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Shared Occupational Risks for Transitional Cell Cancer of the Bladder and Renal Pelvis among Men and Women in Sweden

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Abstract

Background: Unlike cancer of the bladder, cancer of the renal pelvis is not considered an occupational cancer and little is known about risks among women.

Methods: Using the Swedish national census and cancer registry-linked data (1971-1989), we identified transitional cell cancers of the renal pelvis (N=1374) and bladder (N=21,591). Correlation between cancer sites for the Standardized Incidence Ratios (SIR) were determined using Pearson's coefficient of the log SIR. Relative risks of job exposure matrix variables were calculated using Poisson regression.

Results: Both cancer sites were significantly elevated among women and men employed in the machine/electronics industry, sedentary work, and indoor work, as well as among men employed in the shop and construction metal industry, contributing 10-14% of cases among men. Risks by industry were more highly correlated among women ($r=0.49$, $p=0.002$) than men ($r=0.24$, $p=0.04$).

Conclusion: Cancers of the renal pelvis and bladder share common occupational risk factors that may be more frequent among women. In addition, there may be several jobs that pose an increased risk specifically for cancer of the renal pelvis but not bladder.

Keywords

epidemiology; bladder neoplasms; kidney neoplasms; occupational exposure; industry

Background

In Sweden, the incidence of bladder cancer has doubled since the 1960s and reasons for this are not entirely clear [National Board of Health and Welfare of Sweden 2000, Thorn, et al. 1997, Mattsson and Wallgren 1984]. In addition, although bladder cancer accounts for a higher proportion of all cancers among men (7.3%) than women (2.9%), women have experienced a

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Conflict of Interest

The authors do not presently have affiliations with organizations that have a direct financial interest in the subject matter or materials discussed.

comparatively lower survival, and a greater increase in incidence [Ries, et al. 2003, McLaughlin, et al. 1996, Madeb and Messing 2004]. A significant proportion of bladder cancers among men (10-25%) have been attributed to occupational exposures, and changes in the workforce suggest that these exposures are also becoming more relevant for women [Kogevinas, et al. 2003, Vineis and Magnani 1985, Mannetje, et al. 1999].

At the same time, very little is known about occupational risk factors for cancers of the renal pelvis, particularly among women. Cancers of the bladder and renal pelvis are both predominantly of transitional cell origin (90-95%). Secondary cancer studies suggest that these two cancer sites are etiologically related because approximately 1-4% of bladder cancer patients will develop cancers of the renal pelvis and ureter, and 20-50% of renal pelvis cancer patients will also have bladder cancer [Rabbani, et al. 2001, Sharir and Jewett 1999, Kirkali and Tuzel 2003, Huguet-Perez, et al. 2001]. Two known carcinogens that are associated with both cancers include tobacco smoking and ionizing radiation.[Silverman, et al. 2006]

In this study, our purpose is to explore similar occupational risk factors between these two cancer sites among employed Swedish men and women.

Methods

Data

The cohort was defined as all male and female Swedish residents reporting gainful employment at either the 1960-or-1970 censuses, and alive on January 1, 1971. Person-years were accrued for each member of the cohort beginning January 1, 1971 until a diagnosis of cancer, emigration, death or end of follow-up on December 31, 1989, whichever occurred first. We used the Swedish Cancer-Environment Registry (CER), Version III, to determine the incidence of transitional cell cancers of the renal pelvis (International Classification of Diseases, 7th Revision (ICD-7) code 180.1), and bladder (181.0) between 1971-1989. We also investigated mortality from these two cancers, but do not report these results in the tables. Cancers were limited by histology according to the Swedish Cancer Registry PAD (codes 114 and 116). Microscopic confirmation occurred for 97% of cancers in this study. CER III is the linked dataset between the 1960-and-1970 National Population and Housing Censuses and the Swedish cancer registry. The proportion of unlinked cancer cases was less than 1%, and the Census response rate was 99% [Wiklund and Eklund 1986]. Job titles reported to the Census were converted to the three-digit National Swedish Classification of Occupations and Industries, as described elsewhere [Shields, et al. 2002]. Urban residence was defined according to the place of residence at the 1970 Census (i.e. residence in one of the 3 largest Swedish cities of Stockholm, Göteborg, and Malmö).

Job exposure matrices (JEM), developed by American and Swedish experts in occupational medicine, were used to assess risks associated with the following occupational exposures: asbestos, ionizing radiation, low physical activity and indoor work. JEMs for other known or suspected bladder carcinogens have not yet been developed for this dataset. All scoring was blinded to the health status of subjects. Ionizing radiation and asbestos exposures were scored in the categories of probability (none, low, medium, high), intensity (none, low, medium, high), and confidence (low, high) of exposure, and have been used in previous research [Shields, et al. 2002]. Occupational physical activity was categorized as heavy, medium, light, and sedentary. This JEM has been shown to correlate reasonably well with self-reported occupational physical activity (spearman rank coefficient=0.62) [Moradi, et al. 1998]. Work location was classified into 3 categories, (outdoor only, both indoor and outdoor, and indoor only). Individuals were classified into a JEM category according to the occupation held in 1970.

Analysis

We calculated the standardized incidence ratio (SIR), the ratio of observed to expected number of cancers, for each two- and three-digit occupation and industry category. Individuals were assigned to an industry or occupation category in a specified category if they reported employment in either 1960 or 1970. Thus, an individual reporting a different occupation in 1960 than in 1970 would be considered separately for each occupational exposure group. According to our calculations, 34% and 37% of men and 24% and 24% of women with cancer of the bladder and renal pelvis cancer, respectively, held a different occupation in 1960 than in 1970. The expected number of cases was based on the incidence rates in attained age (by 5-year-age groups), sex, site and calendar-year (by 4-year calendar periods from 1971-1989) specific cancer incidence rates. The expected rate was based on cancer incidence rates in the total employed population. The total employed population was defined as those individuals reporting employment at either the 1960 or 1970 census. Autopsy-only reported cases were excluded from both observed and expected rate calculations.

We present SIR results for occupations and industries with at least 3 exposed cases and meeting at least one the following criteria: 1) statistically significant ($p < 0.05$), 2) $SIR = 2.0$ or greater, and 3) *a priori* risk based on published literature [Kogevinas, et al. 2003]. For completeness, if the SIR met these criteria for renal pelvis cancer, we also reported the SIR value for bladder cancer, even if it did not meet the above criteria.

In order to test the hypothesis that bladder and renal pelvis cancers were similarly elevated in each occupation and industry category, the Pearson's correlation coefficient and two-tailed *p*-values were calculated from the log of the SIR values, stratified by sex. In addition, because occupational correlations could be related to smoking, we also estimated the correlation for SIR values using a conservative approach to adjust the SIR values for smoking. Using this approach, we identified occupations that were significantly elevated for lung cancer in this dataset as previously reported [Pollan and Gustavsson, 1999]. The list of male occupations elevated for bladder and/or renal pelvis cancer was then reviewed by the authors and placed into the following categories based on knowledge of the existing literature: definitely not tobacco-related only (occupation codes 633, 754, 757, 781, 794 and 826); probably not tobacco-related only (occupation codes 662, 751, 752, 795 and 932); and possibly tobacco-related only (295, 333, 603, 793, 941). The list of female occupations with both bladder and/or renal pelvis cancer elevations occurred in only three occupations (085, 758 and 921) all three of which were categorized as possibly tobacco-related only. Based on the existing literature that reports attenuation of occupation-related risks for cancers of the bladder and lung to range between 5 to 30 percent [Blair, et al. 1985, Siemiatycki, et al., 1988, Haldorsen, et al., 2004, Mannetje, et al., 1999, Richiardi, et al., 2005], we conservatively adjusted the number of observed cancers in each of the occupation groups above by reducing them by 30 percent and then calculated the tobacco-adjusted correlation between bladder and renal pelvis SIR values.

