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OCCUPATION AND BREAST CANCER RISK AMONG SHANGHAI WOMEN IN A POPULATION-BASED COHORT STUDY

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Abstract

Introduction—A total of 74,942 female subjects were recruited in a population-based cohort study in Shanghai, China between 1997 and 2000. We examined the relationship between occupation and breast cancer risk by using baseline data from the cohort study.

Methods—Cases were 586 women previously diagnosed with breast cancer at baseline and 438 women newly diagnosed with breast cancer by December 2004 during follow-up. Eight controls were randomly selected for each case from cancer-free cohort members and frequency-matched to the cases by year of birth and age at diagnosis, respectively. Logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) of breast cancer risk associated with occupations adjusting for typical breast cancer risk factors.

Results—In the prevalent breast cancer data analysis, increased risks of breast cancer were associated with technicians in engineering/agriculture/forestry (OR= 1.6, 1.0-2.4), teaching personnel (OR=1.5, 1.1-2.0), tailoring/sewing workers (OR=1.6, 1.0-2.7), examiners/measurers/testers (OR=1.5, 1.1-2.1) among those who started the jobs at least 20 years ago. In the incident cases, the significantly increased risks were associated with medical/health care workers (OR=1.4, 1.0-2.0), administrative clerical workers (OR=1.5, 1.0-2.4), postal/telecommunication workers (OR=2.2, 1.0-5.5), and odd-job workers (OR=1.7, 1.1-2.8) among those who started the jobs at least 20 years ago. The excess risks were found in both prevalent and incident cases for postal/telecommunication workers and purchasing/marketing personnel, although ORs reached only marginal significance.

Conclusions—This study suggests that white-collar professionals and several production occupations may be associated with an increased risk of breast cancer.

Keywords

occupations; breast cancer; Shanghai women health study (SWHS); Shanghai China

Introduction

Breast cancer is a major cause of cancer death among women. Over one million women were diagnosed with breast cancer worldwide in 2002 [Parkin et al., 2005]. The incidence of breast

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cancer has a four-fold variation around the world [Althuis et al., 2005]. The incidence rate in Shanghai, China, is among the lowest in the world, but has been increasing rapidly over the past two decades to a rate of 30.1 per 100,000 person-years in 1993-97 [Jin et al., 1993a: Hao et al., 2002]. The relative 5-year survival rate in China was 61.2% in 1990, lower than in the United States and Japan, but higher than in Eastern Europe, India, and other developing countries [Pisani et al., 1999; Parkin et al., 2005]. Although the improvement of diagnosis, adoption of a western life style, and changes in traditional breast cancer risk factors, such as increased age at first birth and decrease in parity, are major reasons for the upward trends, these factors cannot fully explain the increasing trend of breast cancer in Shanghai [Jin et al., 1993b; Gao et al., 2000]. Occupational and environmental factors have not been shown to be major causes of breast cancer [Zahm and Blair, 2003]. However, a number of chemicals have been shown to induce mammary tumors in animals [Bennett and Davis, 2002], and excess risks of breast cancer have been reported among medical and health care personnel, clerical workers, teachers, agriculture workers, and some production workers [Gardner et al., 2002; Goldberg and Labreche, 1996]. Most previous studies of occupational breast cancer risk were conducted in North American and European countries. Very few occupational studies have been conducted in Asian populations [Goldberg and Labreche, 1996]. A cohort study of 75,000 women was initiated in 1997 in Shanghai, providing a unique opportunity to evaluate the etiology of cancer and other outcomes. Over 99.6% of participants were ever employed and around 60% were employed in blue collar work with infrequent job changes. The average number of jobs held was 1.5, with an overall average duration of employment of 14 years. We used data from this cohort to evaluate the role of occupational factors in the development of breast cancer.

Materials and Methods

The Shanghai Women's Health Study (SWHS) is a population-based prospective cohort study. A detailed description of the study population and data collection has been published elsewhere [Zheng et al., 2005]. Between March 1997 and May 2000, all eligible women aged 40-70 residing permanently in seven communities of urban Shanghai were invited to participate in the study (n=81,316). A total of 75,221 women completed the baseline interview for a participation rate of 92.7% (3.0% refused to participate, 2.6% were absent during the enrolment period, and 1.7% did not participate for other reasons). Of the women who were interviewed, 278 were later found to be younger than 40 or older than 70 years at the time of baseline interview and thus were excluded from the cohort, yielding a total of 74,942 subjects available for analysis.

