Occupations and the Risk of Head and Neck Cancer: A Pooled Analysis of the International Head and Neck Cancer Epidemiology (INHANCE) Consortium

Prerna Khetan, Paolo Boffetta, Danièle Luce, Isabelle Stücker, Maria Paula Curado, Ana Menezes, Victor Wunsch-Filho, Wolfgang Ahrens, Pagona Lagiou, Diego Serraino, et al.

Published in final edited form as:

J Occup Environ Med. 2019 May ; 61(5): 397–404. doi:10.1097/JOM.0000000000001563.

Occupations and the risk of head and neck cancer: a pooled analysis of the International Head and Neck Cancer Epidemiology (INHANCE) consortium.

Prerna Khetan, MPH,
The Tisch Cancer Institute, Icahn School of Medicine at Mount Sinai, New York, NY, USA

Paolo Boffetta, MD,
The Tisch Cancer Institute, Icahn School of Medicine at Mount Sinai, New York, NY, USA

Daniele Luce, PhD,
Univ Rennes, Inserm, EHESP, Irset (Institut de recherche en santé, environnement et travail)-UMR_S 1085, Pointe-à-Pitre, France

Isabelle Stucker, PhD,
CESP, Cancer and Environment team, INSERM U1018, Université Paris-Sud, Université Paris-Saclay, Villejuif, France

Maria Paula Curado, PhD,
Epidemiology- CIPE/ACCAMARGO, Sao Paulo, Brazil

Ana Menezes, PhD,
Universidade Federal de Pelotas, Pelotas, Brazil

Victor Wunsch-Filho, PhD,
Universidade de Sao Paulo, Sao Paulo, Brazil

Wolfgang Ahrens, PhD,
Leibniz Institute for Prevention Research and Epidemiology, BIPS, Bremen, Germany

Pagona Lagiou, MD,
School of Medicine, National and Kapodistrian University of Athens, Greece

Diego Serraino, PhD,
Centro di Riferimento Oncologico (CRO), IRCCS, 33081 Aviano, Italy

Lorenzo Richiardi, PhD,
Department of Medical Sciences, University of Turin, Turin, Italy

Kristina Kjaerheim, PhD,
Cancer Registry of Norway, Institute of Population-based Cancer Research, Oslo, Norway

David Conway, PhD,

Corresponding author: Prerna Khetan, MPH, Address: Icahn School of Medicine at Mount Sinai, 1 Gustave L. Levy Pl, New York, NY 10029, Telephone number: 646-464-0714, Fax number- 2124100111, prernakhetan13@gmail.com. **Address for reprints:** Same as corresponding author.

Conflict of Interest declaration:
None declared.

School of Medicine, Dentistry, and Nursing, College of Medical, Veterinary and Life Sciences, University of Glasgow, Glasgow, UK

Peter Thomson, MD,
University of Hong Kong, Hong Kong, China

Joshua Muscat, PhD,
Penn State College of Medicine, Hershey, PA, USA

Dana Mates, PhD,
National Institute of Public Health, Bucharest, Romania

Heribert Ramroth, PhD,
University of Heidelberg;

Gwenn Menvielle, PhD,
INSERM, Sorbonne Université, Institut Pierre Louis d'Epidémiologie et de Santé Publique IPLESP, F75012 Paris, France

Thomas L. Vaughan, MD,
Fred Hutchinson Cancer Research Center, Seattle, WA, USA;

Hermann Brenner, MD,
Division of Clinical Epidemiology and Aging Research, German Cancer Research Center (DKFZ), Heidelberg, Germany;

Division of Preventive Oncology, German Cancer Research Center (DKFZ) and National Center for Tumor Diseases (NCT), Heidelberg, Germany;

German Cancer Consortium (DKTK), German Cancer Research Center (DKFZ), Heidelberg, Germany Hermann Brenner

Yuan-Chin Amy Lee, PhD,
Division of Public Health, Department of Family & Preventive Medicine and Huntsman Cancer Institute, University of Utah School of Medicine, Salt Lake City, Utah

Carlo La Vecchia, PhD,
Department of Clinical Sciences and Community Health, University of Milan, Italy

Mia Hashibe, PhD, and
Division of Public Health, Department of Family & Preventive Medicine and Huntsman Cancer Institute, University of Utah School of Medicine, Salt Lake City, Utah

Dana Hashim, MD
The Tisch Cancer Institute, Icahn School of Medicine at Mount Sinai, New York, NY, USA

Abstract

Objective: To investigate the associations between head and neck cancer (HNC) risk and occupations.

Methods: We harmonized data on occupations in a pooled analysis of 8,839 HNC cases and 13,730 controls in International Head and Neck Cancer Epidemiology (INHANCE) consortium.

Logistic regression was used to estimate odds ratios (ORs) for associations of occupations and HNC risk. Population attributable fraction (PAF) for occupations was calculated using the formula $P_{EC} \times (OR - 1)/OR$.[1]

Results: Trend of increasing HNC risk was found with increasing duration of employment for many occupations, including cooks (OR=1.36; 95% CI 1.09–1.68), cleaners (OR=1.38; 95% CI 1.13–1.69), painters (OR=1.82; 95% CI 1.42–2.35). The PAF for a priori occupations was 14.5% (95% CI 7.1%−21.9%) for HNC.

