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Occupation and risk of prostate cancer in Canadian men: A case-control study across eight Canadian provinces

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ABSTRACT

Background: The etiology of prostate cancer continues to be poorly understood, including the role of occupation. Past Canadian studies have not been able to thoroughly examine prostate cancer by occupation with detailed information on individual level factors.

Methods: Occupation, industry and prostate cancer were examined using data from the National Enhanced Cancer Surveillance System, a large population-based case-control study conducted across eight Canadian provinces from 1994 to 1997. This analysis included 1737 incident cases and 1803 controls aged 50 to 79 years. Lifetime occupational histories were used to group individuals by occupation and industry employment. Odds ratios and 95% confidence intervals were calculated and adjustments were made for known and possible risk factors.

Results: By occupation, elevated risks were observed in farming and farm management (OR = 1.37, 95% CI 1.02–1.84), armed forces (OR = 1.33, 95% CI 1.06-1.65) and legal work (OR = 2.58, 95% CI 1.05–6.35). Elevated risks were also observed in office work (OR = 1.20, 95% CI 1.00–1.43) and plumbing (OR = 1.77, 95% CI 1.07–2.93) and with ≥10 years duration of employment. Decreased risks were observed in senior management (OR = 0.65, 95% CI 0.46–0.91), construction management (OR = 0.69, 95% CI 0.50–0.94) and travel work (OR = 0.37, 95% CI 0.16–0.88). Industry results were similar to occupation results, except for an elevated risk in forestry/logging (OR = 1.54, 95% CI 1.06–2.25) and a decreased risk in primary metal products (OR = 0.70, 95% CI 0.51–0.96).

Conclusion: This study presents associations between occupation, industry and prostate cancer, while accounting for individual level factors. Further research is needed on potential job-specific exposures and screening behaviours.

1. Introduction

Worldwide, prostate cancer is the second most commonly diagnosed cancer in men, with higher rates in industrialized countries [1], and it is the third leading cause of death from cancer [2]. The only well-established risk factors for prostate cancer are age, family history of prostate cancer and ethnicity [1,2]. Occupational factors may also play a role in prostate cancer development, however in Canada these are understudied due to small sample sizes and limited information on occupation and non-occupational factors [3–8].

The International Agency for Research on Cancer (IARC) has reported on possible associations between occupation and industry groups, specific exposures and prostate cancer. These include firefighters, rubber production workers, shift workers, cadmium compounds, arsenic compounds, X and γ radiation, and malathion [9–13]. IARC has shown some evidence that linked firefighter and rubber manufacturing occupations to prostate cancer risk [9,10]. Other international studies have shown mixed findings for occupation and industry groups and prostate cancer

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based on cohorts with limited information on employment or non-occupational factors [14–16]. Some studies have observed associations between shift work and prostate cancer but the mechanism relating circadian rhythm disruption to prostate cancer is unclear [9]. The association between prostate cancer risk and cadmium compounds, arsenic compounds, and X and γ radiation has also been inconsistent across studies [11,12]. Occupational exposure to malathion insecticides has been positively associated with prostate cancer, but only with aggressive forms [13]. It is likely that different mechanisms are involved in job-related exposures, and some exposures can mimic endocrine disruptors or affect estrogen levels in the body, leading to tumor initiation in the prostate gland [17–20]. There is also evidence that a sedentary work environment and lifestyle can lead to lower levels of physical activity and increased weight or obesity, increasing the risk for prostate cancer [21,22].

Few population-based studies have been able to thoroughly capture a range of occupation and industry groups and account for known and possible prostate cancer risk factors [3–8,14–16,23]. Our study sought to examine prostate cancer by occupation, industry and by duration of employment, while including individual level factors. Our study used the National Enhanced Cancer Surveillance System (NECSS) population-based case-control study which was established to provide a better understanding of the environmental risk factors for cancer [24–26]. The NECSS is one of the few large Canadian population-based studies that has multiple covariates and substantial power to detect relationships between occupation, industry and prostate cancer. *The objective of our study was to examine the relationship between job title and prostate cancer using the NECSS.*

2. Methods

2.1. Study design and population

The NECSS was conducted in eight Canadian provinces from 1994 to 1997 and examined 19 cancer sites and multiple environmental factors. Details on the NECSS case-control study design have been published elsewhere [24–26]. Briefly, prostate cancer cases were defined using the International Classification of Diseases for Oncology (ICDO-2) and were histologically confirmed [24–26]. Controls were sampled by random digit dialing in Newfoundland and Alberta, from provincial health insurance plan databases in British Columbia, Manitoba, Saskatchewan, Nova Scotia, and Prince Edward Island, and from a stratified random sample using Ministry of Finance data in Ontario [24–26]. Controls were frequency matched to all cancer cases by sex, province and by 5 year age groups. Self-administered questionnaires were used to collect data with a response rate of 69% for cases and 69% for controls [24]. The analyse reported here were restricted to male participants aged ≥50 years as prostate cancer in younger populations is rare [24].