Because the follow-up time of the cohort is still short (about 5-7 years) and relatively limited new incident cases were identified during the follow-up, we include both prevalent cases diagnosed prior to the interview and the incident cases during follow-up to extend our observations by using information on lifetime occupation history obtained in the baseline questionnaire. At baseline, each subject was asked if she had ever received a physician's diagnosis of breast cancer and her age at diagnosis, yielding a total of 586 prevalent breast cancer cases. No pathological or other medical records were available to verify the diagnosis of the prevalent cases. The incident breast cancer cases were identified through biennial follow-up and linkage to the population-based Shanghai Cancer Registry through December 2004. A total of 438 incident cases were identified. Of these, 99.1% had pathological evidence of diagnosis, with the remainder confirmed by radiography including computed tomographic scans or ultrasound. Eight controls were randomly selected for each prevalent or incident case from the cohort and matched on year of birth (same year) and age at diagnosis (4-year period) of cases. The study was approved by the relevant Institutional Review Boards for human research in China and the United States. A written informed consent was obtained from all study participants.

In-person interviews were conducted at baseline by trained interviewers using a structured questionnaire to elicit information on demographic background, socioeconomic status (income and education), tobacco and alcohol use, dietary habits, physical activity, menstrual and reproductive history, residential history, history of cooking oil use, medical history, height and weight, history of hormone use, and lifetime occupational history. For each job that lasted longer than one year, we obtained information on the name of the work place, job title including main duties and products, year started and year ended. Each occupation and industry was coded according to the Chinese National Standard Occupation and Industry Codes Manual [1986].

Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated by logistic regression analysis adjusted for education level (elementary and less, middle school, high school, and college or above), age at menarche, age at first live birth, number of live births, and menopausal status with stratification by the two matched variables, age at diagnosis for cases (same 4-year strata for controls) and year of birth in the matched analysis. All time-dependent exposure variables were censored at 5 years (lag time) prior to the age at diagnosis for cases and the equivalent cut-off age for controls. Risk of breast cancer was evaluated for each 2-digit or 3-digit classification of occupation (ever *vs*. never employed by the occupation). Further analyses were performed to test trends by duration of employment (never [referent], <10, 10-19, and ≥20 years) and by time since first starting a job. Trend tests for the duration of employment were performed by using ordinal scores in comparison to never employment of the job. A 10% change in OR value was used to select covariates as confounding variables in the final models

Results

Table I shows the demographic information and distributions of non-occupational risk factors of breast cancer in the prevalent and incident data sets. Overall, the distribution patterns of non-occupational risk factors were similar between the prevalent and incident breast cancer cases, except that prevalent cases were younger at index date (i.e., age at breast cancer diagnosis and age at cut-off for controls) and older at time of baseline interview than incident cases. In both data pools, cases had higher educational level and were more likely to have a family history of breast cancer than controls, but cases and controls were similar in distributions of age at diagnosis (match variable), marital status, income, tobacco and alcohol use. Consistent with well-established breast cancer risk patterns, cases in our study also had younger age at menarche, older age at menopause, later age of first live birth, and a lower number of live births than controls.

Three-digit occupations associated with a 20% or higher excess risk of breast cancer with 3 or more cases in the “ever exposed” cells and the associated 2-digit occupations are listed in Table II for prevalent cases and Table III for incident cases. The patterns of association between prevalent and incident cases appeared to be somewhat different. In Table II, significantly elevated risks were associated with ever employment as teaching personnel (OR=1.3, 95% CI= 1.0-1.7), particularly among university teachers (OR=2.0, 95% CI=1.2-3.4). Significant excesses were also observed among ticket sellers (OR=2.2, 95% CI=1.0-5.2); pickling, canning, and preserved foods workers (OR=3.5, 95%CI=1.2-10.1); and other food and beverage production workers (OR=4.3, 95% CI=1.3-15.2). Borderline significant excess risks of 50% or higher were observed among science and technology support personnel; service workers in restaurants; plastic process machine operators; and lab technicians and analysts.

Of note, several occupations associated with elevated risks of prevalent breast cancer were also observed with increased risks of incident cancer, including purchasing and marketing personnel; service workers; postal and telecommunication workers; and paper production workers, although only purchasing and marketing personnel (OR=1.7, 95% CI=1.1-2.6) and service workers (OR=1.5, 95% CI= 1.0-2.2) were significant for incident cases (Table III). In addition, significantly elevated risks of incident breast cancer were found among medical and health care personnel (OR=1.4, 95% CI= 1.0-1.9); odd-job workers (OR=1.5, 95% CI=1.0-2.1); and cotton plantation workers (OR=3.2, 95% CI = 1.1-8.8). Borderline significant excess risks of 50% or higher were found for fitters and power generation equipment operators.

