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Occupation and thyroid cancer: a population-based case-control study in Connecticut

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Abstract

Objective—The study aims to explore the associations between various occupations and thyroid cancer risk.

Methods—A population-based case-control study involving 462 histologically confirmed incident cases and 498 controls was conducted in Connecticut in 2010–2011.

Results—A significantly increased risk of thyroid cancer, particularly papillary microcarcinoma, was observed for those working as the healthcare practitioners and technical workers, health diagnosing and treating practitioners and registered nurses. Those working in building and grounds cleaning, maintenance occupations, pest control, retail sales, and customer service also had increased risk for papillary thyroid cancer. Subjects who worked as cooks, janitors, cleaners, and customer service representatives were at an increased risk of papillary thyroid cancer with tumor size >1 cm.

Conclusions—Certain occupations were associated with an increased risk of thyroid cancer, with some tumor size and subtype specificity.

Background

Thyroid cancer has been appreciably increasing worldwide over the last several decades (1–4). Thyroid cancer incidence is three-fold higher for women than men (5). It is now the fifth most common cancer among women; by 2030 it may become the fourth most common cancer among women in the United States (6, 7). The incidence rate has been increasing for

both small and large size tumors in various populations (8), although growing incidence of smaller tumors appears to drive the overall increase (9). The few known thyroid cancer risk factors include gender, exposure to ionizing radiation during childhood, excess iodine consumption, family history of thyroid cancer, and prior diagnosis of benign thyroid diseases (10–12).

Certain occupational exposures have been linked to the risk of thyroid cancer; however, results have been inconclusive (13). Occupations involving radiation exposure, such as radiological technologists, are most consistently linked to increased risk of thyroid cancer (14–21). Other healthcare or medical workers including dentists and dentist assistants, female nurses, pharmacists, and psychologists that may or may not have radiation exposure have been less consistently associated with an increased risk of thyroid cancer (22–28). Some studies have reported that farmers and agricultural workers experienced an increased risk of thyroid cancer (23, 24, 29, 30), others, however, found no association (17, 18, 26, 31–33). Studies have inconsistently linked teachers, economists, female bookkeepers, saleswomen and stenographers, female textile workers, women worked in video display terminals, administrative staff, firefighters, and clerical workers to thyroid cancer risk (17, 22–26, 34–36). In light of these inconclusive results, we analyzed data from a population-based case-control study of thyroid cancer in Connecticut to further examine the relationship between occupation and risk of thyroid cancer.

Materials and Methods

Detailed information regarding the study design is described elsewhere (37). Briefly, a total of 701 histologically confirmed incident thyroid cancer cases aged 21 to 84 years were identified between 2010 and 2011. Among those, 462 (65.9%) completed in-person interviews. Population-based controls with Connecticut addresses were recruited using a random digit dialing method. A total of 498 controls participated in the study, with a participation rate of 61.5%. Cases and controls were frequency matched based on age (± 5 years). Distributions of age and gender were similar between participants and non-participants for both cases and controls (37).

All procedures were performed in accordance to protocols approved by the Human Investigation Committees at Yale University and the Connecticut Department of Public Health. After approval by the hospitals and by each subject's physician (cancer cases), or following selection through random sampling (control population), potential participants were approached by letter and then by phone. Those who agreed were interviewed by trained study interviewers, either at the subject's home or at a convenient location. After obtaining written consent, a standardized, structured questionnaire was used to collect information on lifetime occupational history and other suspected risk factors for thyroid cancer. Participants were asked to report all jobs held for a year or longer during their lifetime. For each reported job, detailed information on job title, activities or duties, company name, type of business, year begun, and year ended was elicited. Jobs were coded according to the 2010 Standard Occupational Classification (SOC) Manual (38).

Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated using unconditional logistic regression models to estimate the associations between occupations and the risk of thyroid cancer. ORs were calculated for all 2-digit, 3-digit, and 6-digit SOC codes when there were at least five or more exposed cases. We also evaluated the risk of thyroid cancer by duration of employment (<10 years and ≥10 years) in various SOC groups. The reference group was composed of subjects not employed in the occupation of interest. Potential confounding variables included in the final model were age, gender, race, family history of thyroid cancer among first degree relatives, body mass index (BMI), tobacco smoking, educational level, and alcohol consumption. Further adjustment for other variables, such as family income, prior history of radiation treatment, and prior exposure to diagnostic x-rays did not result in material changes for the observed associations, and thus were not included in the final model. We performed stratified analyses by histologic subtype and tumor size, using all controls. All analyses were performed using SAS version 9.3 (SAS Institute, Inc., Cary, NC).

Results

Of the 462 patients with thyroid cancer, the majority were diagnosed with papillary thyroid cancer (84.8%) followed by follicular (12.1%), medullary (2.6%), anaplastic (0.2%), and others (0.2%). A total of 214 (47.0%) cases were microcarcinoma (tumor size ≤1 cm). As shown in Table 1, cases were more likely to be women, middle aged, and obese compared to controls. Cases were more likely to be non-drinkers and of lower education compared to controls. A higher proportion of cases than controls reported having a first-degree relative with thyroid cancer. Distributions of family income, race, and smoking between cases and controls were similar.

Table 2 presents occupations by 2-, 3-, and 6-digit SOC codes with significant associations for thyroid cancer, either overall or in one of the duration categories. Non-statistically significant associations were presented in Supplementary Table 1. A significantly increased risk of thyroid cancer was associated with working as a healthcare practitioner and technical worker (OR=1.71, 95% CI: 1.09–2.70), health diagnosing and treating practitioner (OR=1.80, 95% CI: 1.05–3.08), cooks and food preparation workers (OR=4.13, 95% CI: 1.04–16.39), building cleaning and pest control worker (OR=2.36, 95% CI: 1.02–5.50), and retail salesperson (OR=3.13, 95% CI: 1.27–7.67). A borderline significantly increased risk was also observed for building and grounds cleaning and maintenance workers (OR=2.12, 95% CI: 0.99–4.54), and customer service representatives (OR=3.07, 95% CI: 1.00–9.41). After stratification by duration, a significantly increased risk was observed for individuals who worked for 10 years or more as general and operations managers (OR=5.36, 95% CI: 1.05–27.25), healthcare practitioners and technical workers (OR=2.32, 95% CI: 1.22–4.41), health diagnosing and treating practitioners (OR=2.77, 95% CI: 1.32–5.82), retail sales workers (OR=5.04, 95% CI: 1.23–20.61), and retail salespersons (OR=16.01, 95% CI: 1.85–138.66).

Similar patterns were observed when the outcome was restricted to papillary thyroid cancers (Table 3) and well-differentiated thyroid cancers (papillary and follicular thyroid cancer,

data not shown). No significant differences were observed between men and women (Supplementary Table 2).

We further stratified analyses by tumor size for papillary thyroid cancer (Table 4). Working as financial managers (OR=4.34, 95% CI: 1.32–14.31), healthcare practitioners and technical workers (OR=2.31, 95% CI: 1.34–3.97), health diagnosing and treating practitioners (OR=2.97, 95% CI: 1.61–5.47), registered nurses (OR=2.97, 95% CI: 1.33–6.63), and building cleaning and pest control worker (OR=2.85, 95% CI: 1.06–7.64) were associated with an increased risk of microcarcinoma but not larger papillary thyroid cancers (tumor size >1 cm). On the other hand, cooks and food preparation workers (OR=6.68, 95% CI: 1.47–30.33), janitors and cleaners (except maids and housekeeping cleaners) (OR=6.67, 95% CI: 1.42–31.46), and customer service representatives (OR=3.91, 95% CI: 1.09–13.96) were significantly associated with an increased risk of larger papillary thyroid cancer but not papillary microcarcinoma. Working as information and record clerks was associated with a borderline significant increased risk of larger papillary thyroid cancer (OR=2.22, 95% CI: 0.97–5.08).