We used multivariate Poisson regression to estimate the relative risk of bladder and renal pelvis cancer with respect to the job-exposure matrix (JEM) estimated exposure to asbestos, ionizing radiation, physical activity, and indoor/outdoor work. The JEM variables were adjusted for urban residence, as well as attained age and calendar year.

Results

Among the 4,197,684 employed Swedish residents there were 70,083,912 person-years of follow-up, with a mean follow-up of 16.70 years. There were 1,014 and 360 renal pelvis cancers and 18,244 and 3,347 bladder cancers among men and women, respectively.

Occupation

Among women, there were no occupations with significantly elevated risks for both cancer sites (Table 1). Risk for both cancer sites was significantly reduced among women employed as agriculture and animal management workers. The correlation between bladder and renal pelvis risks was statistically significant, and this correlation was not altered once we adjusted the SIR values for smoking ($r=0.47$, $p=0.02$). Occupations which demonstrated excess risk for cancer of the bladder among women included: personnel work, business administration, bank cashier, clerk/secretary/stenographer, insurance clerk, switchboard operator, graphic work, bookbinder, photographic lab work, and waitress. Cancers of the renal pelvis were significantly elevated among women employed as pharmacists, journalists/editors, business executives, food-related workers, food process workers, and chemical/cellulose workers, unspecified. The largest proportion of bladder and renal pelvis cancers occurred among clerk/secretary/stenographers and waitresses combined (16% of bladder cancers and 18% of renal pelvis cancers), data not shown.

Among men, both cancer sites were elevated for purchasers/office sales people, shop and construction metal work, and, civil security and enforcement. Risks for both cancer sites were significantly reduced among men employed in agriculture and forestry work. The highest proportion of cases occurred in shop and construction metal work, accounting for 12% of bladder and 14% of renal pelvis cancers. There was not a statistically significant correlation between the non-smoking adjusted SIR values for occupation among men ($r=0.17$, $p=0.12$). However, once we adjusted SIR values for smoking the correlation increased slightly and became statistically significant ($r=0.25$, $p=0.02$).

Industry

Among women, risks for both cancer sites were elevated in the machine/electronics industry, and both cancer sites were significantly reduced in the agriculture and stock raising industry (Table 3). The correlation coefficient for the bladder and renal pelvis SIR industry values was statistically significant among women ($r=0.49$, $p=0.002$). Bladder cancer was significantly elevated among women employed in the following industries: graphics and publishing, book binderies, machine/electronics, radio/TV, wholesale durable goods (fuels, chemical, hardware and machines), banking, insurance, state administration (general), universities and higher learning, public functions, and hotel and restaurant work. Renal pelvis cancer was elevated among women employed in the food, chocolate and candy, machine/electronics, transportation equipment construction, hardware and machine business, and drugstore industries.

Among men, both cancer sites were significantly elevated among men employed in the machine/electronics industry, and both cancer sites were reduced among men employed in agriculture. The correlation coefficient between bladder and renal pelvis cancer risks was statistically significant ($r=0.25$, $p=0.04$). Employees in the machine/electronics industry accounted for 10% of bladder and 12% of renal pelvis cancers.

Job-exposure matrix and urban residence

Urban residence was associated with a 26 to 36% elevated risk for cancers of the bladder among men and women, respectively, but was not statistically significant for renal pelvis cancer (Table 5). Among both men and women, sedentary (versus physically active) and indoor (versus outdoor) work were associated with a significantly increased risk of both cancer sites and trends for both sexes and cancer sites were statistically significant (p -trends ranging from <0.001 to <0.03).

Among men, moderate occupational ionizing radiation exposure was associated with an elevated risk of bladder cancer, however, there was no evidence of a trend. There was also no association with bladder cancer mortality (data not shown).

Summary of Results

Both cancer sites were significantly elevated among workers in the following industries: machine/electronics (men and women), machine (men); and occupations: civil security (men), purchasing and office sales (men), and shop and construction metal (men); as well as indoor and sedentary workers, demonstrating evidence of a trend. Among all industry and occupational categories, shop and construction metal work contributed the highest proportion of cancers among men.

Discussion

Renal Pelvis

Cancer of the renal pelvis occurs less frequently than cancers of the bladder, and unlike bladder cancer, is not generally referred to as an occupational cancer. Our data suggest that among the employed population, the occupation-related correlations between these two cancer sites is moderate (25 percent among men and nearly 50 percent among women) and persists after proportionate adjustment for smoking-related cancers. We also found fewer commonly associated occupations between these two cancer sites than might be expected, given that both cancer sites are associated with tobacco smoking [Silverman, et al. 2006], the fact that cancers of the bladder and renal pelvis frequently occur simultaneously or as secondary cancers in the same individual [Rabbani, et al. 2001, Sharir and Jewett 1999], as well as data from molecular studies of genetic and epigenetic changes in tumors of the bladder and renal pelvis [Vriesema, et al. 2001, Paterson, et al. 2003, Hafner, et al. 2001].

In particular, we identified several jobs for which there was an elevated risk of cancer of the renal pelvis but not bladder. Several of these occupations and industrial groups also had a small number of cases (i.e. 5 or below), suggesting that these results could be due to chance. Those jobs with a significantly elevated risk for renal pelvis cancer, but not bladder cancer, and having more than 5 cases, included: women employed as food processors and employed in the food, transportation and drug store industries; and men employed as insurance clerks, butchers, cleaners and employed in the pulp grinding, metal manufacturing, scientific/surgical instruments, insurance and legal service industries. Cancers of the renal pelvis have been previously associated with work in the dry cleaning and iron and steel industry [McCredie and Stewart 1993]. Other occupational studies have reported an elevated risk of breast cancer in female pharmacists and an elevated risk of bladder cancer in the pharmaceutical industry. [Pelucchi, et al. 2002, Notani, et al. 1993, Baker, et al. 1986] Pharmacologic agents, such as phenacetin-containing analgesics, have been associated with papillary scarring and cancer of the renal pelvis while others are known to significantly alter intra-pelvic pressure as well as the flow rate of urine from the renal pelvis to the ureter [Stewart, et al. 1999, Jung, et al. 2006]. However, the extent of exposure to such agents in our study population is not known. Mycotoxins produced by fungal contamination of grains and cereals have been associated with Balkan endemic nephropathy, and this condition is in turn associated with an elevated risk of transitional cell cancers of the renal pelvis. [Grollman, et al. 2007] Certain mycotoxins, like ochratoxin A, are nephrotoxic and cause renal cell cancer in animal models. [Pfohl-Leszkowicz and Manderville 2007] Exposure to mycotoxins is known to occur in the food processing, meat, and pulp grinding industries [Prazmo, et al. 2003, Thuvander, et al. 2001]. One might hypothesize that that mycotoxin exposure is related to the commonly elevated risk of renal pelvis cancer in these occupational groups, although this is not known.

Conversely, it is notable that in our study all occupations and industrial groups which were protective for renal pelvis cancer (i.e. had a SIR value significantly below 1.0, $p < 0.05$), were also protective for bladder cancer. In addition, consistent with an earlier study, we identified a reduced risk for cancer of the renal pelvis for employment in agriculture, which was lower among women than among men [McLaughlin, et al. 1987]. A large proportion of women in our study sample were employed in agriculture, which may explain why trends for outdoor work and occupational physical activity were steeper among women than men, although the confidence intervals among men and women were overlapping.