We further evaluated breast cancer risks by time since first employment in selected jobs that were linked with increased risk of breast cancer in prevalent or incident cases (Table IV). For both prevalent and incident cases, the magnitude of association was generally stronger for the jobs started 20 years ago than those started within 20 years of diagnosis. For the jobs started at least 20 years before diagnosis, significantly elevated risks were associated with employment as technicians in engineering, agriculture and forestry; teaching personnel; tailoring and sewing workers; and examiners, measurers, and testers in the prevalent breast cancer study, and for medical and health care workers; administrative clerical workers; postal and telecommunication workers; and odd-job workers in the incident breast cancer study. Elevated, but not statistically significant ORs were also observed for postal and telecommunication workers and purchasing and marketing personnel for both prevalent and incident cases. Among those who started the job within 20 years of diagnosis, only service workers had a significantly increased risk in incident breast cancer.

Tables V presents ORs for prevalent and incident breast cancer by duration of employment for the selected occupations started 20 years prior to diagnosis with significantly or marginally increased risk of ever exposed. For prevalent cases, a higher risk of breast cancer was seen among those with 20+ years compared shorter years of employment as technicians in engineering, agriculture and forestry; teaching personnel; and tailoring and sewing workers. For incident cases, a significant trend was only seen in medical and health care workers. Elevated risks were also seen among those who were employed 20 years or more as purchasing and marketing personnel (OR=1.9, 95% CI= 0.9-4.0), and service workers (OR=1.9, 95% CI= 0.8-4.4), although the trends of dose pattern did not reach significance. The risk patterns do not appear to be the same between prevalent and incident cases. There may be two explanations for the discrepancies. First, prevalent cases may not fully represent the all previous diagnosed breast cancer cases due to death prior to baseline interview or refusal to participate; secondly, the inconsistency may be also due to misclassification of exposure or/and the small number in the “ever exposed” cells among either prevalent or incident cases.

Analyses were performed to further adjust for body mass index, occupational physical activity, family history of breast cancer, and alcohol drinking; and no material changes were observed in the ORs of the major occupation groups in the study. For comprehensive analyses, we listed deficit ORs for the job titles with OR ≤0.8 and with at least 3 exposed cases (see Appendicis I and II). No statistically significant ORs were observed except for food crop farm workers among prevalent cases (OR=0.7, 95% CI= 0.5-1.0).

Discussion

For both prevalent and incident breast cancers, increased risks were associated with postal and telecommunication workers and purchasing and marketing personnel among those who started the jobs at least 20 years ago and held the jobs for 20 or more years. In addition, increasing years of employment were associated with somewhat elevated risks for teaching personnel, tailoring and sewing workers, and technicians in engineering, agriculture and forestry in prevalent cases; and for medical and health care personnel in incident cases.

Some of the findings in our analyses were consistent with those in two earlier breast cancer studies conducted in Shanghai women [Petralia et al., 1998a; Gardner et al., 2002]. Similar to our observations, the Shanghai incidence linkage study [Petralia et al., 1998a] reported

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significantly increased risks of breast cancer associated with teachers, medical and public health workers, scientific research workers, cultural workers, administrative clerks, and a non-significant 40% increased risk for postal and telecommunication workers. However, we did not confirm the increased risk associated with rubber and plastic product workers in that study. In contrast, the Shanghai breast cancer case-control study [Gardner et al., 2002] reported positive findings for clerical and related workers. Health care workers were not found to have an increased risk of breast cancer as a whole, but a 10-fold increased risk was found among laboratory technicians. A non-significant 3-fold increase in risk associated with postal and telecommunication workers was also observed. The excess risk for teaching personnel observed in our study was not seen in the case-control study.

In addition to the positive associations seen in three studies in Shanghai including the present study [Gardner et al., 2002; Petralia et al., 1998a], studies from other countries have also reported the increased risk of breast cancer among electric equipment manufacturing and telecommunication workers [Doebbert et al., 1988; Roman et al., 1985; Bulbulyan et al., 1992; Dosemeci and Blair, 1994; Aronson and Howe, 1994; Morton, 1995; Brinton and Devesa, 1996; Pollan and Gustavsson, 1999; Simpson et al, 1999], although not all studies have reported such associations [Bulbulyan et al., 1992; Calle et al., 1998Band et al., 2000]. No clear biological mechanism is available to explain the association between the telecommunication workers or electric operators, but exposure to low frequency electromagnetic fields (EMF) has been hypothesized as a possibility. EMF may suppress pineal gland production of melatonin, a hormone that may protect against the development of breast cancer by lowering the circulating levels of estrogen [Cohen et al., 1978; Stevens and Davis, 1996; Kliukiene et al., 2004]. A meta-analysis from 24 epidemiologic studies revealed an overall relative risk of 1.12 (95% CI 1.09-1.15) for EMF exposures [Erren, 2001]. Several studies have reported excess of breast cancer risk related to high level of exposure to EMF from occupations or residence [Brainard et al., 1999; Caplan et al.; 2000; Labreche et al., 2003; Kliukiene et al.; 2004], but negative results were found in a few recent studies [Schoenfeld et al., 2003; London et al., 2003; Forssen et al; 2005].