Discussion

In the present population-based case-control study of thyroid cancer, we observed several statistically significant associations between employment in certain occupations and thyroid cancer. These include some that have been previously noted and some new observations. The major findings in the current study are summarized and discussed below.

We found a significantly increased risk of thyroid cancer for healthcare practitioners and technical workers including health diagnosing and treating practitioners, especially papillary thyroid cancer among those worked more than 10 years. Working as a registered nurse was also associated with increased risk of papillary thyroid cancer, especially among those employed for more than 10 years. Several prior studies have assessed the association between healthcare occupations and risk of thyroid cancer. While two studies found no association between healthcare occupations and risk of thyroid cancer (23, 26), the literature largely suggests that working in healthcare occupations are associated with an increased risk of thyroid cancer (20, 22, 24, 25, 27, 28, 39). Zielinski et al. (27) observed greater incidence of thyroid cancer both in men and women among a cohort of Canadian medical workers who were identified using the National Dose Registry of radiation workers, compared to the Canadian general population. Zabel et al. (20) found that X-ray technologists with more than 5 years of working experience had increased risk of thyroid cancer. Haselkorn et al. (25) presented similar results in a cohort of non-Spanish surnamed medical workers including dentists, pharmacists, physicians, and radiological technicians. Lope et al. (24) in Sweden also observed an increased risk of thyroid cancer in nurses, orderlies, and medical technicians. In Israel, Shaham et al. (26) observed a significantly increased risk of thyroid cancer among female medical laboratory workers who worked for more than 20 years. A case-control study from Sweden including 185 female cases and 426 controls reported increased risk of thyroid cancer associated with working as dentists/dental assistants (22). Elevated, but not statistically significant, risk was observed for female nurses in Denmark (28). The category of health diagnosing and treating practitioners includes dentists, oral and

maxillofacial surgeons, orthodontists, prosthodontists, physicians and surgeons, pharmacists, anesthesiologists, therapists (including physical and radiation therapists), health technologists and technicians, and some other healthcare occupations according to the SOC 2010. Therefore, increased risk of thyroid cancer associated with these jobs may be explained by exposure to radiation from diagnosing and treating experience, given that radiation exposure is one of the few established risk factors for thyroid cancer. In our study, the observed association between healthcare workers including health diagnosing and treating practitioners and registered nurses and thyroid cancer was limited to papillary thyroid microcarcinoma. Although it is unclear why this association was only seen in microcarcinoma, our recent study found that diagnostic radiography exposure can increase the risk of thyroid cancer and this increased risk was specific to microcarcinoma (37), suggesting that thyroid microcarcinoma may represent a new disease entity with distinct etiology. It is also possible that healthcare workers have better access to healthcare and are more health conscious, leading to their disease being diagnosed earlier. We also observed a stronger association among men than women. While chance finding cannot be ruled out, it is also possible. It could be due to chance, it also could be due to higher. Future studies are warranted to confirm this association, as well as to quantify radiation exposure among healthcare workers.

We also noted increased risk of thyroid cancer among building and ground cleaning and maintenance workers, especially those working as building cleaners and pest control workers. Few studies have highlighted the association between building cleaning, ground cleaning, and maintenance occupations and thyroid cancer. Solan et al. (40) examined cancer incidence in World Trade Center (WTC) rescue and recovery workers during the first seven years after September 11, 2001. They found excess thyroid cancer incidence in a group of occupations including protective services, construction, building and ground cleaning and maintenance, electrical, telecommunications and other installation and repair groups (CM&IRG); and all other occupations related to the rescue and recovery work of WTC compared to the incidence of general population in the United States. However, the increased risk was not observed when limited those working in protective services group and CM&IRG (40). Pukkala et al. (23) reported a significantly increased risk of thyroid cancer in female building care takers. Exposure to various chemicals may partly explain the increased risk of thyroid cancer among those working in building and ground cleaning and maintenance occupations especially janitors and cleaners because they perform tasks which involve chemical exposures (38). Some chemicals such as petrochemicals and solvents have been associated with increased risk of thyroid cancer (31). Additionally, exposure to pesticides, has been linked, somewhat inconsistently, to thyroid cancer (17, 18, 23, 24, 26, 29, 31–33, 41). Building and ground cleaning and maintenance occupations may involve exposure to variety of biocides, though exposures would differ compared to farmers and agricultural workers. For example, cresols that are widely used in cleaners, disinfectants, and fumigants were found to increase risk of thyroid gland follicular degeneration in exposed groups of mice (42). Thus, further studies are needed to understand specific potentially harmful exposures, as well as intensity and probability of exposure.

