; Band *et al*., 2000) Interestingly, several occupations in higher SES groups such as designers, clinical pathology technicians, computer programmers, engineering technicians and technologists, authors, musicians and composers, and financial officers had a decreased risk of breast cancer. Since most of those occupations would

[6] Postal clerks do not include mail carriers, who could not be studied separately due to insufficient numbers. However, mail carriers contributed to the low risk of breast cancer in the "postal workers" occupational group.

not appear to have increased physical activities, their decreased risk of breast cancer is noteworthy. One possible explanation is the chance variation arising from multiple comparisons, although we cannot rule out the presence of protective factors specific to those occupations.

Several previous studies have corroborated our overall results. Of the 25 ORs calculated in a recent study of breast cancer risk and occupation (Coogan *et al*., 1996), about 75 percent were in general agreement with our study's ORs, with regards to excess or decreased risk. Several ORs differed by no more than 0.10 between the two studies. Comparison to Coogan's study is highly relevant because cases were derived from cancer registries for both studies, and there was even some overlap among the cases.

Band *et al*. (2000) compared occupations among breast cancer cases in the British Columbia Cancer Registry to those of population referents, and found excess risk for several white-collar occupations. More specifically, increased risk was observed: (1) among pre-menopausal women employed: as electronic data-processing operators; as barbers and hairdressers; in sales and material processing occupations; and in the food, clothing, chemical and transportation industries; (2) among post-menopausal women employed: as school teachers; in medicine, health, and nursing occupations; in laundry and dry-cleaning occupations; and in the aircraft and automotive (including gasoline service stations) industries. Several significant associations were also seen in the combined group of pre- and post-menopausal women, particularly among crop farmers and in the fruit and vegetable, publishing and printing, and motor vehicle repair industries. The researchers suggested that occupations with exposure to pesticides and solvents may have an increased risk of breast cancer. (Band *et al*., 2000)

Pollán *et al*. (1999) studied occupation-specific risks of breast cancer among Swedish women employed in 1970. Excess risks were reported for pharmacists, teachers of theoretical

subjects, schoolmasters, systems analysts and programmers, telephone operators, telegraph and radio operators, metal platers and coaters, and hairdressers and beauticians, as well as for women working in 1960 and 1970 as physicians, religious workers, social workers, bank tellers, cost accountants, and telephonists. They concluded that the high risks observed among professional, administrative, and clerical workers might be related to lower birth rates and increased case detection. (Pollán *et al*., 1999) It is interesting that many of the occupations with increased risks of breast cancer reported in Band's and Pollán's studies were also identified in our study.

In our study, the risk of breast cancer among radiologic technicians was almost twice as high as other occupations within the same SES group. A report based on Finnish census data from 1971 to 1995 indicated that occupational exposure to ionizing radiation may be associated with an increased risk of breast cancer. (Weiderpass *et al*., 1998) Radiologic technicians have been studied repeatedly because of their potential exposure to ionizing radiation. Although initial reports indicated a possible increase in breast cancer incidence and mortality, a larger-scale study failed to show a significantly elevated risk (Boice *et al*., 1995); however, the study's methodology has been questioned. (Swift *et al*., 1996) A recent report suggested that radiologic technicians who worked before 1950, when the exposure to x-rays was not well controlled, had an increased breast cancer mortality risk. (Mohan *et al*., 2002) Our data add an interesting finding to the literature on breast cancer risk for radiologic technicians. In this study, we could not obtain information on the calendar years of work period, however, older radiologic technicians experienced a higher relative risk of breast cancer. It would be interesting to further examine whether the excess risk is only observed among the radiologic technicians in Massachusetts who worked prior to 1950.

Utilization of a population-based database, such as the Massachusetts Cancer Registry, has inherent strengths as well as limitations. The data were readily accessible with few additional costs, and the cancer diagnoses were of high accuracy and completeness. Another strength of the study is that age and SES were accounted for. We have shown that it is possible to use Nam-Powers scores to attempt to control for SES, when better indicators of SES, such as income, education, husband's SES, and Census-tract, are missing.

Information on industry and occupation may not be highly reliable because they are reported in narrative words and coded from the narratives. However, large numbers of cases and referents result in stable estimates for the distribution of most of the major occupational groups as well as many of the individual occupations. Although there were too few women in certain occupations of interest to study, particularly mechanics and construction trades, this will change over time, as more women are employed in traditionally male-dominated jobs. Furthermore, as more years of MCR data becomes available to add to the current study period, the numbers will increase.

Another limitation of this study arising from the use of surveillance data is the inability to account for key confounding factors. (Goldberg and Labrèche, 1996) Since breast cancer occurs at relatively younger ages than other cancers, breast cancer cases had a disproportionately lower percentage of women who were reported as retired at the time of diagnosis. Since we adjusted for age, a proxy for retirement status, this should not have resulted in a bias. Furthermore, the difference in the mean ages of breast cancer cases and referents was too minor to impact the study, and the occupational distribution would be expected to be similar among those ages. However, information on key risk factors, including parity, physical activity, body mass index, family history, alcohol use, etc., as well as confounding external environmental factors, was not

available in the MCR data. Even though we attempted to take age and SES into account by adjusting for age and restricting the data analysis within each SES level, there is likely to be residual confounding by SES. Due to the lack of key variables available in the MCR data, we could not control for income, education, husband's SES, and Census tract, all of which could be major determinants of the subjects' SES.

On the other hand, we might actually have over-controlled for SES, since SES is associated with occupations, and scores of SES were derived from occupation. In other words, we accounted for SES using the crude Nam-Powers scoring system, which is closely associated with occupations. As a consequence, we might have diluted the strength of association attributable to occupation in the analysis, leading to the underestimation of the effect size. SES-restricted results should be interpreted with caution, because of possible residual confounding. In other words, it is possible for two occupations in the same SES group to have different mean parity, thus limiting our control of parity, a major confounder in any study of breast cancer.