We found a slightly elevated risk of breast cancer among service and odd-job workers in the present study. The major occupations included in service work were restaurant workers, service workers in hotels, and ticket sellers in all public transportation and entertainment places. Odd-jobs in our study included odds-and-ends workers, laundering and dyeing workers, and sanitation, cleaning, and garbage disposal workers. No previous study has reported an association between service workers and breast cancer risk. One cohort study in Norway found waitresses to have a lower risk of breast cancer [Kjaerheim and Anderson, 1994]. Laundry and dry cleaning workers may be exposed to organic solvents, such as Stoddard solvent, perchloroethylene, trichloroethylene, and fluorocarbons. However, no direct lab evidence or animal study has supported the association between these chemicals and breast cancer to date [Goldberg and Labreche, 1996]. Several previous studies found no association of laundry and dry cleaning workers with breast cancer risk [Brown and Kaplan, 1987; Ruder et al, 1994; Blair et al., 1979; 1990].

Occupations with possible solvent exposure in our study include rubber and plastic product workers; agriculture workers; fitters; pipeline workers, welders, and metal component installers; laboratory technicians; and examiners, measurers, and testers. The non-significantly increased risk we observed among rubber and plastic product workers was also reported in the Shanghai linkage study [Petralia, et al., 1998a] and the previous case-control study in Shanghai [Gardner et al., 2002], and by a study in the US [Chiazze and Ference, 1981]. Others did not indicate any positive association with breast cancer among women employed in this industry [Andjelkovich et al., 1978; Cantor et al., 1995].

Risk of breast cancer associated with farming has been evaluated in a number of studies. In our incident breast cancer study, women ever employed on farms, particularly in cotton plantations, had an excess risk of breast cancer as compared to women never employed in this occupation. No association with farming was found in the present study or the other two Shanghai breast cancer studies [Petralia et al., 1998a; Gardner et al., 2002]. Studies among female agriculture workers have not strongly supported an association with pesticide exposures or other agricultural exposures. Pesticide use overall was not associated with an increased risk of breast cancer among the wives of farmers in the Agricultural Health Study cohort [Engel et al., 2005]. Other studies found a decreased risk of breast cancer among female farmers [Wiklund and Dich, 1994; Settimi et al., 1999; Mills and Kwong, 2001]. Some have postulated a biological hypothesis involving exogenous chemicals, so-called xenoestrogens, and altered endocrine function in the development of breast cancer [Goldberg and Labreche, 1996; Labreche and Goldberg, 1997]. These xenoestrogenic agents may be in a wide range of industrial solvents, including polycyclic aromatic hydrocarbons (PAHs) (e.g., benzene, toluene, xylene) and certain organochlorine pesticides [Morton, 1995], but supportive epidemiologic data are rare.

Associations with clerical and professional jobs have been reported frequently in previous breast cancer studies; and the elevated risks have been observed among a wide range of white collar occupation categories, including professional and managerial occupations, clerical/ secretarial and related jobs, teachers, nurses, scientists, physicians and other health professionals, and clergy [Goldberg and Labreche, 1996; Gardner et al., 2002]. In our study, we found that increased risks were associated with teaching personnel, technicians in engineering, medical and health care personnel, and a few other professional workers. Our results are consistent with findings in the two previous Shanghai studies [Petralia et al, 1998a; Gardner et al., 2002], and support the findings from studies in other countries [Goldberg and Labreche, 1996; Petralia et al., 1998b; Bernstein et al., 2002; Zheng et al., 2002; Teitelbaum et al., 2003]. The interpretation of the increased risk for these occupations for breast cancer is not clear, since the exposures to the specific occupational agents from these occupations or occupation groups are not obvious. Medical and health care workers may be exposed to sterilizing agents, anaesthetic gases, organic solvents, ionizing radiation, cytostatic drugs, viruses and other infectious agents, and other chemical mutagens [Katz, 1983; Sankila et al., 1990]. Undetected potential risk factors or poorly controlled established risk factors could confound the associations between breast cancer and medical health workers and teachers, such as work stress and late night or night shift work [Megdal et al., 2005]. Some of these occupations require high level of professional training, such as research scientists, medical and health care workers, and teachers, and therefore may be linked to the established reproductive risk factors of breast cancer, such as delayed age at first birth and reduced number of pregnancies. In the present study, we were able to adjust for many traditional breast cancer risk factors in the final models.