Retail salespersons were at increased risk of thyroid cancer; the risk was mainly observed for the papillary subtype among workers with more than 10 years of experience. Fincham et

al. (26) reported that occupations in sales and service were associated with excess risk for thyroid cancer in a Canadian case-control study. Haselkorn et al. (25) also observed an increased risk of thyroid cancer in sales workers. However, some other studies have not seen an association with thyroid cancer among sales workers (17, 24, 43). It is difficult to interpret this finding because of the heterogeneous nature of occupational exposures among this group. Finchem et al. (26) postulated that this association may be related to the emission of low-frequency electromagnetic fields from jobs requiring equipment such as computerized cash registers. In addition, cashiers are exposed to high levels of bisphenol A (BPA), an endocrine disrupting chemical that has been linked to an increased risk of breast cancer, prostate cancer and other malignancies (44, 45). While there has been no direct link between BPA and thyroid cancer, studies have shown that BPA exposure can alter thyroid hormone levels (46, 47). However, retail salespersons refer to those who sell merchandise such as furniture, motor vehicles, appliances, or apparel to consumers (cashiers not included) according to 2010 SOC code; emission of low-frequency electromagnetic fields from jobs requiring equipment and BPA exposure from receipts may not explain these association. The increased risk of thyroid cancer in this group may be also partly explained by exposure to solvents such as volatile organic compounds including formaldehyde, benzene and homologues emitted from furniture or gasoline from motor vehicles (48, 49).

Our study also noted an increased risk of papillary thyroid cancer associated with working as financial managers and customer service representatives, as well as general and operations managers who worked for 10 years or longer. Haselkorn et al. (25) observed a significantly increased risk of thyroid cancer for many of the white-collar workers, including male economists, managers and administrators, female bookkeepers, saleswomen and stenographers, and by socioeconomic status among non-Spanish surnamed whites. However, Pukkala et al. (23) presented a decreased risk of thyroid cancer in female administrators in Sweden. No increased risk of thyroid cancer among those in administrative occupations was observed in a Swedish cohort (24), a U.S. cohort (50), and a Canadian case-control study (26). "White-collar" is defined broadly and includes administrators and many detailed professional workers. Thus, the association between administrative occupations and thyroid cancer need to be confirmed by a large population-based study with detailed occupational exposure information. On the other hand, the observed association between working as financial managers and customer service representatives and papillary thyroid microcarcinoma could reflect a better access to medical care because persons employed in administrative or managerial white-collar jobs are more likely to have comprehensive private health insurance and therefore detection of small tumors among them are more likely (51).

We found an increased risk of thyroid cancer, particularly papillary carcinoma with tumor size >1 cm, among cooks and food preparation workers. To our knowledge, no previous study has reported an elevated risk of thyroid cancer among those workers. Cooks and food preparation workers may be more frequently exposed to radiation from microwave ovens. A previous study has reported a non-significantly increased risk of thyroid cancer associated with microwave exposure (52). However, because the observed association was based on small numbers, chance finding cannot be ruled out.