A major weakness of this study is potential information bias due to our limited occupational data. The most relevant occupational exposure in relation to cancer occurrence should consider the latency period, which is the duration from the initial exposure to the cancer diagnosis. For solid tumors such as breast cancer, the latency period is generally considered to be ten to thirty years. Therefore, "usual occupation," as collected at the Massachusetts Cancer Registry, is not the best measure of occupational exposure in relation to cancer occurrence. The patient's "usual occupation" may be in fact the most recent occupation, and not necessarily the occupation held the longest, nor the occupation at which the patient was exposed to carcinogens before the latency period. In addition, occupations served as surrogates for occupational exposure in this study. Since there may be a wide variety of tasks in a given occupation, two

women classified in the same occupation may have markedly different exposures. Furthermore, there may have been occupation coding errors. However, since it is highly unlikely that these misclassifications of exposure differ across cancer types and occupations, the results would likely have been biased toward the null, underestimating the true magnitude of occupational risk, if any. Therefore, the associations between occupations and breast cancer incidence might actually be stronger than those reported in this study.

Another problem that arises from the limited occupational data is the potential confounding in assignment of occupation on the basis of preconceptions of profession and occupational risk of cancer. Recall that almost seventy percent of the potential study population was excluded based on occupation codes. Subjects with more professional occupations (e.g., nurses, lawyers) are more likely to be reported as having a classifiable occupation, even if they are not working at the time of diagnosis, compared to subjects with less professional occupations (e.g., retail clerks, waitresses). In other words, non-professionals may be more likely to be classified as retired, unknown, or housewife, compared to professionals. Furthermore, subjects with low-paying jobs may be less likely than subjects with higher-paying jobs to have their occupations recorded by clinicians, because low paying jobs are often not a source of health insurance coverage. A final issue is that certain cancers that are perceived to be occupationally related may be more likely to have an occupation listed. It is important to note that these limitations, especially the exclusion of such a large portion of the potential study population, would not necessarily lead to a systematic bias.

Although the degree of occupational exposure was not measured quantitatively in terms of duration or intensity, information on smoking status was available in the MCR data. However, we chose not to report results controlling for smoking, because smoking has not been

consistently shown to be a risk factor for breast cancer, and thus may not be a significant confounder. In fact, when we compared the results with and without controlling for smoking to determine whether there was any confounding bias, we did not notice any significant changes in odds ratios. Therefore, positive findings in our results are not likely to be attributable to uncontrolled confounding bias by smoking.

We did not exclude non-Caucasians or Caucasians of Hispanic ethnicity as a way of controlling for race, because their small proportion (6.5 percent) in this study would have had an insignificant effect on the results. In previous reports, it was shown that African Americans have a lower breast cancer incidence than Caucasians, but that their mortality rate is significantly higher. (Commonwealth of Massachusetts, 2002) This phenomenon is considered to result in part from the higher proportion of African-American women diagnosed at a more distant stage than their Caucasian counterparts. (Krieger, 2002) This may be attributed to the disparity in health care (particularly access to mammography) between Caucasians and African-Americans, the higher proportion of severe obesity among African-Americans, or to a potentially more histologically aggressive form of breast cancer among African-Americans. (Moorman *et al*., 2001) The relatively higher SES and sedentary occupations among Caucasians might explain the increased incidence of breast cancer among them, though African-Americans are "catching up" to the Caucasians' incidence rate. (Krieger, 2002)

Potential detection bias may be present in this study; higher SES women may have higher mammography rates and thus a greater chance of being diagnosed with breast cancer, as compared to lower SES women, leading to an artificially inflated higher risk of breast cancer. However, since it is highly likely that this increased detection occurs in the same direction across

other types of cancers, the effect of differential detection on our study results is not likely to have been large.

The statistical inference on the ORs reported in this study should take into account the problems arising from multiple comparisons. Since large numbers of ORs have been calculated, several of them would be expected to be significantly away from the null due to chance alone.

The numbers of excess breast cancer cases were presented to provide information about the potential public health impact of these findings. Several points must be borne in mind in interpreting these numbers. These "excess" numbers of cases can be considered "attributable" to the occupation only if a causal association is presumed to exist. Since this study based on surveillance data is not confirmatory for etiological considerations, the numbers of excess cases reported in Table 6 should be used for the limited purpose of priority setting for preventive interventions.

Future work on this study may include an analysis of breast cancer stage by occupation to identify occupations that need improved screening for early detection of breast cancer. In addition, it would provide us with information on the social disparities of access to and utilization of health care services. Analyzing staging by industry could also prove valuable, because screening rates and propensity to be screened may be different by industry. Comparing specific levels of staging in breast cancer and referent cancers may not be a valid approach, since different types of cancer utilize different staging systems. However, it may be of value to design a case-referent study examining metastases versus non-metastases by occupation and industry.

Another proposal could involve controlling for each occupation's level of physical activity since sedentary lifestyle is an established risk factor for breast cancer. Geographic adjustment (county-level or Census tract) of breast cancer risk may also prove useful by helping

to control for SES, as well as for the different screening rates across the Commonwealth. We may also calculate breast cancer relative risks for industry-occupation combinations of interest, such as hospital nurses and elementary/secondary school teachers. Age stratification by probable pre- and post-menopausal status (using age 51) is another proposed method.

An additional area for future research involves developing better statistical methods for identifying which occupations are most likely to warrant further investigation. Current methods rely on measures of association (the odds ratio in this study), confidence intervals, and numbers of cases, and are not well-suited to setting public health priorities. Methods developed in other areas of statistics that use Bayesian approaches to evaluate the weight of evidence provided by data may be applicable to occupational cancer surveillance. This work might permit a better way to set priorities for further research or intervention, incorporating prior evidence of hazards when it exists. Finally, as more recent MCR data with complete industry and occupation coding become available, they can be added to all analyses, thereby increasing the power of the study as well as improving our ability to examine trends.