Some limitations in this study should be noted. As in other occupational case-control studies, our study often had a small number of “ever employed” cases under an individual job title. We did not obtain the specific exposures to various industrial agents that may be related to cancer risk in the baseline interview. For the incident cancer study, we have relatively few cases in most occupations and a short follow-up time, thus we have relatively low statistical power to identify the risk by occupation. Classification of exposures by occupation title or occupation groups is also a limitation, because of likely misclassification of occupational exposures. Use of prevalent cases may have limitations due to death prior to the baseline interview or refusals. Given an over 60% 5-year breast cancer survival rate in China, the majority of breast cancer patients may survive many years after diagnosis. The average interval between diagnosis and time at baseline interview was 9 years and survival might bias our analysis of the associations between occupations and breast cancer risk if it is related to occupation. We conducted separate analyses among the prevalent cases after excluding cases who died later in the follow-up study, and the risk patterns for the major occupations were largely unchanged.

In summary, this study added further evidence of increased risk of breast cancer among white-collar professionals. Suggested excesses among service workers and postal and communication workers are similar to the findings reported in two breast cancer studies previously conducted in Shanghai, China and deserve further attention. Overall, however, breast cancer was not strongly related to occupation in this analysis.

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Appendix

Appendix I

Job titles with Risk deficits in the Prevalent Breast Cancer Study, Shanghai, 1997-2004*

Occupations	No. of ever exposed cases	No. of ever exposed controls	OR (95% CI)
Mechanical engineering personnel (034)	3	40	0.4 (0.1-1.4)
Practitioners of western medicine (072)	7	55	0.8 (0.4-1.7)
Administrators of research committees (232)	3	51	0.5 (0.2-1.6)
Chefs and cooks (530)	18	200	0.8 (0.5-1.4)
Food crops farm workers (611)	41	430	0.7 (0.5-1.0)
Surface treatment of metals (726)	3	43	0.7 (0.2-2.3)
Other forge and machine tool installation and operation workers (849)	6	95	0.6 (0.3-1.4)
Machinery maintenance workers (852)	3	42	0.6 (0.2-2.0)
Painters (901)	4	66	0.6 (0.2-1.5)
Loading/Unloading workers and movers (941)	3	45	0.7 (0.2-2.1)
Motor vehicle drivers (954)	3	32	0.8 (0.3-2.6)
Warehouse workers (994)	16	172	0.7 (0.4-1.2)

ORs adjusted for education levels, age at menarche, age at first live birth, number of live births, and menopausal status by strata of two match variables of age at diagnosis and year of birth.

*Only 3-digit job titles with ORs being 20% lower than unit and number of exposed cases being 3 or more were presented.

Appendix

Appendix II

Job titles with Risk deficits in the Incident Breast Cancer Study, Shanghai, 1997-2004*

Occupations	No. of ever exposed cases	No. of ever exposed controls	OR (95% CI)
Mechanical engineering personnel (034)	3	40	0.5 (0.1-1.5)
Chemical engineering personnel (035)	3	20	0.8 (0.2-2.4)

Occupations	No. of ever exposed cases	No. of ever exposed controls	OR (95% CI)
University level teachers (111)	6	41	0.8 (0.3-1.9)
Administrators of Chinese communist party (221)	5	39	0.7 (0.3-1.6)
Political workers (321)	8	63	0.7 (0.3-1.5)
Chefs and cooks (530)	10	184	0.6 (0.3-1.1)
Plastic process machine operators (742)	3	43	0.7 (0.2-2.1)
Spinning, Filature, Plying and Twisting Workers (752)	10	140	0.7 (0.4-1.3)
Knitting workers (755)	4	51	0.7 (0.3-1.9)
Welders (882)	3	33	0.8 (0.2-2.4)
Painters (901)	3	58	0.5 (0.2-1.6)
Motor vehicle drivers (954)	3	48	0.6 (0.2-1.9)
Workers in packaging/bailing	4	88	0.4 (0.2-1.2)

ORs adjusted for education levels, age at menarche, age at first live birth, number of live births, and menopausal status by strata of two match variables of age at diagnosis and year of birth.

*Only 3-digit job titles with ORs being 20% lower than unit and number of exposed cases being 3 or more were presented.