One of the main strengths of this study is that all cases were histologically confirmed, minimizing potential for disease misclassification. Another strength is the population-based study design with relatively high response rates from all participants, minimizing the potential for selection bias. Furthermore, we included only occupations for which people had been employed for at least one year in order to reduce potential recall bias. Detailed information on lifetime job exposure history and potential confounding factors was collected and controlled for in this study; therefore, residual confounding is an unlikely explanation for the observed associations. However, chance cannot be entirely ruled out as a possible explanation for some associations because of the small number of exposed cases for certain occupational groupings.

Because of the multiple statistical comparisons resulting from numerous categories of occupations (23 major groups by 2-digit SOC code and 840 detailed occupations by 6-digit SOC code) and the relatively small number of exposed cases, spurious associations may be expected. However, many of the significant findings here are supported by the literature and we do not believe they are due to chance alone.

In summary, we observed increased risk of thyroid cancer associated with health diagnosing and treating practitioners, registered nurses, building cleaning and pest control workers, janitors and cleaners, cooks and food preparation workers, retail salesperson, customer service representatives and financial managers. Our finding that healthcare workers experienced an increased risk of papillary microcarcinoma warrants further investigation. Future studies will attempt expand on these analyses, examining specific occupational exposures and risk of thyroid cancer by applying job exposure matrices.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Distribution of selected characteristics among thyroid cancer cases and controls.

	<u>Cases (n=462)</u>		<u>Controls (n=498)</u>		P*
	Number	%	Number	%	
Age (years)					<0.001
40	92	19.9	74	14.9	
41–55	218	47.2	194	39.0	
56–70	125	27.1	168	33.7	
71	27	5.8	62	12.5	
Gender					<0.001
Male	87	18.8	154	30.9	
Female	375	81.2	344	69.1	
Race					0.782
White	415	89.8	450	90.4	
Other	47	10.2	48	9.6	
Educational attainment					0.002
High school or less	129	27.9	88	17.7	
College or Technical school	216	46.8	261	52.4	
Graduate school	100	21.7	130	26.1	
Other	17	3.7	19	3.8	
Family income					0.713
Below poverty level	21	4.6	28	5.6	
Above poverty level	294	63.6	318	63.9	
Unknown	147	31.8	152	30.5	
Body mass index (kg/m ²)					<0.001
<25	145	31.4	203	40.8	
25–29.9	146	31.6	168	33.7	
30	166	35.9	118	23.7	
Missing	5	1.1	9	1.8	
First-degree relatives with thyroid cancer					0.025
Yes	55	11.9	38	7.6	

	Cases (n=462)		Controls (n=498)		P*
	Number	%	Number	%	
No	407	88.1	460	92.4	0.612 [†]
Tobacco smoking (pack-years of cigarettes)					
No	321	69.5	326	65.5	
<5.3	40	8.7	56	11.2	
5.3–23.2	46	10.0	56	11.5	
>23.2	53	11.5	57	0.6	0.002 [†]
Missing	2	0.4	3	1.0	
Alcohol consumption (total drinks)					
No	274	59.3	231	46.4	
<5200	68	14.7	86	17.3	
5200–16560	52	11.3	87	17.5	
>16560	62	13.4	84	16.9	
Missing	6	1.3	10	2.0	

* Chi-square test for homogeneity unless otherwise specified

[†] Fisher's exact test

Table 2
Statistically Significant Associations Between Thyroid Cancer and Duration of Employment by Occupation