Increased emphasis on cancer screening in several occupational groups with a high excess risk of breast cancer would appear justified. Among them, health care workers, teachers, and office workers (including managerial/administrative and clerical workers) may be the most important target populations. Recommended public health interventions would include promoting less cancer-prone, healthier lifestyles, minimizing shift work and workplace carcinogens, and encouraging regular screening such as regular checkups and mammography. In addition, occupations with an apparently increased risk identified in this study may be targeted for further study.

Through this study, we have shown that state cancer registry data can be utilized for hypothesis-generating surveillance studies. Our results have given further strength to the notion that occupation may be an important risk factor for breast cancer among women. While we are still trying to solve the complex etiologic puzzle for breast cancer, occupations with significantly elevated risks of breast cancer or high numbers of excess cases may be given higher priority for screening and education. The organizational structure of occupations makes them conducive to such interventions. Occupations can serve as important avenues for intervention because they may be targeted for health promotion activities through employers, unions, professional organizations and trade associations, as well as through direct outreach to workers themselves.

TABLE 1. Characteristics of Cases and Referents in the Occupational Breast Cancer Study, 1982-1992

	Cases		Referents		Total	
	N	%	N	%	N	%
Age group (Years)						
18-29	131	0.8%	1204	4.2%	1335	3.0%
30-34	393	2.5%	947	3.3%	1340	3.0%
35-39	926	6.0%	1157	4.0%	2083	4.7%
40-44	1471	9.5%	1577	5.5%	3048	6.9%
45-49	1956	12.6%	2088	7.2%	4044	9.1%
50-54	1832	11.8%	2633	9.1%	4465	10.1%
55-59	1990	12.8%	3542	12.3%	5532	12.5%
60-64	2138	13.8%	4097	14.2%	6235	14.1%
65-69	1701	10.9%	3654	12.7%	5355	12.1%
70-74	1262	8.1%	3106	10.8%	4368	9.8%
75-79	937	6.0%	2432	8.4%	3369	7.6%
80+	812	5.2%	2377	8.2%	3189	7.2%
Mean Age	*57.3*	----	*59.6*	----	*58.8*	----
Race						
Caucasian of Spanish origin or Surname	74	0.5%	128	0.4%	202	0.5%
Caucasian, not otherwise specified	14540	93.5%	27079	94.0%	41619	93.8%
Black, including Haitian and Cape Verdean	385	2.5%	718	2.5%	1103	2.5%
American Indian or Alaskan Native	5	0.0%	11	0.0%	16	0.0%
Chinese	32	0.2%	69	0.2%	101	0.2%
Japanese	2	0.0%	8	0.0%	10	0.0%
Other Asian or Pacific Islander	31	0.2%	54	0.2%	85	0.2%
Other non-white	29	0.2%	55	0.2%	84	0.2%
Unknown	451	2.9%	692	2.4%	1143	2.6%

TABLE 1 (Continued)

	Cases		Referents		Total	
	N	**%**	**N**	**%**	**N**	**%**
Socioeconomic Level[a]						
1	3332	21.4%	7587	26.3%	10919	24.6%
2	3170	20.4%	6157	21.4%	9327	21.0%
3	3593	23.1%	6428	22.3%	10021	22.6%
4	5454	35.1%	8642	30.0%	14096	31.8%
Mean Nam-Powers Score	*53.5*	----	*50.1*	----	*51.3*	----
Smoking Status						
Never smoked	7327	47.1%	11345	39.4%	18672	42.1%
Former smoker	2446	15.7%	5149	17.9%	7595	17.1%
Smoker at time of diagnosis	3512	22.6%	8678	30.1%	12190	27.5%
Unknown	2264	14.6%	3642	12.6%	5906	13.3%
Year of diagnosis						
1982	852	5.5%	1657	5.8%	2509	5.7%
1983	1003	6.5%	1976	6.9%	2979	6.7%
1984	1199	7.7%	2604	9.0%	3803	8.6%
1985	1507	9.7%	2848	9.9%	4355	9.8%
1986	1571	10.1%	2722	9.4%	4293	9.7%
1987	1549	10.0%	2795	9.7%	4344	9.8%
1988	1549	10.0%	2873	10.0%	4422	10.0%
1989	1535	9.9%	2837	9.8%	4372	9.9%
1990	1481	9.5%	2710	9.4%	4191	9.4%
1991	1628	10.5%	2958	10.3%	4586	10.3%
1992	1675	10.8%	2834	9.8%	4509	10.2%
Summary stage of cancer[b,c]			N/A		N/A	
Local	9001	57.9%				
Regional	4962	31.9%				
Distant	855	5.5%				
Unknown	731	4.7%				

TABLE 1 (Continued)

	Cases		Referents		Total	
	N	**%**	**N**	**%**	**N**	**%**
Primary site	N/A				N/A	
Lung, bronchus and trachea			5364	18.6%		
Colon			3862	13.4%		
Corpus uteri			2561	8.9%		
Ovary			2231	7.7%		
Lymph nodes			1431	5.0%		
Cervix uteri			1206	4.2%		
Skin			1184	4.1%		
Hematopoeitic & reticuloendothelial			1079	3.7%		
Rectum			933	3.2%		
Bladder			871	3.0%		
Pancreas			866	3.0%		
Brain			771	2.7%		
Thyroid			748	2.6%		
Stomach			646	2.2%		
Kidney, except pelvis			639	2.2%		
All Others			4422	15.3%		
Total	15549	35.0%	28814	65.0%	44363	100.0%

[a] SES levels (1=lowest, 4=highest) were based on quartiles of Nam-Powers scores in the study population.

[b] Summary stage was available for breast cancer cases only.