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Table I

Demographic Information and Distributions of Non-occupation Risk Factors of Cases and Controls among Prevalent and Incident Breast Cancer Case-control Pools

	Prevalent case-control pool		Incident case-control pool	
	Cases (N=586)	**Controls (N=4,688)**	**Cases (N=438)**	**Controls (N=3,504)**
Age at index date with 5-year lag (Mean, ±s.d.)	(43.0, 8.7)	(42.4, 8.7)	(50.6, 9.0)	(50.1, 9.1)
Age at interview (Mean, ±s.d.)	(56.0, 8.6)	(55.9, 8.6)	(52.4, 8.8)	(52.5, 8.9)
BMI (Mean, ±s.d.)	(24.4, 3.5)	(24.4, 3.6)	(24.3, 3.4)	(24.0, 3.4)
Married (%)	97.4	96.8	98.9	99.1
Last Year Income (% of 20,000+ Yuan)	42.5	38.8	47.8	45.6
Education (%)				
Elementary or less	23.6	31.6	13.0	22.3
Middle School	29.0	29.7	31.7	36.2
High School	27.6	23.9	35.4	26.8
College +	19.8	14.8**	19.6	14.6**
Ever smoked (%)	2.4	2.8	1.6	2.7
Ever drank alcohol (%)	1.0	1.5	2.1	2.1
Breast cancer family history (%)	5.5	2.1**	3.7	1.8**
Age at menarche (Mean, ±s.d.)	(14.7, 1.7)	(15.1, 1.8)	(14.8,1.9)	(14.9, 1.7)
<14	26.3	20.7	25.1	22.1
14-<15	23.7	19.2	21.2	21.5
15-<16	17.8	20.1	21.2	20.5
16+	31.9	40.0**	32.4	35.9
Age at 1st live birth (Mean, ±s.d.)	(25.8, 4.2)	(24.7, 4.2)	(26.8, 4.1)	(25.8, 4.1)
Non-parous	8.2	7.2	4.5	3.4
<25	34.5	43.0	24.2	33.2
25-<30	41.6	39.5	50.5	48.5
30+	15.7	10.3**	20.8	14.9**
Age at Menopause (Mean, ±s.d.)	(48.0,4.8)	(46.5, 5.0)	(48.8, 4.7)	(47.8, 4.3)
Pre-menopausal women (%)	73.9	77.5*	53.2	56.7
Number of live births (%) (Mean, ±s.d.)	(1.75, 1.2)	(2.0, 1.4)	(1.6, 1.1)	(1.8, 1.2)
<=1	51.9	42.5	60.5	56.1
2-3	38.1	41.8	32.7	33.6
4+	10.0	15.7**	6.8	10.3*

Statistical test:

* $P<0.05$

** $P<0.01$

Table II

Associations of Occupation Groups and Individual Occupations with Prevalent Breast Cancer, Shanghai, 1997-2000

Occupations	No. of ever exposed cases	No. of ever exposed controls	OR (95% CI)
Technicians in engineering, agriculture and forestry (031-049)	33	192	1.1 (0.7-1.6)
Light industry and textile technical personnel (042)	8	24	2.0 (0.9-4.1)
Administration, support science and technology personnel (051-059)	9	38	1.5 (0.8-3.0)
Science and technology support personnel (052)	9	34	1.7 (0.9-3.4)
Teaching personnel (111-119)	83	402	**1.3 (1.0-1.7)**
University teachers (111)	18	52	**2.0 (1.2-3.4)**
Middle school teachers (112)	36	160	1.3 (0.9-2.0)
Elementary school teachers (113)	34	161	1.3 (0.9-2.0)
Culture workers (141-149)	16	72	1.3 (0.8-2.2)
Librarians and library workers (145)	5	17	1.7 (0.7-4.3)
Files and archives management workers (146)	7	33	1.2 (0.6-2.7)
Postal and telecommunication workers (331-339)	7	40	1.3 (0.6-2.9)
Purchasing and marketing personnel (421-429)	14	88	1.2 (0.7-2.1)
Services workers (511-519)	27	195	1.2 (0.8-1.8)
Service workers in restaurants (511)	6	29	2.2 (0.9-5.0)
Ticket sellers (516)	6	24	**2.2 (1.0-5.2)**
Rubber and plastic products workers (741-749)	11	82	1.3 (0.7-2.4)
Rubber process machine operators (741)	3	22	1.5 (0.5-4.6)
Plastic process machine operators (742)	7	29	2.0 (0.9-4.3)
Tailoring and sewing workers (771-779)	22	152	1.4 (0.9-2.1)
Sewing workers (772)	13	100	1.2 (0.7-1.7)
Shoe and hat makers (773)	3	18	1.7 (0.5-5.4)
Other tailoring and sewing workers (779)	3	13	2.6 (0.8-8.5)
Food and beverage production workers (781-789)	11	60	1.5 (0.8-2.8)
Pickling, canning, and preserved food workers (784)	4	9	**3.5 (1.2-10.1)**
Bakers and confectioners (786)	3	27	1.2 (0.4-3.3)
Other food and beverage production workers (789)	3	5	**4.3 (1.3-15.2)**
Timber processing workers (801-809)	4	24	1.7 (0.6-4.6)
Paper production workers (811-819)	6	48	1.3 (0.6-2.9)
Installation/assembling and precise instrument makers (851-859)	15	106	1.2 (0.7-2.0)
Electric equipment installing, repairing, and assembling workers (861-869)	32	236	1.2 (0.8-1.7)
Electricians (864)	6	35	1.4 (0.6-3.2)
Electric repairer and assembling workers (863)	21	147	1.2 (0.8-1.9)
Pipeline workers, welders, and metal component installers (881-889)	15	113	1.3 (0.8-2.2)
Construction workers (921-929)	6	47	1.3 (0.6-3.0)
Examiners, measurers, and testers (961-969)	61	387	1.2 (0.9-1.6)
Testers/Experimenters (963)	7	27	1.7 (0.8-3.7)