Occupation (SOC code)	All (adjusted)			<10 years			10 years		
	ca/co	OR(95% CI)	P	ca/co	OR(95% CI)		ca/co	OR(95% CI)	P for trend
General and Operations Managers (11–1021)	10/8	1.71(0.64–4.54)	0.282	3/4	0.94(0.20–4.49)		7/2	5.36(1.05–27.25)	0.041
Financial Managers (11–3031)	7/7	1.59(0.53–4.75)	0.410	3/0	—		4/4	0.99(0.28–3.51)	0.625
Education, Training, and Library Occupations (25)	64/84	0.84(0.57–1.26)	0.403	43/37	1.27(0.77–2.10)		20/41	0.57(0.31–1.03)	0.073
Healthcare Practitioners and Technical Occupations (29)	57/38	1.71(1.09–2.70)	0.020	28/21	1.30(0.71–2.38)			2.32(1.22–4.41)	0.014
Health Diagnosing and Treating Practitioners (29–1000)	39/26	1.80(1.05–3.08)	0.034	15/14	1.08(0.50–2.33)			2.77(1.32–5.82)	0.014
Registered Nurses (29–1141)	21/13	1.82(0.86–3.83)	0.116	10/8	1.26(0.48–3.32)		11/5	2.92(0.92–9.21)	0.178
Cooks and Food Preparation Workers (35–2000)	9/3	4.13(1.04–16.39)	0.044	9/1	12.04(1.46–99.44)		0/1	—	0.314
Building and Grounds Cleaning and Maintenance Occupations (37)	22/12	2.12(0.99–4.54)	0.053	13/8	1.81(0.70–4.68)		9/4	2.75(0.79–9.54)	0.274
Building Cleaning and Pest Control Workers (37–2000)	20/9	2.36(1.02–5.50)	0.046	12/7	1.86(0.68–5.12)		8/2	3.93(0.81–19.07)	0.217
Janitors and Cleaners, Except Maids and Housekeeping Cleaners (37–2011)	8/3	3.50(0.85–14.43)	0.082	6/3	2.94(0.67–12.86)		2/0	—	0.143
Retail Sales Workers (41–2000)	24/19	1.42(0.73–2.76)	0.296	16/15	0.99(0.46–2.12)		8/3	5.04(1.23–20.61)	0.026
Retail Salespersons (41–2031)	16/9	3.13(1.27–7.67)	0.013	9/7	1.96(0.66–5.81)		7/1	16.01(1.85–138.66)	0.012
Information and Record Clerks (43–4000)	26/13	1.60(0.79–3.22)	0.189	20/9	1.72(0.76–3.90)		6/3	1.72(0.41–7.30)	0.246
Customer Service Representatives (43–4051)	17/4	3.07(1.00–9.41)	0.050	12/3	2.92(0.80–10.67)		5/1	3.52(0.39–31.79)	0.184

* Adjusted for age, gender, race, education, BMI, family history of thyroid cancer, smoking status, alcohol consumption Bolded values significant at $\alpha=0.05$

Table 3
Associations Between Papillary Thyroid Cancer and Duration of Employment by Occupation

Occupation (SOC code)	Papillary			<10 years			10 years		
	ca/co	OR(95% CI)	P	ca/co	OR(95% CI)	P	ca/co	OR(95% CI)	P for trend
General and Operations Managers (11–1021)	10/8	2.04(0.76–5.45)	0.154	3/4	1.12(0.24–5.34)		7/2	6.60(1.28–33.96)	0.021
Financial Managers (11–3031)	7/7	1.99(0.66–6.00)	0.222	3/0	—		4/7	1.24(0.35–4.45)	0.878
Education, Training, and Library Occupations (25)	54/84	0.80(0.52–1.22)	0.297	36/37	1.19(0.70–2.02)		17/41	0.56(0.29–1.05)	0.070
Healthcare Practitioners and Technical Occupations (29)	50/38	1.76(1.10–2.81)	0.019	24/21	1.25(0.66–2.34)		26/17	2.52(1.30–4.89)	0.012
Health Diagnosing and Treating Practitioners (29–1000)	36/26	1.96(1.13–3.42)	0.017	14/14	1.17(0.53–2.57)		22/12	3.07(1.44–6.55)	0.010
Registered Nurses (29–1141)	21/13	2.21(1.04–4.67)	0.039	10/8	1.51(0.57–4.01)		11/5	3.59(1.13–11.44)	0.083
Cooks and Food Preparation Workers (35–2000)	7/3	3.81(0.90–16.11)	0.069	7/1	10.91(1.26–94.32)		0/1	—	0.298
Building and Grounds Cleaning and Maintenance Occupations (37)	18/12	2.10(0.95–4.64)	0.067	9/8	1.50(0.54–4.18)		9/4	3.35(0.96–11.74)	0.179
Building Cleaning and Pest Control Workers (37–2000)	17/9	2.44(1.03–5.79)	0.044	9/7	1.70(0.59–4.94)		8/2	4.72(0.97–22.96)	0.126
Janitors and Cleaners, Except Maids and Housekeeping Cleaners (37–2011)	7/3	4.09(0.95–17.52)	0.058	5/3	3.34(0.72–15.52)		2/0	—	0.097
Retail Sales Workers (41–2000)	19/19	1.29(0.64–2.62)	0.474	14/15	1.00(0.45–2.23)		5/3	4.12(0.88–19.34)	0.074
Retail Salespersons (41–2031)	11/9	2.82(1.06–7.49)	0.037	7/7	2.00(0.63–6.38)		4/1	13.72(1.40–134.39)	0.028
Information and Record Clerks (43–4000)	19/19	1.63(0.79–3.36)	0.185	10/3	1.70(0.73–3.94)		4/1	1.96(0.45–8.61)	0.185
Customer Service Representatives (43–4051)	14/4	3.03(0.96–9.56)	0.058	9/2	2.75(0.73–10.39)		5/2	3.91(0.42–36.49)	0.168