Conclusions: We found associations between certain occupations and HNC risks, including for subsites, with a duration-response relationship.

INTRODUCTION

Head and neck cancer (HNC) accounts for more than 550,000 cases and 380,000 deaths annually, worldwide.[2] HNC includes cancers originating in the oral cavity, the oropharynx, the hypopharynx, and the larynx. The majority of HNC cases are preventable by limiting exposure to risk factors.[3] Tobacco use, alcohol consumption, human papillomavirus (HPV) infection, and a diet poor in fruits and vegetables are the primary risk factors known to be associated with HNC.[4]

In addition to these major risk factors, several occupational exposures are recognized risk factors for some HNC sites (asbestos and strong acids for larynx; leather dust and wood dust for sinonasal cancer) and suspected to be risk factors for other cancers of the head and neck. According to the International Agency for Cancer Research (IARC), all forms of asbestos are carcinogenic to humans (Group 1).[5] They had observed positive associations between exposure to asbestos and cancer of the pharynx, stomach, and colorectum.[5] IARC had also classified wood and leather dust as type 1carcinogens, with enough evidence to establish a causal link between these materials and cancer. In particular, these were considered causal for cancers of the nasal cavity and paranasal sinus.[6] However, the relationship of these exposures with other cancers of head and neck, especially oral and pharyngeal cancers, has been sparsely studied due to small sample sizes.[6] Several toxic metals and inorganic compounds including nickel, cobalt, lead, vanadium, beryllium, arsenic, and chromium are also considered by IARC to be definite or probable carcinogens.[7–10] Thus, occupations involving these exposures were associated with the risk of developing head and neck cancer.

Specific to HNC, occupational or environmental toxins have been investigated for a potential role in carcinogenesis. However, previous epidemiological studies had small sample size to study the association of occupations by HNC subsites and inadequate adjustment for the potential confounding by tobacco smoking, alcohol drinking, race, study, geographical region, education, and sex.[11] This is a study to determine the associations between occupations and HNC with higher power, while adjusting for potential confounders. We pooled occupations and HNC data from studies participating in the international head and neck cancer epidemiology (INHANCE) consortium and studied occupations which have shown limited evidence in previous studies to be associated with HNC risk[12–15] and entailed exposure to agents which were identified by IARC as known or suspected carcinogens.[16,17]

MATERIALS AND METHODS

Studies and participants

The INHANCE consortium is a collaboration of research groups leading studies of HNC to improve the understanding of the causes and mechanisms of HNC. For the purpose of this analysis, we selected 12 case-control studies[1,18] with comparable data on occupations out of the 16 studies which had information on occupations. Six of the selected studies were from Europe, four from North America, and two from Latin America. Four studies which were excluded were Seattle (1985–1995), Los Angeles, Boston, and Rome. The reason for excluding them was large number of missing data on occupations: Los Angeles (37.2 % missing), Boston (69.3% missing), Rome (63.5% missing). Seattle (1985–1995) was excluded because we did not have necessary information on the coding system used for the occupations in that study (see Table, Supplemental Digital Content 1, which details on the individual studies). Some of these data were partially analyzed and published in previous studies.[12–14,19] The methods used for questionnaire harmonization and pooling of data have been described previously.[1,18] This pooled analysis included 12,214 incident HNC cases and 14,255 controls. Incident cases consisted of patients with invasive tumors of the head and neck (n=8839), including oral cavity (n= 1,859), oropharynx (n= 1,513), hypopharynx (n= 991), larynx (n= 3,848), and oral cavity/pharynx not otherwise specified (n= 2,515), as defined by International Classification of Disease, 2nd edition (ICD-O2) or ICD 9th or 10th edition.[1] We excluded participants with missing information on age (n= 204), sex (n= 253), or occupation (n= 3,852), leaving 8,839 cases and 13,730 controls in the analysis. Written informed consent was obtained from study subjects, and approvals were obtained by the institutional review board at each institution involved.[15]

Harmonization of occupations

The occupations were chosen, a priori (see list, Supplemental Digital Content 2, which shows the occupations under consideration in our study). Studies had their occupations coded according to International Standard Classification of Occupations codes. It was possible to convert them all to International Standard Classification of Occupations- 1968 version and were then able to harmonize them.

Covariates

We considered age (5-year categories), sex, race/ethnicity (White, Black, Hispanic, Asian and Pacific Islander, Brazilian, and other), study, geographic region (Europe, North America, South or Central America) and education level (no education, junior high school, some high school, high school graduate, technical school, college graduate, depending on country). Cumulative tobacco smoking was categorized as those who smoked 0–10.0, 10.1–20.0, 20.1–30.0, 30.1–40.0, 40.1–50.0, and 50.0+ pack-years.[20] Alcohol consumption was calculated as the number of drinks/day based on average cumulative lifetime consumption, assuming one standardized drink contains 15.6 ml of pure ethanol (never drinker, 0.1–0.9, 1.0–2.9, 3.0–4.9, and 5.0+).[1] We included missing data on race/ ethnicity (0.06%), tobacco smoking (8.19%), and alcohol drinking (3.83%) in separate categories.