Differences in risk factors for cancers of the bladder and renal pelvis for certain occupation and industry groups may be explained because certain carcinogens can act selectively or more intensively upon either the bladder or the renal pelvis, as is evidenced by animal studies [Murai, et al. 1993, Bach 1991], and as suggested by differences in genetic instability between bladder and renal pelvis tumors occurring within the same patient [Takahashi, et al. 2001]. In summary, however, our results suggest that while there are a few occupations with shared increased risk, these occupations account for a moderate proportion of the total number of cases in the employed population.

Bladder Cancer

Due to the sparse amount of information on risks for cancers of the renal pelvis, by necessity, the following discussion will focus primarily on the consistency of our findings with other studies of bladder cancer.

Physical Activity

In other studies, greater physical activity has been related to a reduced risk of bladder cancer, although these reports were not-statistically significant [Dosemeci, et al. 1993, Hardman 2001, Hu, et al. 2003, McTiernan, et al. 1998, Mellemegaard, et al. 1995, Severson, et al. 1989, Sommer, et al. 2004, Thune and Furberg 2001, Tripathi, et al. 2002, Brownson, et al. 1991]. While the biologic mechanisms of physical activity in cancer prevention are not clear, it has been hypothesized that moderate physical activity may improve mucosal immunity and alter cytokine expression [Sommer, et al. 2004, Tripathi, et al. 2002, Gleeson, et al. 2004, Bevers, et al. 2004, Griffiths and Mellon 2004, Drela, et al. 2004]. Notably, intravesical administration of *Bacillus Calmette-Guerin* (BCG) used to treat superficial bladder cancer, results in altered cytokine production (as measured in urine), and *in vitro*, BCG has been shown to induce T-cell and NK-cell activity [Moldoveanu, et al. 2001, Saint, et al. 2003, Ma, et al. 1987]. In addition, other epidemiologic studies and animal models suggest that other physical-activity related disease pathways, including IGF-1 and diabetes, may also be relevant [Tripathi, et al. 2002, Hursting, et al. 2004, Coughlin, et al. 2004].

Outdoor Work

An association with indoor work has not been previously reported. Sunlight is the major source of vitamin D [Holick 2004]. The active metabolite of Vitamin ($1\alpha,25(\text{OH})_2\text{D}_3$) is reported to promote apoptosis in human bladder cancer cell lines, and intravesical administration of vitamin D3 in the bladder has been shown to reduce the incidence of bladder tumors in animal models [Konety, et al. 2001, Yazawa, et al. 2000]. However, it is important to note that most physically active occupations are also outdoors and our study is unable to disentangle the differential relation of outdoor exposure and physical activity. Follow-up in future studies is necessary.

Farm Work

Reduced bladder cancer risk has been frequently found among farmers [McLaughlin, et al. 1987, Lee, et al. 2004, Blair, et al. 1992, Acquavella, et al. 1998, Porru, et al. 1996, Wiklund and Dich 1994]. However, elevated risks have been reported for professional gardeners [Silverman, et al. 1989, Teschke, et al. 1997, Colt, et al. 2004], orchard and greenhouse workers [Kristensen, et al. 1996], nursery workers [Kogevinas, et al. 2003], herbicide applicators [Lee, et al. 2004, Rusiecki, et al. 2004, la Vecchia, et al. 1990], and field crop workers [Mannetje, et al. 1999]. Several other cancers are reduced among farmers, possibly related to the generally lower smoking rate among farmers [Wiklund and Dich 1994, Statistics 1965, Wiklund and Dich 1995], although studies adjusting for smoking still find a reduced risk of bladder cancer among farmers [Barbone, et al. 1994, Folsom, et al. 1996]. Similarities in the risk for bladder cancer among men and women employed in farming and the agricultural sector suggest that non-occupational factors may be important since job-related exposures may be quite different between men and women [Alavanja, et al. 1999].

Urban Residence—Urban residence has been previously associated with higher risk of bladder cancer, possibly related to environmental agents more frequently encountered in urban environments, including chlorination by-products in drinking water, tobacco smoke, and decreased fluid intake [Villanueva, et al. 2004].

Ionizing Radiation—Ionizing radiation is an established cause of bladder cancer, primarily through studies of high-dose radiotherapy, radioactive iodine therapy, and atomic bomb survivors [Silverman, et al. 2006]. Only a few studies have reported excess bladder cancer risk due to ‘low-dose’ ionizing radiation exposures which are generally found in the occupational setting, and most of these studies focus on cancer mortality rather than incidence [McGeoghegan and Binks 2000, Sont, et al. 2001, Cardis, et al. 1995, Ugnat, et al. 2004]. Our study found evidence of an association between ionizing radiation and bladder cancer incidence. However, we did not find a trend with higher exposure, possibly due to the small number of individuals in highly exposed jobs or to exposure misclassification. The plausibility of lower-dose exposure in bladder cancer risk has been suggested by the positive relation between Cs 137 levels in urine, chronic proliferative atypical cystitis (Chernobyl cystitis), and the development of dysplasia and carcinoma *in situ* of the bladder among individuals living in the Chernobyl region [Romanenko, et al. 2003].

Machine & Electronics—Several studies report elevated risk of bladder cancer among machinists [Kogevinas, et al. 2003, Colt, et al. 2004, Tolbert 1997] and a previous follow-up of this cohort found elevated risk for cancer of the renal pelvis among this occupational group [McLaughlin, et al. 1987]. Metal-workers and machinists account for approximately 15% of occupationally-related bladder cancers in Europe [Kogevinas, et al. 2003]. Other electronics-related work associated with increased bladder cancer risk in this study include: radio and TV, electrical installation, electrical power/gas/waterworks, and electrical work. Electric power plant workers may be at excess risk for kidney and bladder cancer [Mattos, et al. 2002, Mattos and Koifman 1996], although this has not been consistently found [Mattos and Koifman 1996, Baris, et al. 1996, Keller and Howe 1993]. Electricians and electrical workers are exposed to polychlorinated biphenyls, asbestos, and low frequency EMF, none of which have been conclusively linked to occupational bladder cancer. Workers in the semiconductor industry exposed to elemental arsenic and/or gaseous arsenic hydride in the manufacture of silicon chips have been shown to have higher urinary metabolites of arsenic [Hwang, et al. 2002]. While arsenic is classified as a known bladder carcinogen, the carcinogenic potential of occupational exposures is not clear [Cancer 2004].

Bladder Cancer among Women—Our results are consistent with previous studies among women finding excess bladder cancer risks among, secretarial and clerical [Zheng, et al. 2002], cashiers [Colt, et al. 2004] [Colt, et al. 2004], education work [Zheng, et al. 2002], sales [Mannetje, et al. 1999, Colt, et al. 2004, Swanson and Burns 1995, Silverman, et al. 1990], graphics and publishing [Bulbulyan, et al. 1999], machine [Barbone, et al. 1994], electronics [Mannetje, et al. 1999, Silverman, et al. 1990, Simpson, et al. 1999], telephone industry [Dosemeci and Blair 1994], and waitresses [Simpson, et al. 1999]. In addition, among women, Gridley et al. (1999) report a 20% elevated risk of bladder cancers among the employed population, compared with the non-employed female population in Sweden [Gridley, et al. 1999]. Because our study was limited to the employed population, this suggests that the occupational bladder cancer risks among women reported in this study may be higher when compared with the general population. We did not confirm observations of significantly elevated bladder cancer risk among women employed in pulp and paper processing [Langseth and Andersen 1999], health services [Colt, et al. 2004, Simpson, et al. 1999, Carpenter and Roman 1999], leather [Garabrant and Wegman 1984], metal work [Mannetje, et al. 1999, Silverman, et al. 1990], chemical [Pelucchi, et al. 2002, Silverman, et al. 1990, Dolin and Cook-Mozaffari 1992], rubber [Swanson and Burns 1995, Silverman, et al. 1990, Simpson, et al. 1999, Carpenter and Roman 1999], and textile [Mannetje, et al. 1999, Simpson, et al. 1999, Carpenter and Roman 1999] industries. A large pooled analysis of case-control studies in Europe among leather and rubber work also did not report elevated risks [Mannetje, et al. 1999]. Elevations in bladder cancer risk among women employed as photographic laboratory workers, book binders, and business administrators, and the radio and TV industry have not been previously reported. Finally, although the relative risks we found in this study among women employed as clerks/secretaries and waitresses were modest, these occupations accounted for a large proportion of the total number of cases.