[c] *In situ* cancers were previously excluded by the MCR until 1992

TABLE 2. Adult Female Breast Cancer Risk by SES Level[a]: Odds Ratios for 109 Individual Occupations

Occupation (1980 Bureau of Census Code)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
SES Level 1			
Sales workers, other commodities (274)	538	0.98 (0.88-1.09)	1.18 (1.05-1.32)*
Nursing aides, orderlies & attendants (447)	344	0.80 (0.70-0.91)*	0.95 (0.83-1.09)
Textile sewing machine operators (744)	262	0.90 (0.78-1.04)	1.06 (0.91-1.24)
Waitresses (435)	218	0.66 (0.57-0.78)*	0.77 (0.66-0.91)*
Hairdressers & cosmetologists (458)	188	1.02 (0.85-1.23)	1.22 (1.01-1.47)*
Miscellaneous food preparation (444)	184	0.91 (0.76-1.08)	1.08 (0.90-1.29)
Laborers, except construction (889)	170	0.72 (0.60-0.86)*	0.83 (0.70-1.00)*
Cashiers (276)	160	0.87 (0.72-1.05)	1.03 (0.85-1.26)
Personal services, n.e.c. (469)	127	0.86 (0.70-1.06)	1.01 (0.82-1.26)
Maids (449)	101	0.84 (0.66-1.07)	1.00 (0.78-1.27)
Cooks, except short order (436)	95	0.76 (0.60-0.96)*	0.88 (0.69-1.13)
Electrical & electronic equipment assemblers (683)	74	0.91 (0.69-1.22)	1.09 (0.82-1.45)
Dressmakers (666)	58	0.95 (0.70-1.30)	1.11 (0.81-1.52)
Laundering & dry cleaning machine operators (748)	55	0.80 (0.58-1.10)	0.94 (0.68-1.30)
Hand packers & packagers (888)	55	0.99 (0.71-1.38)	1.17 (0.84-1.65)
Child care workers, except private household (468)	54	1.00 (0.72-1.41)	1.20 (0.85-1.69)
Private household cleaners & servants (407)	51	1.04 (0.74-1.47)	1.23 (0.87-1.73)
Packaging & filling machine operators (754)	48	0.88 (0.62-1.25)	1.04 (0.74-1.48)
Shoe machine operators (745)	43	0.54 (0.39-0.76)*	0.62 (0.44-0.87)*
Janitors & cleaners (453)	40	0.63 (0.43-0.90)*	0.74 (0.51-1.07)
Pressing machine operators (747)	37	1.24 (0.82-1.89)	1.47 (0.97-2.24)
Bus drivers (808)	35	0.56 (0.38-0.83)*	0.68 (0.46-1.00)
Supervisors, food preparation & service (433)	27	0.88 (0.55-1.39)	1.04 (0.65-1.66)
Stock handlers & baggers (877)	25	0.67 (0.42-1.07)	0.80 (0.50-1.27)
Child care workers, private household (406)	23	0.86 (0.52-1.41)	1.00 (0.61-1.64)
Sales workers, apparel (264)	21	0.78 (0.46-1.30)	0.92 (0.55-1.55)
Sales counter clerks (275)	21	1.11 (0.64-1.91)	1.31 (0.76-2.26)

TABLE 2 (Continued)

Occupation (1980 Bureau of Census Code)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
SES Level 2			
General office clerks (379)	899	1.02 (0.93-1.11)	1.06 (0.97-1.17)
Bookkeepers, accounting & auditing clerks (337)	565	1.01 (0.91-1.13)	1.06 (0.94-1.18)
Assemblers (785)	191	0.93 (0.78-1.11)	0.97 (0.81-1.17)
Machine operators, not specified (779)	173	0.85 (0.71-1.02)	0.86 (0.71-1.04)
Telephone operators (348)	145	0.84 (0.69-1.03)	0.86 (0.70-1.05)
Production inspectors, checkers & examiners (796)	136	0.91 (0.74-1.12)	0.95 (0.77-1.17)
Receptionists (319)	131	0.94 (0.76-1.17)	0.99 (0.79-1.24)
Typists (315)	89	1.18 (0.90-1.55)	1.24 (0.95-1.64)
Bank tellers (383)	80	0.88 (0.67-1.15)	0.93 (0.70-1.22)
Teachers' aides (387)	78	1.08 (0.80-1.44)	1.15 (0.86-1.55)
Data-entry keyers (385)	77	1.00 (0.75-1.34)	1.07 (0.80-1.44)
Miscellaneous machine operators, n.e.c. (777)	68	0.95 (0.70-1.27)	0.99 (0.73-1.33)
Health aides, except nursing (446)	66	0.94 (0.69-1.27)	0.98 (0.72-1.34)
Stock & inventory clerks (365)	51	1.00 (0.70-1.41)	1.04 (0.73-1.48)
Billing clerks (339)	34	2.32 (1.37-3.93)*	2.46 (1.45-4.16)*
Traffic, shipping & receiving clerks (364)	31	1.55 (0.94-2.54)	1.62 (0.99-2.66)
Dental assistants (445)	29	1.18 (0.73-1.90)	1.23 (0.76-1.99)
Bartenders (434)	27	0.83 (0.52-1.34)	0.89 (0.55-1.44)
Military (905)	25	0.88 (0.55-1.41)	0.89 (0.56-1.43)
Proofreaders (384)	21	2.58 (1.35-4.94)*	2.61 (1.37-4.99)*
SES Level 3			
Secretaries (313)	1653	1.08 (1.01-1.15)*	1.06 (0.97-1.15)
Supervisors & proprietors, sales (243)	190	0.90 (0.75-1.07)	0.86 (0.72-1.04)
Religious workers (177)	155	1.17 (0.96-1.43)	1.13 (0.92-1.39)
Licensed practical nurses (207)	149	0.93 (0.76-1.13)	0.89 (0.72-1.09)
Librarians (164)	144	1.22 (0.98-1.51)	1.17 (0.94-1.45)
Administrative support, n.e.c. (389)	115	1.06 (0.84-1.35)	1.03 (0.80-1.31)
Teachers, except postsecondary, n.e.c. (159)	94	1.20 (0.92-1.55)	1.16 (0.89-1.50)
Computer operators (308)	75	1.01 (0.76-1.35)	0.98 (0.73-1.32)
Designers (185)	74	0.75 (0.57-0.99)*	0.73 (0.55-0.96)*