Statistical analysis

We used frequency distribution analysis to describe our data. Multivariable logistic regression models were used to estimate odds ratios (ORs) and corresponding 95% confidence intervals (95% CI) for associations between occupations and incident HNC. We first studied broad occupation categories defined by two-digit ISCO-68 codes and then, specific occupations defined by three-digit ISCO- 68 codes. We used a dichotomous variable "ever having worked in a given occupation under our study" versus "never having worked in all the occupations under our study" to determine the association. We chose this unique group as our reference because we wanted to investigate the association of specific occupations with HNC verses those who have never been exposed to any of the a priori suspected occupational carcinogen through those occupations. In this way we tried to keep the occupational carcinogen exposure in the reference group to its minimum. The risk estimates of the various occupations selected for the analysis were directly comparable. p-values were adjusted for multiple hypothesis testing (p') (because we are testing multiple occupations) according to the Ryan-Holm step-down Bonferroni method (controlling for familywise error rate) and dependent FDR method (controlling for false discovery rate).[21] The 2-sided p or p' <= 0.05 was considered statistically significant. Subsequent analyses focused on the occupations for which p-value on multiple hypothesis adjustment was <=0.05. We studied the relationship to duration of employment (<=10 years vs >10 years). Tests for linear trend were conducted using duration of employment as a continuous variable. For the analysis including duration of employment, data were contributed by all studies except New York Multicenter. ORs were also estimated separately by cancer subsite. All ORs were adjusted for age, sex, race, education, study, geographical region, alcohol consumption, and tobacco smoking. To test the robustness of our findings, we conducted sensitivity analyses excluding alcohol drinking in one model, tobacco smoking in another model and both alcohol drinking & tobacco smoking in a third model. For each occupation category (two-digit), we also assessed potential interactions with smoking, alcohol drinking by including cross-product terms in the models. Smoking and drinking were introduced as categorical variable with many categories. The population attributable fraction (PAF) for occupations was calculated using the formula $P_{EC} \times (OR - 1)/ OR^1$, where OR is the adjusted OR and P_{EC} is the proportion of cases exposed to any of the a priori occupations in our study. For the calculation of PAF, we included all the occupations under our study irrespective of their significant or insignificant findings in our study. Harmonization of occupations and data analysis were done using the SAS Statistical Software (Version 9.4).

RESULTS

87.5% of cases and 61.2% of controls were ever smokers. 87.3% of cases and 77.8% of controls consumed alcohol (see Table, Supplemental Digital Content 3, which reports descriptive characteristics of cases and controls).

We first considered broad categories of occupations (i.e. two-digit ISCO code) and HNC. Significantly increased ORs were observed for many service workers and production and related workers, transport equipment operators and laborers. ORs and 95% CIs are presented by two-digit broad ISCO-68 occupational categories in Table 1.

To understand the role of more specific occupations in HNCs, results of the analyses by duration of employment and respective three-digit ISCO code occupation categories are presented in Table 2. The table reports occupations which showed significantly increased overall OR together with significant trend test. Occupations for which number of both exposed cases and exposed controls were greater than 100 with overall significant OR even with insignificant trend test are also reported (see Table, Supplemental Digital Content 4, which reports complete results for analyses by duration of employment).

Increased ORs, with significant trend in risk with increasing duration of employment were observed for the majority of occupations we studied under groups service workers and production and related workers, transport equipment operators and laborers. A positive association, without trend in risk with increasing duration of employment, was observed for few production and related workers: machine-tool operators (OR=1.37; 95% CI 1.1–1.7), blacksmiths, toolmakers and machine-tool operators (OR=1.28; 95% CI 1.01–1.63), painters not elsewhere classified (OR=1.36; 95% CI 1–1.85), and some construction occupations.

HNC risk by selected occupation categories (three-digit ISCO code) for subsites are reported in Table 3a and Table 3b (see Table, Supplemental Digital Content 5, which presents complete results for analysis by subsites). The ORs were consistently increased for larynx for most of the occupations we studied. Motor vehicle mechanics (OR=1.41; 95% CI 1.11–1.78), motor vehicle drivers (OR=1.22; 95% CI 1.04–1.44), cleaners (OR=1.56; 95% CI 1.2–2.03) and few occupations involving handling and producing textile showed significantly increased ORs only for larynx. Waiters, bartenders showed increased ORs for oral cavity (OR=1.67; 95% CI 1.13–2.48) and larynx (OR=1.44; 95% CI 1.09–1.9). Plumbers, pipe fitters, structural metal preparers and erectors showed significantly increased ORs for all subsites except larynx. Butchers and meat preparers, material-handling equipment operators showed significantly increased ORs for oral cavity, pharynx and oropharynx.