* Adjusted for age, gender, race, education, BMI, family history of thyroid cancer, smoking status, alcohol consumption Bolded values significant at $\alpha=0.05$

Table 4**Occupation and Risk of Papillary Thyroid Cancer by Tumor Size**

Occupation (SOC code)	1cm			>1cm		
	ca/co	OR(95% CI)	P	ca/co	OR(95% CI)	P
General and Operations Managers (11–1021)	3/8	1.11(0.28–4.46)	0.883	7/8	2.75(0.91–8.24)	0.072
Financial Managers (11–3031)	6/7	4.34(1.32–14.31)	0.016	1/7	0.46(0.05–3.97)	0.481
Education, Training, and Library Occupations (25)	30/84	0.95(0.57–1.58)	0.841	23/84	0.60(0.34–1.05)	0.075
Healthcare Practitioners and Technical Occupations (29)	31/38	2.31(1.34–3.97)	0.003	18/38	1.08(0.58–2.00)	0.818
Health Diagnosing and Treating Practitioners (29–1000)	26/26	2.97(1.61–5.47)	0.001	9/26	0.85(0.38–1.91)	0.691
Registered Nurses (29–1141)	15/13	2.97(1.33–6.63)	0.008	5/13	0.99(0.33–2.95)	0.980
Cooks and Food Preparation Workers (35–2000)	2/3	1.72(0.22–13.64)	0.609	5/3	6.68(1.47–30.33)	0.014
Building and Grounds Cleaning and Maintenance Occupations (37)	10/12	2.38(0.94–6.04)	0.069	8/12	1.99(0.74–5.34)	0.174
Building Cleaning and Pest Control Workers (37–2000)	10/9	2.85(1.06–7.64)	0.037	7/9	2.16(0.73–6.38)	0.164
Janitors and Cleaners, Except Maids and Housekeeping Cleaners (37–2011)	2/3	2.76(0.35–21.50)	0.333	5/3	6.67(1.42–31.46)	0.016
Retail Sales Workers (41–2000)	9/19	1.21(0.50–2.91)	0.679	10/19	1.19(0.51–2.77)	0.669
Retail Salespersons (41–2031)	5/9	2.83(0.82–9.74)	0.099	6/9	2.54(0.81–7.98)	0.112
Information and Record Clerks (43–4000)	9/13	1.30(0.53–3.21)	0.566	13/13	2.22(0.97–5.08)	0.061
Customer Service Representatives (43–4051)	6/4	2.47(0.66–9.19)	0.179	8/4	3.91(1.09–13.96)	0.036

* Adjusted for age, gender, race, education, BMI, family history of thyroid cancer, smoking status, alcohol consumption Bolded values significant at $\alpha=0.05$