TABLE 2 (Continued)

Occupation (1980 Bureau of Census Code)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
SES Level 3 (Continued)			
Painters, sculptors, craft-artists & artist printmakers (188)	68	1.19 (0.87-1.63)	1.16 (0.85-1.60)
Investigators & adjusters, except insurance (376)	65	0.95 (0.70-1.30)	0.93 (0.68-1.27)
Supervisors, precision production (633)	59	0.99 (0.72-1.35)	0.94 (0.69-1.29)
Dieticians (097)	51	1.45 (1.00-2.09)*	1.39 (0.96-2.01)
Personnel clerks, except payroll & timekeeping (328)	43	1.56 (1.04-2.36)*	1.50 (0.99-2.26)
Clinical laboratory technologists & technicians (203)	41	0.81 (0.55-1.18)	0.79 (0.54-1.16)
Payroll & timekeeping clerks (338)	36	0.83 (0.56-1.23)	0.79 (0.53-1.18)
Authors (183)	33	0.86 (0.56-1.31)	0.84 (0.55-1.28)
Insurance adjusters, examiners & investigators (375)	27	1.31 (0.80-2.16)	1.30 (0.79-2.15)
Musicians & composers (186)	26	0.88 (0.56-1.38)	0.85 (0.54-1.34)
Radiologic technicians (206)	25	1.93 (1.05-3.55)*	1.93 (1.05-3.55)*
Machinists (637)	24	1.08 (0.65-1.81)	1.04 (0.62-1.73)
Managers, properties & real estate (016)	23	1.67 (0.93-2.99)	1.60 (0.89-2.86)
Buyers, wholesale & retail trade, exc. farm products (029)	23	0.98 (0.59-1.64)	0.96 (0.57-1.61)
Dental hygienists (204)	22	0.95 (0.57-1.58)	0.93 (0.55-1.55)
Supervisors, general office (303)	22	1.16 (0.67-2.02)	1.14 (0.65-1.98)
Production coordinators (363)	20	0.88 (0.51-1.53)	0.86 (0.50-1.50)
SES Level 4			
Teachers, elementary school (156)	1190	1.28 (1.19-1.39)*	1.16 (1.07-1.27)*
Registered nurses (095)	1088	1.04 (0.97-1.13)	0.91 (0.84-0.99)*
Managers & administrators, n.e.c. (019)	902	1.09 (1.00-1.19)	0.95 (0.86-1.04)
Accountants & auditors (023)	218	0.98 (0.83-1.16)	0.86 (0.73-1.02)
Social workers (174)	176	1.06 (0.87-1.28)	0.94 (0.77-1.14)
Real estate sales (254)	146	1.28 (1.03-1.59)*	1.13 (0.91-1.41)
Management related, n.e.c. (037)	112	1.22 (0.95-1.56)	1.07 (0.83-1.38)
Administrators, education & related fields (014)	109	1.24 (0.97-1.60)	1.10 (0.85-1.42)
Postsecondary teachers, subject not specified (154)	87	1.25 (0.95-1.67)	1.10 (0.83-1.47)
Physicians (084)	78	1.42 (1.05-1.93)*	1.26 (0.93-1.71)
Insurance sales (253)	66	1.16 (0.85-1.60)	1.03 (0.75-1.42)
Teachers, secondary school (157)	65	1.00 (0.74-1.36)	0.89 (0.66-1.22)

TABLE 2 (Continued)

Occupation (1980 Bureau of Census Code)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
SES Level 4 (Continued)			
Lawyers (178)	62	1.05 (0.76-1.45)	0.93 (0.67-1.29)
Administrators & officials, public administration (005)	59	1.34 (0.95-1.87)	1.20 (0.86-1.68)
Other financial officers (025)	55	0.93 (0.66-1.30)	0.81 (0.58-1.14)
Editors & reporters (195)	53	1.33 (0.93-1.91)	1.19 (0.83-1.71)
Financial managers (007)	50	1.68 (1.13-2.50)*	1.49 (1.00-2.22)
Psychologists (167)	48	1.24 (0.84-1.82)	1.09 (0.74-1.60)
Technicians, n.e.c. (235)	48	1.08 (0.75-1.56)	0.96 (0.66-1.38)
Operations & systems researchers & analysts (065)	43	1.40 (0.92-2.12)	1.24 (0.81-1.87)
Management analysts (026)	41	1.11 (0.73-1.67)	0.97 (0.64-1.47)
Managers, marketing, advertising & public relations (013)	37	1.57 (1.00-2.48)	1.39 (0.88-2.20)
Personnel & labor relations managers (008)	36	1.68 (1.05-2.70)*	1.47 (0.91-2.36)
Computer programmers (229)	36	0.89 (0.59-1.34)	0.78 (0.51-1.18)
Purchasing agents & buyers, n.e.c. (033)	32	1.05 (0.66-1.65)	0.92 (0.58-1.45)
Managers, medicine & health (015)	31	2.04 (1.20-3.46)*	1.81 (1.06-3.08)*
Postal clerks, except mail carriers (354)	31	0.67 (0.45-1.02)	0.60 (0.40-0.91)*
Personnel, training & labor relations specialists (027)	29	1.21 (0.74-1.96)	1.07 (0.66-1.74)
Counselors, educational & vocational (163)	25	0.99 (0.60-1.65)	0.87 (0.52-1.45)
Electrical & electronic technicians (213)	25	1.01 (0.62-1.65)	0.90 (0.55-1.47)
Electrical & electronic engineers (055)	22	1.03 (0.60-1.77)	0.90 (0.52-1.55)
Sales representatives, mining, manuf. & wholesale (259)	22	1.05 (0.61-1.79)	0.91 (0.53-1.56)
Computer systems analysts & scientists (064)	21	1.49 (0.81-2.74)	1.30 (0.71-2.41)
Chemists, except biochemists (073)	21	2.36 (1.21-4.61)*	2.10 (1.07-4.11)*
Economists (166)	20	1.10 (0.62-1.95)	0.97 (0.55-1.73)
Clergy (176)	20	1.54 (0.84-2.82)	1.37 (0.75-2.50)

n.e.c.: not elsewhere classified

SES: Socioeconomic Status

[a] SES levels, ordered from lowest to highest, were based on quartiles of Nam-Powers scores in the study population.