In a sensitivity analysis to assess the impact of confounding by smoking and drinking on HNC risks,[1] we found that after excluding alcohol drinking and tobacco smoking from the regression models, there was increased risk of HNC for service workers: launderers, dry-cleaners and protective service workers; production and related workers: wood preparation workers and paper makers, cabinetmakers and related woodworkers, rubber and plastics product makers. All ORs were in the order of 1.5 (see Table, Supplemental Digital Content 6, which shows confounding by smoking and drinking). This shows that the relationship between certain occupations and HNC may be largely explained by confounding by smoking and drinking.

We observed interactions between building caretakers, charworkers, cleaners and both tobacco smoking & alcohol drinking. Protective service workers showed interaction with alcohol drinking only. Cooks, waiters, bartenders and tailors, dressmakers, sewers, upholsterers showed interaction with tobacco smoking. These associations are magnified by smoking and drinking (data not shown).

Approximately 14.5% (95% CI 7.1%- 21.9%) of head and neck cancer in this study would have been prevented if the at-risk occupations associated with HNC were eliminated, assuming a causal relationship.

DISCUSSION

In this large, pooled analysis of occupations in relation to HNC, we found elevated risks for several occupational categories. These associations were based on a large sample size and on models including adjustment for main confounders, and risks increased with duration of employment. Many of these associations remained significant after adjusting for multiple hypothesis testing. Laryngeal cancer in particular, had the highest and most consistent elevated risk patterns, suggesting an inhalation route of exposure.

The large number of positive associations is not surprising since these occupations were selected on the basis of the findings of previous studies. In this respect, our study should be seen mainly as hypothesis- testing rather than hypothesis- generating.

The mechanism by which chemical carcinogens may cause HNC development is likely to be through a multistep process.[22] Similar to many other cancers, it is initiated by repeated insults to the normal epithelium by carcinogens including tobacco, alcohol, and some occupational factors.[22] Though the precise mechanism of action of occupational carcinogens is not known, it is likely that several steps (e.g. DNA damage, epigenetic changes, chronic inflammation) are involved following exposure to different agents.

We found that the larynx is the cancer site most consistently associated with the occupations we studied. This suggests that the associated occupations may involve exposures which have a detrimental impact on the upper respiratory tract.[23] We observed positive association for painters, construction with laryngeal cancer in our study. IARC has already classified occupational exposures in painting as Group 1 lung carcinogens, supporting a carcinogenic effect on the respiratory tract. In addition, our findings also provide evidence of an association between painters, construction and oral cavity & pharyngeal cancer, suggesting an impact on the digestive tract and an ingestion route of exposure. These associations had been inconclusive in previous studies.[24] This analysis by subsite helped assess etiological differences in terms of specific agents for HNC. The possible mechanism may be similar to what has been observed for exposure to asbestos and welding fumes[14] through inhalation and to a lesser extent ingestion at the workplace environment. The mechanisms of carcinogenicity of asbestos fibers are not know with certainty but they are likely to involve generation of free radicals that directly cause genotoxicity, interference with the mitotic process, activation of macrophage and continuous inflammation producing reactive nitrogen and oxygen species resulting in epigenetic alterations, genotoxicity and tissue injury.[5]

The results of the analysis combining occupations with duration of employment are consistent with the previous observations that employment duration plays a role in HNC development and support a causal interpretation of the findings. We observed increased risks of HNC with significant trend in risk with increasing duration of employment for the majority of occupations we studied, like plumbers and pipe fitters, welders and flame-cutters

similar to previous studies[5,14,25,22,23] possibly due to exposure to asbestos and welding fumes through inhalation and ingestion. A duration-response relationship was also reported.[14] The mechanism by which welding fumes cause development of cancer is thought to be through induction of chronic inflammation and immunosuppression.[26]

We found interaction in our data which shows that occupational exposure to various deleterious agents may facilitate the penetration of other carcinogens (through tobacco smoking or alcohol drinking) in the mucosa and vice-versa, resulting in elevated risks of HNCs. In our population, HNC occurred more often if smoking and having an occupation with exposure to inhalation of engine exhausts, textile dusts, cleaning agents and solvents occurred concurrently. Although smoking is a primary risk factor for HNCs due to exposure to already established human carcinogens, most studies done until today had limited statistical power to study interaction.

Our study showed that approximately 14.5% of the cases of head and neck cancer were attributable to occupations under our study. Previous studies have already shown that among the never drinkers, 24% (95% CI 16%- 31%) of the cases of head and neck cancer were attributable to ever cigarette smoking.[1] Among the never users of tobacco, 7% (95% CI − 4% - 16%) of the cases of head and neck cancer were attributable to alcohol drinking.[1] This shows that occupational factors are weaker risk factors for HNC than smoking.

We found elevated risks for waiters, bartenders and related workers. Such finding has also been reported in several studies[13,14,27–34] and could be explained by the exposure to passive smoking (both mainstream smoke and sidestream smoke). Previous studies have shown that involuntary smoking carcinogens are metabolized by passive smokers and can increase HNC risk.[34,35]

Elevated risks for butchers and meat preparers were also found in our study. Previous studies have already shown elevated risk for them.[14,31,36,37] This could be explained by their exposure to viral agents, nitrosamines, or polycyclic aromatic hydrocarbons.