Occupations	No. of ever exposed cases	No. of ever exposed controls	OR (95% CI)
Lab technicians/analyst (964)	14	63	1.6 (0.9-2.8)

ORs adjusted for education levels, age at menarche, age at first live birth, number of live births, and menopausal status by strata of two match variables of age at diagnosis and year of birth.

Table III

Associations of Occupation Groups and Individual Occupations with Incident Breast Cancer, Shanghai, 1997-2004

Occupations	No. of ever exposed cases	No. of ever exposed controls	OR (95% CI)
Scientific researchers (011-029)	5	22	1.4 (0.6-3.6)
Researchers in engineering (021)	9	15	1.5 (0.5-4.2)
Medical and health care personnel (071-089)	41	186	**1.4 (1.0-1.9)**
Practitioners in Western medicine (072)	12	52	1.3 (0.7-2.4)
Nurses (075)	16	61	1.5 (0.9-2.5)
Hygiene/anti-epidemic health workers (077)	12	59	1.2 (0.7-2.5)
Community health care workers (078)	4	22	1.4 (0.5-3.9)
Leaders of enterprise units (241-249)	30	167	1.3 (0.9-1.9)
Administrative clerical workers (311-319)	29	145	1.3 (0.9-1.9)
Office workers in administration (311)	8	29	1.6 (0.8-3.3)
Secretaries (312)	6	29	1.2 (0.5-2.9)
Postal and telecommunication workers (331-339)	6	30	1.6 (0.7-3.6)
Purchasing and marketing personnel (421-429)	22	97	**1.7 (1.1-2.6)**
Services workers (511-519)	31	189	**1.5 (1.0-2.2)**
Service workers in restaurants (511)	6	28	1.9 (0.8-4.3)
Service workers in hotels and guest houses (512)	6	36	1.6 (0.7-3.7)
Ticket sellers (516)	7	33	1.7 (0.8-3.7)
Nursery child care workers (517)	10	73	1.3 (0.7-2.5)
Odd-job workers (520-529)	34	250	**1.5 (1.0-2.1)**
Agriculture, forest, animal husband, and fish workers (611-619)	89	632	**1.2 (0.94-1.6)**
Food crops farm workers (611)	73	496	1.2 (0.9-1.6)
Cotton plantation workers (612)	4	10	**3.2 (1.1-8.8)**
Leather and fur production workers (761-769)	3	13	2.1 (0.6-6.6)
Tailoring and sewing workers (771-779)	15	127	1.1 (0.7-1.9)
Sewing workers (772)	11	87	1.2 (0.6-2.1)
Paper production workers (811-819)	5	27	1.9 (0.7-4.6)
Forge and machine tool installation and operation	39	319	1.1 (0.8-1.5)
workers (841-849)	7	29	2.0 (0.8-4.7)
Fitters (842)			
Power generation equipment operators (930-939)	5	21	2.2 (0.9-5.5)

ORs adjusted for education levels, age at menarche, age at first live birth, number of live births, and menopausal status by strata of two match variables of age at diagnosis and year of birth.

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Table IV

Comparisons of ORs of Occupation Groups between Employment Started 20-Year's Ago and within 20 Years among Prevalent and Incident Breast Cancer Case Pools, Shanghai, 1997-2004