[b] Adjusted using 5-year age groups (except 18-29, 80+)

[c] Adjusted by age groups and restricted to SES level of occupation under study

* Statistical significance at alpha=.05

TABLE 3. Adult Female Breast Cancer Risk: Odds Ratios for 85 Occupational Groups[a]

Occupational Group (1980 Bureau of Census Codes)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
Executive, administrative & managerial (003-037)	1789	1.15 (1.07-1.22)*	1.04 (0.97-1.12)
Managers & administrators (003-017, 019)	1263	1.18 (1.10-1.28)*	1.08 (1.00-1.17)*
Management related (023-037)	524	1.05 (0.94-1.17)	0.96 (0.85-1.07)
Financial officers (023-025)	276	0.97 (0.83-1.13)	0.85 (0.73-0.99)*
Purchasing agents & buyers (028-033)	55	1.00 (0.71-1.41)	0.92 (0.66-1.30)
Professional specialties (043-199)	3935	1.18 (1.13-1.24)*	1.12 (1.07-1.18)*
Engineers (044-059)	49	1.09 (0.76-1.58)	0.96 (0.66-1.38)
Health care workers (015, 078, 083-106, 133, 203-208, 223, 445-447)	2045	1.00 (0.94-1.06)	1.00 (0.94-1.06)
Managerial & professional health care workers (015, 078, 083-106, 133, 207)	1493	1.07 (1.00-1.14)	0.97 (0.90-1.04)
Health diagnosing (084-089)	88	1.36 (1.02-1.80)*	1.20 (0.90-1.60)
Health assessment & LPNs (095-106, 207)	1356	1.04 (0.97-1.12)	0.95 (0.88-1.02)
Nurses (095, 207)	1237	1.03 (0.96-1.11)	0.94 (0.87-1.01)
Health assessment & treatment, exc. nurses (096-106)	119	1.17 (0.92-1.48)	1.08 (0.85-1.36)
Therapists (098-105)	56	0.97 (0.70-1.36)	0.90 (0.64-1.26)
Teachers (113-159)	1484	1.27 (1.18-1.36)*	1.17 (1.09-1.26)*
Teachers, Postsecondary (113-154)	113	1.25 (0.98-1.60)	1.15 (0.89-1.47)
Non-science teachers, postsecondary (118-129, 135, 137-154)	110	1.33 (1.03-1.71)*	1.22 (0.94-1.57)
Teachers, except postsecondary (155-159)	1371	1.26 (1.17-1.36)*	1.17 (1.08-1.26)*
Librarians & archivists (164-165)	150	1.23 (0.99-1.51)	1.13 (0.91-1.39)
Social, recreation & religious workers (174-177)	359	1.13 (0.99-1.29)	1.07 (0.94-1.22)
Clergy & religious workers (176-177)	175	1.20 (1.00-1.45)	1.12 (0.93-1.35)
Nuns (based on narratives from 176-177)	126	1.35 (1.08-1.69)*	1.26 (1.00-1.57)*
Lawyers & judges (178-179)	64	1.05 (0.76-1.44)	0.93 (0.67-1.28)
Writers, artists, entertainers & athletes (183-199)	312	0.97 (0.84-1.12)	0.92 (0.80-1.06)
Writers (183, 184, 195)	94	1.08 (0.83-1.40)	1.00 (0.77-1.29)
Entertainers (186, 187, 193, 194, 198)	53	0.95 (0.68-1.31)	0.90 (0.65-1.25)

TABLE 3 (Continued)

Occupational Group (1980 Bureau of Census Codes)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
Technicians & related support (203-235)	434	0.97 (0.86-1.10)	0.89 (0.79-1.01)
Health technologists & technicians (203-208)	261	0.97 (0.83-1.13)	0.93 (0.79-1.09)
Engineering & related technologists & technicians (213-218)	52	0.80 (0.57-1.11)	0.73 (0.53-1.02)
Technicians, except health, engineering & science (226-235)	105	0.99 (0.77-1.26)	0.91 (0.71-1.16)
Sales (243-285)	1227	0.98 (0.91-1.05)	0.98 (0.91-1.05)
Sales representatives, finance & business services (253-257)	237	1.22 (1.03-1.45)*	1.08 (0.91-1.29)
Sales representatives, commodities except retail (258-259)	24	1.15 (0.68-1.94)	1.00 (0.59-1.69)
Sales workers, retail & personal services (263-278)	764	0.93 (0.85-1.02)	0.99 (0.90-1.09)
Administrative support, including clerical (303-389)	4464	1.03 (0.99-1.08)	1.03 (0.99-1.08)
Computer workers (064, 229, 304, 308, 309, 385)	211	1.01 (0.85-1.21)	0.96 (0.81-1.15)
Computer equipment operators (304, 308, 309)	77	1.00 (0.75-1.34)	0.92 (0.69-1.22)
Secretaries, stenographers & typists (313-315)	1756	1.08 (1.01-1.15)*	1.10 (1.02-1.17)*
Information clerks (316-323)	163	0.91 (0.75-1.11)	0.86 (0.70-1.04)
Financial records processing (305, 337-344)	651	1.02 (0.92-1.12)	0.96 (0.87-1.06)
Financial records processing, except supervisors (337-344)	642	1.02 (0.93-1.13)	1.02 (0.92-1.13)
Postal workers (017, 354-356)	50	0.70 (0.51-0.98)*	0.67 (0.48-0.93)*
Postal service workers (017, 354-355)	40	0.71 (0.49-1.02)	0.63 (0.44-0.92)*
Mail & message distributing (354-357)	50	0.71 (0.51-0.99)*	0.72 (0.51-1.00)*
Material recording, scheduling & distributing clerks (359-374)	120	1.01 (0.80-1.27)	1.02 (0.81-1.28)
Adjusters & investigators (375-378)	97	1.00 (0.78-1.29)	0.98 (0.76-1.26)
Miscellaneous administrative support (379-389)	1277	1.02 (0.95-1.10)	1.02 (0.94-1.11)