The study found elevated risk for dockers and freight handlers, crane and hoist operators, earth-moving and related machinery operators. Increased risks in these occupations have been previously reported.[13,14,28,38] This might be explained by their exposure to engine exhausts, materials they load or transport.

Reinforced-concreters, cement finishers and terrazzo workers, roofers, carpenters, joiners and parquetry workers, plasterers showed positive association similar to many previous studies.[13,14,27,29,31,32,34,38,39] A plausible explanation for these associations might be the exposure to asbestos, silica, man-made vitreous fibers, and cement dust.

We found high OR for spinners, winders, weavers, knitters, similar to previous studies.[17,40] The mechanisms involved in the process may be chronic irritation of the mucosa by textile dusts, an exposure to nickel compounds, cadmium compounds, chromium compounds, lubricating oils, acrylonitrile and asbestos.[17] According to IARC, working in the textile manufacturing industry involves exposures that are possibly carcinogenic to humans.[41]

We observed that occupations that are strongly associated with higher risks of HNC are service workers including cooks, waiters, bartenders, cleaners; production and related workers including butchers and meat preparers, occupations involving work with metal and machinery, occupations involving handling and producing textile, carpenters and other construction workers painters, construction, material-handling and related equipment operators, dockers and freight handlers, transport equipment operators: Motor vehicle drivers and laborers. The association for HNC and protective service workers, cabinetmakers and related woodworkers, rubber and plastics product makers, launderers, dry-cleaners, wood preparation workers and paper makers, is likely due to strong confounding effect of smoking and drinking behavior in these occupations.

Potential limitations of this study include the possibility of recall bias, as with any observational retrospective study. However, this is unlikely to be based on case/control status as occupational exposures as causes of HNC are not well known in general population. Another limitation is that we could not analyze occupations at the 5-digit level (or most specific occupation level). This was due to the coding system we used to harmonize the occupational data. Updated ISCO −68 coding system classifies occupations upto three-digit level and it does not detail up to the five-digit level. Another limitation is that we do not have industrial data to study the association with HNC. Additionally, we could not study exposures in particular occupations as we did not have data on exposure agents. Lastly, we do not have information regarding frequency or intensity of each occupational exposure, although we used duration of employment at each exposed occupation as a surrogate for dose.[7]

There are several strengths of this study. First, it included a large sample size which provided adequate statistical power to detect associations between major occupational groups and allowed analyses by cancer subsites. Second, external validity of the study is strengthened by inclusion of three different geographic regions (sensitivity analysis did not show any significant findings-data not shown). Third, we adjusted for multiple hypotheses testing to control the Type 1 error rate and last, the analyses by duration of employment reinforced the associations which we found in our study.

In conclusion, this study shows potential risks for HNC subsites from occupational factors, with dose-response analyses according to duration of employment and simultaneous exposure to cofactors like tobacco and alcohol. It is important to stress that elimination of occupational factors by taking correct precautions at work place may reduce the risk of HNC. The identification of specific occupations that are associated with HNC could inform occupational health policy and potentially reduce the HNC burden. Further studies on specific exposure agents needs to be done.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Sources of funding:

The INHANCE Consortium was supported by NIH grants NCI R03CA113157 and NIDCR R03DE016611. Studies participating in the pooled analysis were supported by: Latin America study: Fondo para la Investigacion Cientifica y Tecnologica (FONCYT) Argentina, IMIM (Barcelona), Fundaco de Amparo a` Pesquisa no Estado de Sao Paulo (FAPESP) [No 01/01768–2], and European Commission [IC18-CT97–0222]. Sao Paulo: Sao Paulo Research Foundation (FAPESP) (GENCAPO 04/12054–9, 10/51168–0). Western Europe multicenter (ARCAGE): European Community (5th Framework Programme) grant no QLK1-CT-2001-00182. New York multicenter: NY multicenter study: NIH [P01CA068384 K07CA104231]. Central Europe multicenter (INCO): Central Europe study: World Cancer Research Fund and the European Commission INCO-COPERNICUS Program [Contract No. IC15- CT98–0332]. Tampa study: NIH [P01CA068384, K07CA104231, R01DE013158] Germany-Heidelberg: Germany-Heidelberg study: grant No. 01GB9702/3 from the German Ministry of Education and Research. Seattle-Leo: Seattle-LEO study: NIH[R01CA030022]. MSKCC: MSKCC study: NIH [R01CA051845]. Germany-Saarland: Saarland study: Ministry of Science, Research and Arts Baden-Wurttemberg.. France multicenter (ICARE): French National Research Agency (ANR); French National Cancer Institute (INCA); French Agency for Food, Environmental and Occupational Health and Safety (ANSES); French Association for Research on Cancer (ARC); Fondation pour la Recherche Médicale (FRM); French Institute for Public Health Surveillance (InVS); Fondation de France; Ministry of Labour; Ministry of Health.

For the remaining authors none were declared.

All sources of support: We do not any acknowledgement to make.