Bladder Cancer among Men—Our results are similar to research reporting elevated bladder cancer risk among men employed in: administrative and clerical work [Porru, et al. 1996, Schumacher, et al. 1989], artistic work [Brown, et al. 2002], automotive repair [Zheng, et al. 2002], chemical industry [Silverman, et al. 1989, Teschke, et al. 1997, la Vecchia, et al. 1990], electronics and electrical work [Mattos, et al. 2002, Dolin and Cook-Mozaffari 1992, Tynes, et al. 1992], engineering [Dolin and Cook-Mozaffari 1992], electrical power/gas and waterworks [Dolin and Cook-Mozaffari 1992], executives [Dolin and Cook-Mozaffari 1992], food processors [Dolin and Cook-Mozaffari 1992], gas stations [Schoenberg, et al. 1984], glass processing [Dolin and Cook-Mozaffari 1992], health care (including physicians) [Wynder and Goldsmith 1977, Howe, et al. 1980], machine industry [Kogevinas, et al. 2003, Colt, et al. 2004, Tolbert 1997, Dolin and Cook-Mozaffari 1992, Howe, et al. 1980, Claude, et al. 1988], metal work [Silverman, et al. 1989, Zheng, et al. 2002], photographic lab work, printing/graphics work [Lyng, et al. 1995, Pesch, et al. 2000], railroad work [Dolin and Cook-Mozaffari 1992], rubber industry [Vineis and Magnani 1985, Zheng, et al. 2002, Straif, et al. 1998], ship's machine command [Dolin and Cook-Mozaffari 1992], shop and metal industry [Kogevinas, et al. 2003, Teschke, et al. 1997, Colt, et al. 2004, Pesch, et al. 2000], transportation workers [Colt, et al. 2004, Dolin and Cook-Mozaffari 1992, Pesch, et al. 2000, Hoar and Hoover 1985, Silverman, et al. 1983, Guo, et al. 2004], and waiters [Porru, et al. 1996]. This study did not confirm elevations in bladder cancer among men employed as asbestos workers [Ugnat, et al. 2004], dry cleaners [Teschke, et al. 1997, Zheng, et al. 2002, Pesch, et al. 2000, Ruder, et al. 2001, Brown and Kaplan 1987], dyestuffs workers [Vineis and Magnani 1985, Ugnat, et al. 2004, Vineis and Pirastu 1997], hairdressers [Teschke, et al. 1997, Lyng 1990, Miller and Bartsch 2001], leather workers [Dolin and Cook-Mozaffari 1992, Schumacher, et al. 1989, Pesch, et al. 2000, Montanaro, et al. 1997], miners [Teschke, et al. 1997, Dolin and Cook-Mozaffari 1992], painters [Silverman, et al. 1989, Teschke, et al. 1997, Zheng, et al. 2002, Dolin and Cook-Mozaffari 1992], petroleum workers [Teschke, et al. 1997], textile workers

[Kogevinas, et al. 2003, Teschke, et al. 1997, Frumin, et al. 1990], or welders [Silverman, et al. 1989]. A large pooled case-control study also reported no association with hairdressing [Mannetje, et al. 1999], and the lack of association during the time period of this study may be related to changes in the constituents of the hair dyes used [Czene et al. 2003]. There may also be unique aspects of the Swedish work environment which might be important in comparing our results with other studies [Kleinman 1984]. Similar to our study, Axelson et al. (1994) did not observe an increased risk of bladder cancer in Swedish dry cleaners [Axelson, et al. 1994]. In addition, while previous studies have found quite high risks associated with dyestuffs work (ranging from 4 to 64-fold), benzidine and 2-naphthylamine are two known carcinogenic compounds which have not been widely used in the dye industry in Nordic countries [Vineis and Magnani 1985, la Vecchia, et al. 1990, Naito, et al. 1995], [Dreyer, et al. 1997].

Strengths and Limitations—The strengths of this study include: a large number of cases in a population with excellent cancer surveillance, the investigation of risk factors among the working population in order to control for the ‘healthy-worker bias,’ and the ascertainment of occupational exposure prior to cancer diagnosis. Important limitations of this study include: 1) no adjustment for the effects of other potential confounding factors in the estimation SIR values (e.g. diet, tobacco use, use of protective equipment on the job), 2) exposure misclassification due to classification of occupational exposures based on job title occurring at one point in time, which may be greater for women than for men [Stewart and Blair 1994]; and 3) the large number of comparisons in this analysis, which increases the possibility that a statistically significant finding is due to chance alone [Law, et al. 2001].

Methodologic studies report that adjustment for tobacco use in occupational studies may alter occupational risk estimates [Shavers, et al. 2005, Ji, et al. 2005, Richiardi, et al. 2005]. Studies using diverse methods including the assessment of confounding in case-control studies using self-reported smoking status, and those employing an *a priori* correction factor for smoking-related occupations have found adjustment for smoking to result in attenuation of approximately 10 to 25% [Blair, et al. 1985, Siemiatycki, et al., 1988, Haldorsen, et al., 2004, Mannetje, et al., 1999, Richiardi, et al., 2005]. A recent study reports that, among Swedish men employed in 1960 and 1970, the risk for bladder cancer among men was attenuated downwards by a range 5 to 29%, depending upon the occupation [Ji et al., 2005]. Richiardi et al. (2005) adjusted for self-reported smoking status and found lung cancer risk among men employed in metal and machine industry to be attenuated downwards by 6% and for blue collar workers by 11% [Richiardi, et al. 2005]. We used the upper limit of 30% to adjust for the possibility that smoking could be confounding our SIR results. The smoking-adjusted SIR resulted in an increased correlation between bladder and renal pelvis risks among men. This suggests that the correlations we observed between bladder and renal pelvis cancers were not due to tobacco alone. It is likely, however, that our correction may be too stringent as not all occupations with an elevated risk for lung cancer are solely due to smoking, but may be attributed to recognized workplace carcinogens [Siemiatycki et al., 2004, Rousseau et al., 2005].

Conclusions

Our work suggests that there are common occupational risks for cancers of the bladder and renal pelvis, particularly among women. Further research is needed to confirm commonly elevated risks found for the machine/electronics industry, physical inactivity and indoor work. In addition, there may be several jobs that pose an increased risk specifically for cancer of the renal pelvis but not bladder.