TABLE 3 (Continued)

Occupational Group (1980 Bureau of Census Codes)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
Services (403-469)	1720	0.82 (0.78-0.88)*	0.82 (0.78-0.88)*
Cooks (404, 433, 436, 437)	125	0.78 (0.63-0.96)*	0.92 (0.74-1.13)
Child care workers (406, 468)	77	0.95 (0.72-1.26)	1.13 (0.85-1.50)
Protective services (006, 413-427)	67	0.95 (0.70-1.29)	0.95 (0.70-1.29)
Police & detectives (414, 418-424)	28	0.91 (0.57-1.46)	0.84 (0.53-1.34)
Guards (415, 425-427)	34	0.99 (0.64-1.52)	1.00 (0.65-1.54)
Services, except protective & household (433-469)	1563	0.82 (0.77-0.87)*	0.82 (0.77-0.87)*
Food preparation & service (433-444)	563	0.76 (0.69-0.84)*	0.84 (0.76-0.93)*
Health services/Health care aides (445-447)	439	0.84 (0.74-0.94)*	0.93 (0.83-1.05)
Cleaning, building services, except household (448-455)	146	0.77 (0.63-0.94)*	0.86 (0.70-1.04)
Cleaning services (448, 449, 453)	144	0.77 (0.63-0.94)*	0.86 (0.70-1.04)
Personal services (456-469)	415	0.97 (0.86-1.10)	0.97 (0.86-1.10)
Barbers, hairdressers & cosmetologists (457-458)	193	1.03 (0.86-1.24)	1.15 (0.96-1.38)
Farming, forestry & fishing (473-499)	39	0.78 (0.53-1.15)	0.83 (0.57-1.21)
Farming & related (473-479, 484-489)	37	0.82 (0.55-1.21)	0.87 (0.58-1.28)
Farmers (473-479, 484)	26	0.86 (0.53-1.37)	0.90 (0.56-1.44)
Farm operators & managers (473-476)	21	0.95 (0.56-1.61)	0.94 (0.55-1.59)
Mechanics & repairers (503-549)	36	0.84 (0.56-1.25)	0.84 (0.56-1.25)
Construction trades (553-599, 865, 869)	36	0.80 (0.53-1.19)	0.80 (0.53-1.19)
Construction trades, except helpers & laborers (553-599)	32	0.77 (0.50-1.18)	0.77 (0.50-1.18)

TABLE 3 (Continued)

Occupational Group (1980 Bureau of Census Codes)	N Cases	Age-adjusted OR (95% CI)[b]	Age-adjusted & SES-restricted OR (95% CI)[c]
Precision production (633-699)	323	0.84 (0.74-0.96)*	0.84 (0.74-0.96)*
Precision metalworking (634-655)	41	0.98 (0.67-1.44)	0.98 (0.67-1.44)
Precision textile, apparel & furnishings machine workers (666-674)	77	0.90 (0.69-1.17)	0.98 (0.75-1.28)
Precision textile, apparel & machine workers (666, 667, 673, 674)	71	1.00 (0.75-1.32)	1.09 (0.82-1.45)
Precision food production (686-688)	22	0.64 (0.39-1.05)	0.71 (0.43-1.16)
Machine operators, assemblers & inspectors (703-799)	1191	0.85 (0.79-0.91)*	0.89 (0.83-0.96)*
Machine operators & tenders, except precision (703-779)	817	0.84 (0.77-0.91)*	0.88 (0.81-0.96)*
Printing machine operators (734-737)	20	0.65 (0.39-1.09)	0.65 (0.39-1.09)
Textile & apparel workers (666, 667, 673, 674, 738-744, 749)	383	0.91 (0.80-1.03)	1.00 (0.88-1.13)
Textile, apparel & furnishing machine operators (738-749)	447	0.84 (0.75-0.94)*	0.99 (0.88-1.12)
Textile & apparel machine operators (738-744, 749)	312	0.89 (0.78-1.02)	1.05 (0.92-1.21)
Machine operators, assorted materials (753-779)	324	0.89 (0.78-1.02)	0.94 (0.82-1.07)
Machine operators, n.e.c. (777, 779)	241	0.87 (0.75-1.02)	0.89 (0.76-1.04)
Fabricators, assemblers & hand working (783-795)	225	0.89 (0.76-1.05)	1.00 (0.85-1.17)
Production inspectors, testers, samplers & weighers (796-799)	149	0.90 (0.73-1.09)	0.95 (0.78-1.16)
Transportation & material moving (803-859)	66	0.64 (0.48-0.86)*	0.69 (0.52-0.92)*
Motor vehicle operators (803-814)	55	0.62 (0.45-0.85)*	0.67 (0.49-0.91)*
Handlers, equipment cleaners, helpers & laborers (863-889)	266	0.76 (0.66-0.88)*	0.80 (0.69-0.92)*

SES: Socioeconomic Status

[a] Most occupational groups were based on Bureau of Census groupings, others were based on similar exposures.