	Prevalent				Incident			
	Job started 20 years ago		Job started within 20 years		Job started 20 years ago		Job started within 20 years	
	Cases	OR (95% CI)	Cases	OR (95% CI)	Cases	OR (95% CI)	Cases	OR (95% CI)
Technicians in engineering, agriculture and forestry (031-049)	29	**1.6 (1.0-2.4)**	4	0.3 (0.1-0.9)	19	1.0 (0.6-1.6)	1	0.3 (0.04-2.1)
Medical and health care personnel (071-089)	27	0.9 (0.6-1.4)	9	0.9 (0.5-1.8)	40	**1.4 (1.0-2.0)**	1	0.6 (0.1-4.3)
Teaching personnel (111-119)	70	**1.5 (1.1-2.0)**	13	0.8 (0.5-1.5)	42	0.9 (0.7-1.3)	4	1.5 (0.5-4.0)
Administrative clerical workers (311-319)	10	0.8 (0.4-1.4)	9	1.0 (0.5-2.0)	22	**1.5 (1.0-2.4)**	7	0.9 (0.4-2.0)
Postal and telecommunication workers (331-339)	55	1.9 (0.8-4.9)	2	0.8 (0.2-3.1)	5	**2.2 (1.0-5.5)**	1	0.6 (0.1-4.7)
Purchasing and marketing personnel (421-429)	8	1.7 (0.8-3.5)	6	0.9 (0.4-2.0)	11	1.7 (0.9-3.2)	11	1.7 (0.9-3.1)
Service workers (511-519)	12	1.1 (0.6-2.0)	15	1.3 (0.8-2.2)	16	1.4 (0.8-2.3)	15	**1.7 (1.0-2.9)**
Odd-job workers (520-529)	11	0.9 (0.5-1.7)	15	1.0 (0.6-1.7)	19	**1.7 (1.1-2.8)**	15	1.2 (0.7-2.0)
Agriculture, forest, animal husband, and fish workers (601-699)	50	0.9 (0.6-1.2)	9	0.6 (0.3-1.2)	89	1.2 (0.9-1.6)	0	--
Tailoring and sewing workers (771-779)	15	**1.6 (1.0-2.7)**	7	1.1 (0.5-2.3)	12	1.1 (0.6-1.9)	3	1.4 (0.4-4.5)
Food and beverage production workers (781-789)	8	**1.9 (0.9-3.9)**	3	1.0 (0.3-3.1)	4	1.2 (0.4-3.2)	0	--
Electric equipment installing, repairing, and assembling workers (861-869)	23	1.3 (0.8-1.9)	9	0.9 (0.5-1.9)	17	0.8 (0.5-1.4)	4	1.4 (0.5-3.9)
Examiners, measurers, and testers (961-969)	43	**1.5 (1.1-2.1)**	18	0.9 (0.5-1.4)	38	1.1 (0.8-1.5)	5	0.7 (0.3-1.6)

ORs adjusted for education levels, age at menarche, age at first live birth, number of live births, and menopausal status by strata of two match variables of age at diagnosis and year of birth.

Table V

Associations of Years of Employment for Selected Occupations Started 20 Years Ago with Prevalent and Incident Breast Cancer, Shanghai, 1997-2000

	<10 years		10-19 years		20+ years		
Prevalent Cases	**Cases**	**OR (95% CI)**	**Cases**	**OR (95% CI)**	**Cases**	**OR (95% CI)**	**P for trend**
Technicians in engineering, agriculture and forestry (031-049)	2	1.0 (0.2-3.9)	9	1.5 (0.7-3.0)	18	**1.7 (1.0-2.8)**	**0.03**
Teaching personnel (111-119)	7	1.1 (0.5-2.3)	25	**1.7 (1.1-2.7)**	38	**1.5 (1.0-2.2)**	**0.005**
Service workers (511-519)	2	0.6 (0.1-2.4)	3	0.8 (0.2-2.4)	7	**2.1 (1.0-4.6)**	0.30
Tailoring and sewing workers (771-779)	3	1.3 (0.4-4.2)	3	0.9 (0.3-2.9)	9	**2.3 (1.1-4.6)**	**0.04**
Food and beverage production workers (781-789)	4	**3.2 (1.1-9.2)**	2	1.8 (0.4-7.6)	2	1.1 (0.3-4.6)	0.29
Pipeline workers, welders, and metal component installers (881-889)	1	0.4 (0.06-3.2)	7	**2.2 (1.0-4.8)**	5	1.8 (0.7-4.4)	0.06
Examiners, measurers, and testers (961-969)	11	**2.4 (1.3-4.5)**	14	1.2 (0.7-2.1)	18	1.4 (0.9-2.3)	0.057
Incident Cases							
Medical and health care personnel (071-089)	3	1.1 (0.3-3.5)	4	0.7 (0.3-1.9)	33	**1.7 (1.2-2.5)**	**0.02**
Postal and telecommunication workers (331-339)	2	**4.6 (1.1-19.8)**	1	1.3 (0.2-9.2)	2	1.9 (0.5-8.2)	0.19
Purchasing and marketing personnel (421-429)	1	2.6 (0.3-20.1)	2	1.1 (0.3-4.6)	8	1.9 (0.9-4.0)	0.08
Service workers (511-519)	3	0.7 (0.2-2.1)	7	1.8 (0.8-3.9)	6	1.9 (0.8-4.4)	0.07

ORs adjusted for education levels, age at menarche, age at first live birth, number of live births, and menopausal status by strata of two match variables of age at diagnosis and year of birth.