REFERENCES:

1. Hashibe M, Brennan P, Benhamou S, Castellsague X, Chen C, Curado MP, et al. Alcohol drinking in never users of tobacco, cigarette smoking in never drinkers, and the risk of head and neck cancer: Pooled analysis in the international head and neck cancer epidemiology consortium. J Natl Cancer Inst. 2007;99:777–789. [PubMed: 17505073]
2. Global Burden of Disease Cancer Collaboration. Global, Regional, and National Cancer Incidence, Mortality, Years of Life Lost, Years Lived With Disability, and Disability-Adjusted Life-years for 32 Cancer Groups, 1990 to 2015. JAMA Oncol. 2017;3(4):524. [PubMed: 27918777]
3. Sanderson RJ, Ironside JAD. Squamous cell carcinomas of the head and neck. BMJ. 2002; 325:822–827. [PubMed: 12376446]
4. Sankaranarayanan R, Masuyer E, Swaminathan R, Ferlay J, Whelan S. Head and neck cancer: A global perspective on epidemiology and prognosis. Anticancer Res. 1998; 18: 4779–4786. [PubMed: 9891557]
5. Asbestos (chrysotile, amosite, crocidolite, tremolite, actinolite, and anthophyllite). IARC Monogr Eval Carcinog Risks to Humans. 2011;
6. Iarc. arsenic, metals, fibres and dusts: A review of human carcinogens. IARC Monogr. 2012;
7. Langevin SM, Mcclean MD, Michaud DS, Eliot M, Nelson HH, Kelsey KT. Occupational dust exposure and head and neck squamous cell carcinoma risk in a population-based case-control study conducted in the greater Boston area. Cancer Med. 2013;2: 978–986. [PubMed: 24403272]
8. IARC. Arsenic and arsenic compounds. In Some Metals and Metallic Compounds. IARC Monogr. 1980;23:1–415.
9. Altamirano-Lozano M, Beyersmann D, Carter DE, Fowler BA, Fubini B, Kielhorn J, et al. Cobalt in hard metals and cobalt sulfate, gallium arsenide, indium phosphide and vanadium pentoxide. IARC Monogr. 2006;86–1–294.
10. Beryllium, cadmium, mercury, and exposures in the glass manufacturing industry. Working Group views and expert opinions, Lyon, 9–16 February 1993. In: IARC Monogr. / WHO, IARC. 1993;58:1–415.
11. Awan KH, Hegde R, Cheever VJ, Carroll W, Khan S, Patil S, Warnakulasuriya S. Oral and pharyngeal cancer risk associated with occupational carcinogenic substances: Systematic review. Head Neck. 2018;40:2724–2732. [PubMed: 30387891]
12. Menvielle G, Luce D, Goldberg P, Leclerc A. Smoking, alcohol drinking, occupational exposures and social inequalities in hypopharyngeal and laryngeal cancer. Int J Epidemiol. 2004;33:799–806. [PubMed: 15155704]