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Table I

Risk for bladder and renal pelvis cancer among women in Sweden by occupation, 1971-1989¹

Occupation Number and Name	Employed Women	Bladder			Renal Pelvis		
		Obs	SIR	95% CI	Obs	SIR	95% CI
014 Laboratory technician	5965	9	1.60	(0.73-3.03)			
023 Research: Agriculture, horticulture	512	3	3.60	(0.72-10.51)			
046 Pharmacists	3336	7	1.98	(0.79-4.09)	3	7.23	(1.45-21.12)
056 Preschool teachers	10011	6	0.84	(0.31-1.83)	3	3.75	(0.75-10.95)
08. Literary and artistic work	11217	19	1.17	(0.70-1.83)	5	2.69	(0.87-6.28)
085 Journalists and editors	3268	4	0.79	(0.21-2.02)	3	5.10	(1.03-14.91)
096 Personnel	2798	11	2.57	(1.28-4.60)			
11. Business Administration	10422	41	1.68	(1.20-2.28)	7	2.44	(0.98-5.02)
111 Business executives	2339	11	1.50	(0.75-2.68)	4	4.90	(1.32-12.56)
118 Business administration	8133	30	1.74	(1.17-2.48)	3	1.44	(0.29-4.22)
203 Bank cashiers	5243	13	2.09	(1.11-3.58)			
29. Clerks, secretaries and stenographers	296937	383	1.15	(1.04-1.27)	51	1.31	(0.97-1.72)
296 Insurance clerks	6573	19	1.89	(1.14-2.96)	3	2.50	(0.50-7.31)
331 Purchasers, office sales	9616	15	1.02	(0.57-1.68)	4	2.29	(0.62-5.86)
401 Farmers--owners	10390	24	0.67	(0.43-1.00)			
41. Agriculture and animal management	71192	109	0.66	(0.54-0.80)	9	0.46	(0.21-0.88)
411 Agricultural workers	52713	75	0.62	(0.48-0.77)	5	0.35	(0.11-0.81)
413 Pet keepers	9571	7	0.32	(0.13-0.65)			
654 Switchboard operators	21017	37	1.43	(1.01-1.98)	5	1.63	(0.52-3.79)
722 Shoe workers	5822	15	1.32	(0.74-2.17)			
726 Saddles and leather sewing	2195	5	1.33	(0.43-3.11)			
741 Fine instrument makers	700	3	2.52	(0.51-7.37)			
75. Shop and construction metalwork	24016	52	1.30	(0.97-1.70)	8	1.66	(0.71-3.26)
757 Metal platers	368	3	4.05	(0.81-11.82)			
758 Shop and metal industry, other	14097	34	1.36	(0.94-1.89)	7	2.32	(0.93-4.78)
80. Graphic work	11722	30	1.65	(1.11-2.36)			

Occupation Number and Name	Employed Women	Bladder			Renal Pelvis		
		Obs	SIR	95% CI	Obs	SIR	95% CI
806 Bookbinders	7517	22	1.77	(1.11-2.68)			
819 Glasswork, unspecified	1145	6	2.70	(0.99-5.89)			
82. Food related work	23692	51	0.96	(0.72-1.27)	17	2.73	(1.59-4.37)
825 Food processors	5950	11	0.84	(0.42-1.50)	7	4.53	(1.81-9.33)
83. Chemical and cellulose work	7442	19	1.28	(0.77-2.00)	4	2.28	(0.61-5.83)
831 Chemical process workers	644	4	3.18	(0.86-8.15)			
839 Chemical/cellulose, unspecified	2236	9	2.04	(0.93-3.88)	3	5.77	(1.16-16.87)
851 Rubber product workers	2601	8	1.56	(0.67-3.07)			
854 Photographic laboratory work	1662	6	2.81	(1.03-6.11)			
908 Security work, other ²	1471	7	2.44	(0.98-5.02)			
921 Waitresses	47620	137	1.30	(1.09-1.53)	14	1.12	(0.61-1.88)
941 Barbers, beauticians, etc.	26940	24	0.91	(0.58-1.36)	3	1.01	(0.20-2.96)
943 Laundry workers	13137	37	1.07	(0.75-1.47)	5	1.23	(0.39-2.86)
944 Clothes pressing	5868	15	0.93	(0.52-1.53)	3	1.59	(0.32-4.66)
946 Photographers	1478	5	2.18	(0.70-5.09)			

Bladder and Renal Pelvis SIR Correlation

Unadjusted correlation and p-value

Smoking-adjusted correlation and p-value (Pearson's correlation of the log SIR)

r=0.47, p=0.02

r=0.47, p=0.02

¹ SIR values for categories with fewer than 3 cases not reported.

² Other than police, customs and prison guards.

Table II

Risk for bladder and renal pelvis cancer among men in Sweden by occupation, 1971-1989¹

Male Occupation Number and Name	Employed Men	Bladder			Renal Pelvis		
		Obs	SIR	95% CI	Obs	SIR	95% CI
00. Technical work	262901	1722	1.08	(1.03-1.13)	111	1.15	(0.94-1.38)
003 Mechanical engineers	93433	643	1.10	(1.02-1.19)	41	1.14	(0.82-1.55)
004 Chemical engineers	18638	177	1.28	(1.10-1.49)	9	1.09	(0.50-2.07)
03. Medical work	12933	119	1.36	(1.13-1.63)	9	1.78	(0.81-3.38)
031 Physicians	8370	80	1.42	(1.12-1.76)	4	1.22	(0.33-3.14)
032 Dentists	4617	40	1.27	(0.91-1.73)	5	2.74	(0.88-6.40)
05. Education	65237	310	0.85	(0.76-0.95)	22	1.02	(0.64-1.54)
052 Teachers, special disciplines	19999	77	0.76	(0.60-0.95)	5	0.82	(0.26-1.91)
053 Classroom teachers	15452	69	0.74	(0.58-0.94)	5	0.94	(0.30-2.19)
054 Trainers	7765	31	0.69	(0.47-0.98)			
071 Courtroom lawyers	2338	17	1.19	(0.69-1.90)	5	6.06	(1.95-14.13)
08. Literary and artistic work	25904	184	1.23	(1.06-1.42)	10	1.12	(0.54-2.06)
081 Pictorial artists	5998	59	1.48	(1.13-1.91)	6	2.55	(0.93-5.55)
088 Other literary and artistic work	1512	18	2.42	(1.43-3.82)	0		
091 Accountants and auditors	5987	51	1.37	(1.02-1.80)	4	1.84	(0.49-4.71)
097 Programmer, systems analysis	7013	12	0.92	(0.48-1.61)	3	3.48	(0.70-10.18)
11. Business executives and administrators	84006	909	1.25	(1.17-1.34)	47	1.12	(0.82-1.49)
20. Book keeping and cashiers	30485	238	1.16	(1.02-1.32)	16	1.34	(0.77-2.18)
203 Bank cashiers	998	13	1.92	(1.02-3.29)			
29. Stenographic, typing and office work	126018	894	1.16	(1.08-1.23)	52	1.14	(0.85-1.49)
292 Bank clerks	10611	54	1.48	(1.11-1.93)			
295 Real estate and commodities	31384	312	1.16	(1.04-1.30)	14	0.90	(0.49-1.50)
296 Insurance clerks	4692	39	1.33	(0.94-1.82)	6	3.40	(1.24-7.39)
30. Wholesale and retail business work	51810	536	1.11	(1.02-1.21)	29	1.06	(0.71-1.52)
311 Insurance agents	4258	40	1.26	(0.90-1.72)	5	2.65	(0.85-6.18)
32. Traveling sales people	28904	263	1.38	(1.21-1.55)	7	0.61	(0.24-1.26)