2.2. Analysis of employment history

The NECSS questionnaire asked participants about their lifetime employment history for jobs that were held for at least 12 months. This included job title, industry, location, main tasks, and duration. An occupational hygienist and exposure assessment expert (CP) coded the jobs based on the National Occupational Classification System for Statistics (NOC-S 2006) and the North American Industry Classification System (NAICS 2002). Using the four digit NOC-S 2006 and NAICS 2002 codes, the occupations and industries were then categorized into 63 occupation groups and 44 industry groups based on job titles and tasks. Analysis by occupation provides specific job titles that can act as exposure proxies. Analysis by industry may also acts as an exposure proxy and can support associations found at an occupation level. Occupation and industry groups were examined as ever/never (i.e. did a participant ever have that job title, versus never). Duration of employment was assessed as <10 years ≥10 years of employment.

Unconditional logistic regression was used to compute odds ratios and 95% confidence intervals to determine associations between job title and prostate cancer risk. All models were adjusted for age and province of residence to reflect matching criteria and the varied selection of controls. Adjustments were also made for the known risk factors of family history of prostate cancer and ethnicity. Men of African American/Black ethnicity are at a higher risk and men of Asian ethnicity are at a lower risk for prostate cancer when compared to European/Caucasian men [1,2]. Adjustments for socioeconomic status (education and income) and marital status were also made in an attempt to account for potential screening biases. Men with a higher socioeconomic status have better access to health care and are more likely to get screened compared to men with a lower socioeconomic status [27]. Similarly, men who are married may be more likely to seek out screening than those who are not married [28]. Odds ratios were initially adjusted for both education and income but when income was added there was <10% or no change in findings so income was removed from the final model. Additional adjustments were also made for body mass index, smoking in pack-years, moderate and strenuous physical activity, and total radiation exposure based on associations identified in previous published studies from the NECSS [24–26,29,30]. wAll analyses were minimally adjusted for age, province of residence, ethnicity, and family history of prostate cancer and then fully adjusted with the addition of education, body mass index, smoking in pack-years, marital status, moderate and strenuous physical activity and total radiation exposure. All statistical analyses were performed using SAS 9.4 (SAS Institute Inc.).

3. Results

A total of 1737 prostate cancer cases and 1803 controls were included. Selected non-occupational characteristics of prostate cancer cases and controls are shown in Table 1. Family history of prostate cancer was significantly associated with prostate cancer (OR 2.67, 95% CI 1.52–4.71). Participants with Asian ancestry had a decreased risk of prostate cancer (OR 0.17, 95% CI 0.12–0.26) when compared to those with European ancestry. Levels of income were associated with prostate cancer, however these associations attenuated when fully adjusted. As smoking pack-years increased prostate cancer odds decreased when compared to never smoking participants.

For occupation groups (Table 2), an elevated risk was observed for those in legal work (judges, lawyers, and related) (OR 2.58, 95% CI 1.05–6.35). There was an elevated risk for farmers and farm/agriculture managers (OR 1.38, 95% CI 1.02–1.84) and a non-significantly elevated risk with ≥10 years duration (OR 1.37, 95% CI 0.95–1.96). An increased risk was observed for office workers (OR 1.20, 95% CI 1.00–1.43) and with ≥10 years duration (OR 1.31, 95% CI 1.02–1.68) with a significant trend for duration ($p_{trend} = 0.027$). An elevated risk was observed for industrial mechanics with >0–<10 years duration of employment (OR 1.45, 95% CI 1.01–2.09), but not with longer employment. An elevated risk was observed with plumbing, gas maintenance, and pipefitting (OR 1.77, 95% CI 1.07–2.93) and with ≥10 years duration (OR 2.08, 95% CI 1.10–3.91) with a significant trend for duration ($p_{trend} = 0.037$). An elevated risk was observed for armed forces (OR 1.33, 95% CI 1.06–1.65) and with >0–<10 years duration (OR 1.45, 95% CI 1.11–1.89) with a significant trend for duration ($p_{trend} = 0.001$). A non-significant elevated risk