13. Carton M, Guida F, Paget-Bailly S, Cyr D, Radoi L, Sanchez M, et al. Occupation and head and neck cancer in women-Results of the ICARE study. Am J Ind Med. 2014; 57:1386–1397. [PubMed: 25351857]
14. Paget-Bailly S, Guida F, Carton M, Menvielle G, Radoï L, Cyr D, et al. Occupation and head and neck cancer risk in men: Results from the ICARE Study, a French population-based case-control study. J Occup Environ Med. 2013;55:1065–1073. [PubMed: 23969505]
15. Toporcov TN, Znaor A, Zhang Z-F, Yu G-P, Winn DM, Wei Q, et al. Risk factors for head and neck cancer in young adults: a pooled analysis in the INHANCE consortium. Int J Epidemiol. 2015; 44:169–185. [PubMed: 25613428]
16. Cogliano VJ, Baan R, Straif K, Grosse Y, Lauby-Secretan B, Ghissassi FEl, et al. Preventable exposures associated with human cancers. JNCI. 2010;103:1827–1839.
17. Maier H, Tisch M. Occupation and head and neck cancer. Onkologie. 2000;23:34–40.
18. Conway DI, Hashibe M, Boffetta P, Wunsch-Filho V, Muscat J, Vecchia C La, et al. Enhancing epidemiologic research on head and neck cancer: INHANCE - The international head and neck cancer epidemiology consortium. Oral Oncology. 2009;45(9):743–746. [PubMed: 19442571]
19. Richiardi L, Corbin M, Marron M, Ahrens W, Pohlabeln H, Lagiou P, et al. Occupation and risk of upper aerodigestive tract cancer: The ARCAGE study. Int J Cancer. 2012; 130: 2397–406. [PubMed: 21671472]
20. Hashim D, Sartori S, Brennan P, Curado MP, Wünsch-Filho V, Divaris K, et al. The role of oral hygiene in head and neck cancer: results from International Head and Neck Cancer Epidemiology (INHANCE) consortium. Ann Oncol [Internet]. 2016;27(8):1619–1625.
21. Westfall PH, Westfall PH, Wolfinger RD, Wolfinger RD. Closed multiple testing procedures and PROC MULTTEST. SAS Obs July. 2000; 1–23.
22. Deshpande AM, Wong DT. Molecular Mechanisms of Head and Neck Cancer. Expert Rev Anticancer Ther. 2008;8:799–809. [PubMed: 18471051]
23. Barul C, Fayossé A, Carton M, Pilorget C, Woronoff A-S, Stücker I, et al. Occupational exposure to chlorinated solvents and risk of head and neck cancer in men: a population-based case-control study in France. Environ Heal 2017 161 2017;16:77.
24. Occupational exposure as a painter. IARC Monogr Eval Carcinog Risks to Humans. 2012;100 F.
25. Rubin DB, Schenker N. Multiple imputation in health-care databases: an overview and some applications. Stat Med. 1991;10:585–598. [PubMed: 2057657]
26. Guha N, Loomis D, Guyton KZ, Grosse Y, Ghissassi ElF, Bouvard V, et al. Carcinogenicity of welding, molybdenum trioxide, and indium tin oxide. The Lancet Oncology. 2017.
27. Goldberg P, Leclerc A, Luce D, Morcet JF, Brugere J. Laryngeal and hypopharyngeal cancer and occupation: results of a case control-study. Occup Environ Med. 1997;54:477–482. [PubMed: 9282123]
28. Merletti F, Boffetta P, Ferro G, Pisani P, Terracini B. Occupation and cancer of the oral cavity or oropharynx in Turin, Italy. Scand J Work Environ Heal. 1991;17:248–254.
29. Schildt EB, Eriksson M, Hardell L, Magnuson A. Occupational exposures as risk factors for oral cancer evaluated in a Swedish case-control study. Oncol Rep. 1999;6(2):317–320. [PubMed: 10022996]
30. Wortley P, Vaughan TL, Davis S, Morgan MS, Thomas DB. A case-control study of occupational risk factors for laryngeal cancer. Br J Ind Med. 1992;49(12):837–844. [PubMed: 1472441]
31. Boffetta P, Richiardi L, Berrino F, Estève J, Pisani P, Crosignani P, et al. Occupation and larynx and hypopharynx cancer: An international case-control study in France, Italy, Spain, and Switzerland. Cancer Causes Control. 2003;14(3):203–212. [PubMed: 12814199]
32. Elci OC, Dosemeci M, Blair A. Occupation and the risk of laryngeal cancer in Turkey. Scand J Work Environ Heal. 2001;27:233–239.
33. Olsen J, Sabroe S. Occupational causes of laryngeal cancer. J Epidemiol Community Health. 1984;38:117–121. [PubMed: 6747509]
34. Alavanja M, Baron JA, Brownson RC, Buffler PA, DeMarini DM, Djordjevic MV., et al. Tobacco smoke and involuntary smoking. In: IARC Monogr. 2004;200:1452.

35. Lee Y-CA, Boffetta P, Sturgis EM, Wei Q, Zhang Z-F, Muscat J, et al. Involuntary smoking and head and neck cancer risk: pooled analysis in the International Head and Neck Cancer Epidemiology Consortium. Cancer Epidemiol Biomarkers Prev. 2008;17:1974–1981. [PubMed: 18708387]

36. De Stefani E, Kogevinas M, Boffetta P, Ronco A, Mendilaharsu M. Occupation and the risk of lung cancer in Uruguay. Scand J Work Environ Heal. 1996;22:346–352.

37. Boffetta P, Gridley G, Gustavsson P, Brennan P, Blair A, Ekström AM, et al. Employment as butcher and cancer risk in a record-linkage study from Sweden. Cancer Causes Control. 2000;11:627–633. [PubMed: 10977107]

38. Brown L, Mason T, Pickle L, Stewart P, Buffler P, Burau K, et al. Occupational risk factors for laryngeal cancer on the Texas Gulf Coast. Cancer Res. 1988;48:1960–1964. [PubMed: 3349470]

39. Haguenoer JM, Cordier S, Morel C, Lefebvre JL, Hemon D. Occupational risk factors for upper respiratory tract and upper digestive tract cancers. Br J Ind Med. 1990;47:380–383. [PubMed: 2378815]

40. Bayer O, Cámara R, Zeissig SR, Ressing M, Dietz A, Locati LD, et al. Occupation and cancer of the larynx: a systematic review and meta-analysis. Eur Arch Oto-Rhino-Laryngology. 2016; 273:9–20.

41. Some flame retardants and textile chemicals, and exposures in the textile manufacturing industry. IARC Monogr. 1990;48:1–278.

TABLE 1.