Male Occupation Number and Name		Employed Men	Bladder			Renal Pelvis		
			Obs	SIR	95% CI	Obs	SIR	95% CI
33.	Other commercial work	150729	1001	1.24	(1.16-1.32)	62	1.26	(0.96-1.61)
331	Purchasers/office sales	64354	475	1.23	(1.12-1.35)	36	1.52	(1.06-2.10)
332	Business owners	25008	234	1.28	(1.12-1.45)	13	1.19	(0.63-2.03)
333	Business Personnel, other	54483	260	1.15	(1.01-1.29)	12	0.86	(0.44-1.51)
334	Door to door sales	954	15	1.82	(1.02-3.01)			
338	Gasoline sellers	15475	82	1.38	(1.09-1.71)	3	0.81	(0.16-2.36)
40.	Agriculture, forestry, park management	219701	1627	0.70	(0.67-0.74)	72	0.58	(0.46-0.73)
401	Farmers	201140	1475	0.68	(0.65-0.72)	67	0.58	(0.45-0.74)
41.	Agriculture, horticulture, husbandry	123288	539	0.72	(0.66-0.78)	30	0.72	(0.49-1.03)
411	Agricultural workers	92200	313	0.61	(0.55-0.69)	20	0.71	(0.43-1.10)
44.	Forestry and logging work	80976	434	0.70	(0.64-0.77)	18	0.51	(0.30-0.81)
60.	Ship's officers	10231	92	1.31	(1.06-1.61)	5	1.22	(0.39-2.84)
603	Machine command	3730	33	1.56	(1.07-2.19)			
63.	Railroad engineers and conductors	188473	1150	1.10	(1.04-1.17)	59	0.93	(0.71-1.20)
633	Chauffeurs, streetcar drivers	152,033	945	1.13	(1.06-1.20)	48	0.95	(0.70-1.25)
64.	Traffic administration	17476	170	1.22	(1.05-1.42)	8	0.94	(0.41-1.85)
644	Highway traffic administrators	6741	73	1.35	(1.06-1.70)	5	1.56	(0.50-3.64)
66.	Postal and Messenger Work	36124	242	1.14	(1.00-1.30)	13	1.07	(0.57-1.84)
662	Office caretaker and messenger	16371	150	1.30	(1.10-1.52)	8	1.27	(0.55-2.50)
715	Tailors	3160	20	0.89	(0.54-1.37)	3	2.26	(0.45-6.59)
716	Ready made garment worker	1445	8	0.79	(0.34-1.55)	3	5.08	(1.02-14.85)
75.	Shop and construction metal work	378151	2193	1.10	(1.06-1.15)	143	1.19	(1.00-1.40)
751	Machine assembly	34700	214	1.27	(1.11-1.45)	17	1.62	(0.94-2.59)
752	Machine and motor repair	105336	581	1.09	(1.00-1.18)	33	1.01	(0.70-1.42)
754	Plumbers	32564	220	1.21	(1.05-1.38)	11	1.00	(0.50-1.79)
757	Metal plating work	3861	24	0.97	(0.62-1.44)	4	2.70	(0.73-6.92)
758	Shop and metal industry work	36331	284	1.18	(1.05-1.33)	14	0.98	(0.54-1.65)
76.	Electrical work	110719	550	1.09	(1.00-1.19)	36	1.17	(0.82-1.62)
766	Telephone repair and installation	7309	27	0.90	(0.59-1.31)	4	2.12	(0.57-5.42)

Male Occupation Number and Name		Employed Men	Bladder			Renal Pelvis		
			Obs	SIR	95% CI	Obs	SIR	95% CI
77.	Woodworking	183690	1177	0.85	(0.80-0.90)	62	0.79	(0.61-1.02)
771	Construction carpenters	88429	605	0.89	(0.82-0.96)	29	0.75	(0.51-1.08)
772	Bench and cabinet makers	59241	386	0.87	(0.78-0.96)	26	1.03	(0.67-1.51)
774	Saw and plane operators	13403	84	0.76	(0.61-0.94)	4	0.64	(0.17-1.63)
778	Woodworking, general	16,392	95	0.77	(0.62-0.94)	5	0.71	(0.23-1.66)
781	Painters	37,950	297	1.07	(0.95-1.20)	17	1.08	(0.63-1.73)
793	Rough Construction Workers	82,099	596	0.92	(0.84-0.99)	32	0.86	(0.59-1.21)
794	Insulation specialists	2720	17	1.24	(0.72-1.98)	3	3.56	(0.71-10.39)
795	Glaziers	4007	31	1.66	(1.13-2.36)			
82.	Food related work	50397	333	1.03	(0.92-1.15)	31	1.65	(1.12-2.35)
825	Food processors	2632	22	1.14	(0.71-1.73)	5	4.49	(1.45-10.49)
826	Butchers and meat packers	13973	92	1.09	(0.88-1.34)	11	2.22	(1.11-3.98)
827	Dairy Workers	6166	29	0.68	(0.46-0.98)			
83.	Chemical and cellulose industry	44208	370	1.10	(0.99-1.22)	21	1.09	(0.67-1.66)
838	Chemical cellulose industry (general)	2282	32	1.73	(1.18-2.44)	3	2.78	(0.56-8.12)
851	Rubber product workers	8864	66	1.30	(1.00-1.65)	6	1.95	(0.71-4.25)
853	Tanners and skin processors	1965	18	1.15	(0.68-1.82)			
86.	Heavy laborers	81695	553	0.81	(0.75-0.89)	32	0.84	(0.57-1.18)
90.	Civil security and enforcement work	40120	300	1.19	(1.06-1.33)	25	1.67	(1.08-2.47)
903	Customs personnel	3226	36	1.45	(1.02-2.01)			
904	Prison guards	3725	17	0.90	(0.52-1.43)	4	3.38	(0.91-8.65)
92.	Waiting on tables	5365	36	1.69	(1.18-2.34)			
932	Cleaners	8001	79	1.08	(0.85-1.34)	9	2.27	(1.04-4.31)
933	Chimney sweeps	2996	23	1.78	(1.13-2.67)			
941	Barbers, beauticians, etc.	6831	62	1.24	(0.95-1.58)	6	2.04	(0.75-4.45)
943	Laundry workers	3375	31	1.23	(0.83-1.74)			
944	Clothes pressing	2480	21	1.21	(0.75-1.85)			
945	Race horse trainers, jockeys	1386	3	0.48	(0.10-1.40)	3	7.81	(1.57-22.82)

Bladder and Renal Pelvis SIR Correlation

Unadjusted correlation and p-value:

Smoking-adjusted correlation and p-value (Pearson's correlation of the log SIR)

$r=0.17$, $p=0.12$

$r=0.25$, $p=0.02$

I SIR values for categories with fewer than 3 cases not reported.

Table III

Risk for bladder and renal cancer pelvis cancer among women in Sweden by Industry, 1971-1989¹

Industry Number and Name	Employed Women	Bladder			Renal Pelvis		
		Obs	SIR	95% CI	Obs	SIR	95% CI
01. Agriculture	82717	132	0.65	(0.55-0.78)	10	0.43	(0.20-0.78)
010 Agriculture work and stock raising	70910	101	0.58	(0.47-0.70)	6	0.29	(0.11-0.64)
014 Other animal breeding	535	4	3.33	(0.90-8.53)			
20. Food	60988	125	1.02	(0.85-1.22)	24	1.67	(1.07-2.48)
202 Fruit and vegetable processing	5334	9	0.91	(0.41-1.72)	3	2.57	(0.52-7.52)
203 Fish processing and canning	3241	7	0.98	(0.39-2.02)	3	3.59	(0.72-10.50)
206 Sugar	953	5	2.16	(0.70-5.04)			
207 Chocolate and candy	4696	10	1.17	(0.56-2.15)	4	3.96	(1.06-10.13)
210 Wine and liquor	314	3	3.44	(0.69-10.06)			
225 Rope and twine plants	659	3	2.02	(0.41-5.90)			
25. Furniture	6761	13	1.23	(0.65-2.11)	3	2.36	(0.47-6.89)
250 Furniture making	5987	12	1.34	(0.69-2.34)	3	2.77	(0.56-8.09)
27. Graphic and publishing	32662	71	1.32	(1.03-1.66)	9	1.42	(0.65-2.70)
271 Book and printing shops	5020	17	1.63	(0.95-2.60)			
273 Bookbinderies	4642	15	1.90	(1.06-3.13)			
28. Leather	3799	10	1.54	(0.74-2.84)			
283 Leather fabrication, other ²	2118	8	2.27	(0.98-4.48)			
30. Rubber	5708	12	1.23	(0.64-2.15)			
300 Rubber goods production	4670	9	1.07	(0.49-2.04)			
31. Chemical	22557	41	1.18	(0.85-1.60)	6	1.46	(0.53-3.17)
310 Explosives plants	1200	6	2.44	(0.89-5.31)			
34. Metal	33106	61	1.23	(0.94-1.57)	7	1.18	(0.47-2.44)
341 Pig iron and steel foundries	859	3	2.36	(0.48-6.91)			
35. Machine and electronics	63679	106	1.22	(1.00-1.48)	18	1.75	(1.04-2.76)
351 Radio and TV	13934	28	1.67	(1.11-2.41)	4	1.98	(0.53-5.08)
352 Other electronics	25250	47	1.18	(0.87-1.57)	12	2.53	(1.31-4.42)