[b] Adjusted using 5-year age groups (except 18-29, 80+)

[c] Adjusted by age groups and restricted to SES level(s) (as determined by quartiles of Nam-Powers scores in the study population) of occupational group under study

* Statistical significance at alpha=.05

TABLE 4. Adult Female Breast Cancer Risk: Odds Ratios for Occupations and Occupational Groups with the Highest Risks[a]; In Descending Order of Age-Adjusted & SES-Restricted OR

Occupation/Occupational Group (1980 Bureau of Census Codes)	SES Level[b]	N Cases	Age-adjusted OR (95% CI)[c]	Age-adjusted & SES-restricted OR (95% CI)[d]
Proofreaders (384)	2	21	2.58 (1.35-4.94)*	2.61 (1.37-4.99)*
Billing clerks (339)	2	34	2.32 (1.37-3.93)*	2.46 (1.45-4.16)*
Chemists, except biochemists (073)	4	21	2.36 (1.21-4.61)*	2.10 (1.07-4.11)*
Radiologic technicians (206)	3	25	1.93 (1.05-3.55)*	1.93 (1.05-3.55)*
Managers, medicine and health (015)	4	31	2.04 (1.20-3.46)*	1.81 (1.06-3.08)*
Traffic, shipping & receiving clerks (364)	2	31	1.55 (0.94-2.54)	1.62 (0.99-2.66)
Managers, properties & real estate (016)	3	23	1.67 (0.93-2.99)	1.60 (0.89-2.86)
Personnel clerks, except payroll & timekeeping (328)	3	43	1.56 (1.04-2.36)*	1.50 (0.99-2.26)
Financial managers (007)	4	50	1.68 (1.13-2.50)*	1.49 (1.00-2.22)
Pressing machine operators (747)	1	37	1.24 (0.82-1.89)	1.47 (0.97-2.24)

SES: Socioeconomic Status

[a] Limited to occupations and occupational groups (except for the largest categories) with the ten highest age-adjusted & SES-restricted ORs

[b] SES levels (1=lowest, 4=highest) were based on quartiles of Nam-Powers scores in the study population.

[c] Adjusted using 5-year age groups (except 18-29, 80+)

[d] Adjusted by age groups and restricted to SES level(s) of occupation/occupational group under study

* Statistical significance at alpha=0.05

TABLE 5. Adult Female Breast Cancer Risk: Odds Ratios for Occupations and Occupational Groups with the Lowest Risks[a,b]; In Descending Order of Age-Adjusted & SES-Restricted OR

Occupation/Occupational Group (1980 Bureau of Census Codes)	SES Level[c,d]	N Cases	Age-adjusted OR (95% CI)[e]	Age-adjusted & SES-restricted OR (95% CI)[f]
Shoe machine operators (745)	1	43	0.54 (0.39-0.76)*	0.62 (0.44-0.87)*
Printing machine operators (734-737)	2, 3	20	0.65 (0.39-1.09)	0.65 (0.39-1.09)
Motor vehicle operators (803-814)	1, 2, 3	55	0.62 (0.45-0.85)*	0.67 (0.49-0.91)*
Precision food production (686-688)	1, 2, 3, 4	22	0.64 (0.39-1.05)	0.71 (0.43-1.16)
Mail & message distributing (354-357)	1, 2, 4	50	0.71 (0.51-0.99)*	0.72 (0.51-1.00)*
Designers (185)	3	74	0.75 (0.57-0.99)*	0.73 (0.55-0.96)*
Engineering & related technologists & technicians (213-218)	3, 4	52	0.80 (0.57-1.11)	0.73 (0.53-1.02)
Janitors & cleaners (453)	1	40	0.63 (0.43-0.90)*	0.74 (0.51-1.07)
Waitresses (435)	1	218	0.66 (0.57-0.78)*	0.77 (0.66-0.91)*
Construction trades, except helpers & laborers (553-599)	1, 2, 3, 4	32	0.77 (0.50-1.18)	0.77 (0.50-1.18)

SES: Socioeconomic Status

[a] Limited to occupations and occupational groups (except for the largest categories) with the ten lowest age-adjusted & SES-restricted ORs

[b] When an occupation or occupational group meeting the table's criteria was part of a larger occupational group also meeting the table's criteria, only the larger occupational group was included.

[c] SES levels (1=lowest, 4=highest) were based on quartiles of Nam-Powers scores in the study population.

[d] Some occupational groups consisted of occupations in different SES levels.

[e] Adjusted using 5-year age groups (except 18-29, 80+)

[f] Adjusted by age groups and restricted to SES level(s) of occupation/occupational group under study

* Statistical significance at alpha=0.05

TABLE 6. Adult Female Breast Cancer Risk: Odds Ratios and Excess Number of Cases for Occupations and Occupational Groups of Public Health Importance[a,b]

Occupation/Occupational Group (1980 Bureau of Census Codes)	N Cases	Age-Adjusted OR (95% CI)[c]	Excess N of Cases
Teachers (113-159)	1484	1.27 (1.18-1.36)*	315
Office workers			
Executive, administrative & managerial (003-037)	1789	1.15 (1.07-1.22)*	233
Administrative support, including clerical (303-389)	4464	1.03 (0.99-1.08)	130
Health care workers			
Registered Nurses (095)	1088	1.04 (0.97-1.13)	42
Physicians (084)	78	1.42 (1.50-1.93)*	23
Miscellaneous			
Nuns (based on narratives from 176 and 177)	126	1.35 (1.08-1.69)*	33
Real estate sales (254)	146	1.28 (1.03-1.59)*	32
Librarians (164)	144	1.22 (0.98-1.51)	26

[a] Limited to occupations and occupational groups with at least 20 excess cases

[b] When an occupation or occupational group meeting the table's criteria was part of a larger occupational group also meeting the table's criteria, individual occupations were included only if they had clearly defined tasks and could be targeted for intervention; otherwise, relatively homogeneous occupational groups were included.

[c] Adjusted using 5-year age groups (except 18-29, 80+)

* Statistical significance at alpha=0.05

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