Industry Number and Name	Employed Women	Bladder			Renal Pelvis		
		Obs	SIR	95% CI	Obs	SIR	95% CI
36. Transportation construction	20481	30	1.26	(0.85-1.81)	8	2.84	(1.22-5.59)
363 Automotive plants	6359	6	0.83	(0.30-1.81)	3	3.45	(0.69-10.08)
364 Automotive repair	8042	15	1.75	(0.98-2.88)	3	2.96	(0.60-8.65)
371 Optical and photographic equipment	389	3	4.86	(0.98-14.21)			
61. Wholesale durable goods	45411	81	1.28	(1.02-1.59)	9	1.21	(0.55-2.30)
613 Wholesale fuels	3453	7	1.45	(0.58-2.99)			
617 Wholesale chemical products	4141	11	1.79	(0.89-3.20)	3	4.15	(0.83-12.14)
642 Hardware and machine businesses	3529	4	0.79	(0.21-2.03)	3	5.09	(1.02-14.88)
656 Drugstores	12963	12	0.88	(0.45-1.53)	7	4.46	(1.79-9.19)
67. Banking and insurance	54327	94	1.35	(1.09-1.66)	5	0.62	(0.20-1.44)
673 Insurance (excluding health)	23048	47	1.59	(1.17-2.12)	4	1.15	(0.31-2.95)
700 Railroad traffic	4563	3	0.29	(0.06-0.85)			
805 Customs	753	4	2.77	(0.75-7.10)			
807 Other State Administration	55616	98	1.27	(1.03-1.54)	5	0.55	(0.18-1.27)
810 Universities and higher learning	2834	13	2.20	(1.17-3.76)			
84. Public functions	34405	54	1.34	(1.01-1.75)	6	1.27	(0.46-2.76)
850 Writing and other literary work	1883	8	2.10	(0.90-4.13)			
856 Radio and TV broadcasting	1757	4	2.21	(0.59-5.65)			
87. Hotel and restaurant work	69600	183	1.22	(1.05-1.41)	19	1.09	(0.66-1.71)
870 Restaurants	39995	124	1.42	(1.18-1.70)	11	1.08	(0.54-1.93)
880 Laundry, ironing, dyeing	18669	55	1.18	(0.89-1.53)	8	1.45	(0.63-2.86)

Bladder and Renal Pelvis SIR

Correlation coefficient and p-value

(Pearson's correlation of the log SIR)

r=0.49, p=0.009

¹ SIR values for categories with fewer than 3 cases not reported.

² Excludes tanneries, skin processing, handbags and luggage.

Table IV

Risk for bladder and renal pelvis cancer among men in Sweden by Industry, 1971-1989^a

Industry Code and Name	Employed Men	Bladder (N=18,244)			Renal Pelvis (N=1,014)		
		Obs	SIR	95% CI	Obs	SIR	95% CI
01. Agriculture	312,782	2010	0.71	(0.68-0.74)	95	0.62	(0.50-0.76)
010 Agriculture work and stock raising	277,627	1753	0.68	(0.65-0.72)	75	0.55	(0.43-0.69)
020 Forest management	12,236	79	0.79	(0.62-0.98)	3	0.52	(0.10-1.51)
021 Logging	83,467	475	0.74	(0.67-0.81)	18	0.49	(0.29-0.78)
101 Iron ore mines	14,811	68	0.72	(0.56-0.91)	6	1.09	(0.40-2.36)
106 Peat digging	157	3	2.02	(0.41-5.91)			
206 Sugar industry	3,918	53	1.52	(1.14-1.98)			
208 Other food industries	4,712	51	1.43	(1.07-1.89)			
224 Knitting factories	4,167	30	0.93	(0.63-1.33)	5	2.69	(0.87-6.28)
23. Garment Industry	31,770	291	1.15	(1.02-1.29)	20	1.40	(0.86-2.17)
240 Sawmills and planing mills	47,729	275	0.78	(0.69-0.88)	20	1.00	(0.61-1.54)
243 Wooden house factories	27,487	134	0.77	(0.65-0.92)	6	0.58	(0.21-1.26)
260 Pulp grinding plants	17,656	130	1.07	(0.89-1.27)	15	2.04	(1.14-3.37)
270 Newspaper printing	11,302	86	1.06	(0.85-1.31)	4	0.85	(0.23-2.18)
272 Graphic industries (excl. book printing)	4,694	43	1.65	(1.19-2.22)	4	2.56	(0.69-6.55)
273 Bookbinding	4,264	37	1.34	(0.95-1.85)	4	2.50	(0.67-6.40)
276 Music publishing	56	3	7.86	(1.58-22.98)			
280 Tanneries and other leather processing	2,131	15	0.89	(0.50-1.48)			
300 Rubber goods production	12,276	111	1.47	(1.21-1.77)	6	1.33	(0.49-2.89)
301 Vulcanizing shops	2,235	22	1.60	(1.00-2.42)			
31. Chemical Industry	46,860	346	1.14	(1.02-1.26)	16	0.88	(0.51-1.44)
310 Explosives plants	2,595	24	1.01	(0.65-1.50)			
312 Preparation of industrial basic chemicals	11,228	111	1.33	(1.09-1.60)			
332 Porcelain and earthenware	4,633	34	1.02	(0.70-1.42)	4	2.07	(0.56-5.31)
333 Cement plants	3,121	21	0.92	(0.57-1.41)	3	2.31	(0.46-6.75)
340 Iron and steel plants	61,043	376	0.95	(0.86-1.05)	27	1.16	(0.77-1.69)

Industry Code and Name	Employed Men	Bladder (N=18,244)			Renal Pelvis (N=1,014)		
		Obs	SIR	95% CI	Obs	SIR	95% CI
346 Other metal manufacturing	57,831	341	0.98	(0.88-1.09)	32	1.52	(1.04-2.14)
35. Machine/electronics	263,304	1740	1.13	(1.08-1.18)	120	1.30	(1.08-1.55)
350 Machine industry	182,171	1271	1.14	(1.08-1.21)	84	1.26	(1.00-1.56)
352 Electronics	70,033	467	1.12	(1.02-1.23)	33	1.32	(0.91-1.85)
36. Transportation equipment construction	179,227	1959	1.07	(1.01-1.14)	66	1.10	(0.85-1.40)
360 Shipbuilding	44,048	324	1.13	(1.01-1.26)	22	1.30	(0.82-1.97)
370 Scientific and surgical instruments	7,517	51	1.21	(0.90-1.59)	10	3.87	(1.85-7.12)
376 Toy production	312	6	2.67	(0.97-5.80)			
400 Home building business	261,955	1653	0.93	(0.89-0.98)	90	0.87	(0.70-1.07)
41. Building and construction ²	199,117	1349	1.08	(1.02-1.14)	80	1.09	(0.86-1.35)
411 Glazier work	3,619	32	1.86	(1.27-2.62)			
413 Plumbing installation	34,567	236	1.23	(1.08-1.39)	15	1.30	(0.72-2.14)
414 Electrical installation	31,016	170	1.28	(1.10-1.49)	13	1.60	(0.85-2.74)
50. Electrical Power, Gas and Waterworks	48,533	396	1.12	(1.02-1.24)	23	1.11	(0.70-1.67)
60. Wholesale Foods	39,975	310	1.19	(1.06-1.33)	14	0.91	(0.50-1.53)
614 Wholesale machines	25,421	153	1.19	(1.01-1.39)	14	1.76	(0.96-2.96)
615 Wholesale means of transport	7,860	55	1.39	(1.05-1.81)	6	2.45	(0.90-5.34)
617 Wholesale chemical products	11,433	98	1.35	(1.10-1.65)	5	1.15	(0.37-2.67)
620 Food businesses	45,401	320	1.12	(1.00-1.25)	20	1.19	(0.72-1.83)
641 Retail glass, porcelain, household goods	596	13	2.33	(1.24-3.98)			
642 Hardware and machine businesses	10,718	79	1.35	(1.07-1.68)			
650 Automobile and motorcycle businesses	12,980	74	1.42	(1.11-1.78)			
657 Gasoline stations	16,241	90	1.48	(1.19-1.81)			
670 National bank of Sweden	16,853	125	1.52	(1.26-1.81)	8	1.68	(0.72-3.31)
673 Insurance	13,179	104	1.14	(0.93-1.38)	13	2.45	(1.30-4.18)
680 Real estate	22,757	234	1.15	(1.00-1.30)	18	1.57	(0.93-2.48)
70. Transportation	197,204	1313	1.09	(1.03-1.15)	69	0.94	(0.73-1.20)
701 Trolley and bus traffic	20,917	173	1.16	(1.00-1.35)	8	0.89	(0.38-1.75)

Industry Code and Name	Employed Men	Bladder (N=18,244)			Renal Pelvis (N=1,014)		
		Obs	SIR	95% CI	Obs	SIR	95% CI
704 Long distance travel by water	23,124	117	1.26	(1.04-1.51)	4	0.70	(0.19-1.79)
705 Short distance travel by water	7,810	74	1.38	(1.08-1.73)	5	1.62	(0.52-3.78)
706 Air travel	6,708	54	1.60	(1.21-2.09)	3	1.40	(0.28-4.08)
715 Ship brokering, dispatching	3,286	26	1.25	(0.82-1.84)	3	2.52	(0.51-7.36)
80. Administration	125,978	887	1.11	(1.04-1.19)	59	1.24	(0.94-1.59)
802 Legal services	3,861	37	1.16	(0.81-1.59)	7	3.74	(1.50-7.71)
803 National defense	47,552	335	1.11	(1.00-1.24)	16	0.87	(0.50-1.42)
805 Customs	3,511	46	1.44	(1.05-1.92)	3	1.63	(0.33-4.76)
81. Education	75,024	389	0.87	(0.79-0.96)	23	0.87	(0.55-1.31)
811 Secondary grammar schools	32,560	157	0.84	(0.71-0.98)	11	0.97	(0.48-1.73)
812 Elementary and other schools	35,437	185	0.85	(0.73-0.99)	12	0.95	(0.49-1.66)
820 Health care	39,002	289	1.19	(1.06-1.34)	13	0.91	(0.49-1.56)
832 Other religious societies	3,111	17	0.52	(0.30-0.83)			
835 Professional and trade organizations	8,426	86	1.35	(1.08-1.67)	3	0.80	(0.16-2.32)
844 Typing, duplicating and copying bureaus	11,743	67	1.18	(0.92-1.50)	8	2.29	(0.99-4.52)
850 Literary work	4,169	43	1.42	(1.03-1.91)			
852 Film industry and cinema houses	1,834	23	1.74	(1.10-2.61)			
853 Theaters	2,859	25	1.61	(1.04-2.38)			
870 Restaurants	11,577	91	1.37	(1.11-1.69)	4	1.00	(0.27-2.55)
880 Laundry, ironing, dyeing	6,580	55	1.15	(0.87-1.50)	3	1.07	(0.21-3.12)
881 Hair cutting and beauty salons	6,838	64	1.27	(0.98-1.62)	6	2.03	(0.74-4.42)
884 Chimney sweeping	2,965	23	1.81	(1.15-2.72)			
885 Floor waxing, window washing, cleaning	3,545	30	1.52	(1.02-2.17)			

Bladder and Renal Pelvis SIR

Correlation coefficient and p-value

(Pearson's correlation of the log SIR)

r=0.25, p=0.04

/ SIR values for categories with fewer than 3 cases not reported.

² Other than homes.

Table V

Men						
	Bladder		Renal Pelvis			
	Relative Risk	95% CI or p-value	Exposed Cases	Relative Risk	95% CI or p-value	Exposed Cases
Urban Residence						
Yes	1.26	1.22-1.30	6415	1.05	0.91-1.22	304
No	Reference		9796	Reference		537
Asbestos						
None	Reference		15222	Reference		790
Low	0.98	0.91-1.06	674	0.84	0.59-1.21	32
Medium	1.03	0.92-1.15	306	1.14	0.72-1.82	18
High	1.31	0.68-2.51	9			1
Physical activity						
Heavy	Reference		3844	Reference		192
Medium	1.29	1.23-1.35	2663	1.22	0.98-1.53	129
Light	1.34	1.28-1.40	4282	1.53	1.26-1.85	246
Sedentary	1.40	1.31-1.50	1212	1.52	1.14-2.02	64
Trend p-value		<0.001			<0.001	
Ionizing radiation						
None	Reference		15754	Reference		815
Low	0.83	0.70-0.97	149	0.72	0.34-1.52	7
Medium	1.20	1.07-1.34	294	1.47	0.93-2.32	19
High	0.97	0.57-1.64	14	0		0
Indoor/outdoor work						
Outdoors	Reference		3041	Reference		137
Both in and out	1.28	1.21-1.35	2595	1.39	1.09-1.77	134
Indoors	1.40	1.34-1.46	10569	1.58	1.31-1.91	570
Trend p-value		<0.001			<0.001	

	Bladder		Men		Renal Pelvis	
	Relative Risk	95% CI or p-value	Exposed Cases	Relative Risk	95% CI or p-value	Exposed Cases
<i>Women</i>						
Urban Residence						
Yes	1.36	1.26-1.46	1416	1.24	0.99-1.57	143
No	Reference		1385	Reference		149
Asbestos						
None	Reference		2795	Reference		290
Low	0.86	0.39-1.92	6	n/a		1
Medium	0		0	n/a		1
High	0		0			0
Physical activity						
Heavy	Reference		543	Reference		38
Medium	1.05	0.94-1.18	770	1.62	1.10-2.38	82
Light	1.08	0.96-1.21	629	1.71	1.15-2.55	68
Sedentary	1.17	1.02-1.33	368	1.82	1.15-2.86	39
Trend p-value		0.03			0.008	
Ionizing radiation						
None	Reference		2772	Reference		289
Low	1.43	0.71-2.86	8	0		0
Medium	0.86	0.55-1.35	19	1.35	0.43-4.22	3
High	0.44	0.11-1.74	2	0		0
Indoor/outdoor work						
Outdoors	Reference		114	Reference		7
Both in and out	1.26	0.92-1.71	62	1.63	0.52-5.13	5
Indoors	1.56	1.30-1.89	2624	2.72	1.28-5.76	280
Trend p-value		<0.001			0.003	

† Cells with fewer than 3 cases not shown. All variables adjusted for age, year of diagnosis and urban residence. Urban residence also adjusted for occupational physical activity.