Risk of head and neck cancer for selected occupations (two-digit ISCO- 68 code)- and adjustment for multiple hypothesis testing *

Occupation	ISCO- 68	Cases (exposed/unexposed)	Controls (exposed/unexposed)	Ever employed in occupation- OR(95% CI) **	P-value	Stepdown Bonferroni	Dependent FDR
Reference category		2810	6540	1			
Cooks- Waiters- Bartenders and Relaters Workers	53	470/8369	604/13126	1.36 (1.15– 1.60)	<0.001	0.005	0.003
Maids and Related Housekeeping Service Workers Not Elsewhere Classified	54	250/8589	434/13296	1.08 (0.88– 1.33)	0.48	1.00	1.00
Building Caretakers- Charworkers- Cleaners and Related Workers	55	358/8481	470/13260	1.38 (1.15– 1.66)	0.001	0.007	0.004
Launderers- Dry-Cleaners and Pressers	56	54/8785	69/13661	1.30 (0.85– 2.00)	0.23	1.00	1.00
Protective Service Workers	58	234/8605	359/13371	1.12 (0.91– 1.38)	0.29	1.00	1.00
Miners- Quarrymen- Well Drillers and Related Workers	71	133/8706	125/13605	1.40 (1.03– 1.89)	0.03	0.27	0.17
Metal Processers	72	225/8614	207/13523	1.43 (1.13– 1.81)	0.003	0.04	0.02
Wood Preparation Workers and Paper Makers	73	68/8771	74/13656	1.19 (0.80– 1.77)	0.39	1.00	1.00
Spinners- Weavers- Knitters- Dyers and Related Workers	75	224/8615	200/13530	1.67 (1.31– 2.12)	<0.001	0.002	0.001
Food and Beverage Processers	77	461/8378	450/13280	1.36 (1.15– 1.62)	0.001	0.007	0.004
Tailors- Dressmakers- Sewers- Upholsterers and Related Workers	79	157/8682	341/13389	0.94 (0.74– 1.19)	0.58	1.00	1.00
Shoemakers and Leather Goods Makers	80	96/8743	129/13601	0.95 (0.69– 1.32)	0.77	1.00	1.00
Cabinetmakers and Related Woodworkers	81	211/8628	276/13454	1.15 (0.91– 1.45)	0.24	1.00	1.00
Blacksmiths- Toolmakers and Machine-Tool Operators	83	810/8029	838/12892	1.31 (1.13– 1.51)	<0.001	0.005	0.003
Machinery Fitters- Machine Assemblers and Precision Instrument Makers (except Electrical)	84	947/7892	1325/12405	1.29 (1.13– 1.47)	<0.001	0.002	0.001
Electrical Fitters and Related Electrical and Electronics Workers	85	467/8372	738/12992	1.21 (1.03– 1.42)	0.02	0.20	0.12
Plumbers- Welders- Sheet Metal and Structural Metal Preparers and Erectors	87	653/8186	633/13097	1.41 (1.20– 1.64)	<0.001	0.002	0.001
Rubber and Plastics Product Makers	90	124/8715	126/13604	1.34 (0.99– 1.82)	0.06	0.47	0.31
Painters	93	361/8478	254/13476	1.63 (1.33– 2.01)	<0.001	0.002	0.001
Bricklayers- Carpenters and Other Construction Workers	95	1364/7475	1202/12528	1.37 (1.21– 1.54)	<0.001	0.002	0.001

Occupation	ISCO- 68	Cases (exposed/unexposed)	Controls (exposed/unexposed)	Ever employed in occupation- OR(95% CI)**	P-value	Stepdown Bonferroni	Dependent FDR
Material-Handling and Related Equipment Operators- Dockers and Freight Handlers	97	672/8167	666/13064	1.44 (1.24– 1.67)	<0.001	0.002	0.001
Transport Equipment Operators	98	1229/7610	1265/12465	1.27 (1.12– 1.43)	<0.001	0.002	0.001
Laborers Not Elsewhere Classified	99	713/8126	703/13027	1.37 (1.18– 1.60)	<0.001	0.002	0.001

*Reference category for estimate of a given occupation is never having worked in all of the a priori occupations

**Adjusted for age, sex, level of education-, race, study, region, alcohol and tobacco consumption.

TABLE 2.

Risk of head and neck cancer for selected occupations (three -digit ISCO code)- overall- and by duration of employment [*]

		Overall		Duration of employment<=10years		Duration of employment>10 years		Test for linear trend
Occupation	**ISCO-68**	**Ca/Co**	**OR (95% Cl)** [**]	**Ca/Co**	**OR (95% CI)** [**]	**Ca/Co**	**OR (95% CI)** [**]	**P- value**
Cooks	531	245/327	1.36 (1.09–1.68)	135/212	1.21 (0.89–1.64)	108/99	1.72 (0.69–4.27)	0.005
Waiters- bartenders and related workers	532	258/308	1.45 (1.17–1.80)	158/220	1.36 (1.02–1.81)	94/73	1.27 (0.54–3.01)	0.001
Charworkers- cleaners and related workers	552	277/380	1.38 (1.13–1.69)	184/254	1.13 (0.80–1.60)	88/108	1.27 (0.51–3.15)	0.003
Metal casters	724	25/15	2.54 (1.21–5.33)	15/13	1.18 (0.28–5.04)	10/2	18.2 [***]	0.004
Fibre preparers	751	19/13	3.41 (1.47–7.90)	14/10	2.63 (0.66–10.53)	5/3	81.8 [***]	0.007
Spinners and winders	752	72/61	1.60 (1.06–2.40)	56/50	1.47 (0.73–2.99)	16/11	1.69 (0.20–14.39)	0.02
Weavers and related workers	754	67/60	1.59 (1.04–2.42)	51/45	1.17 (0.50–2.71)	16/15	0.78 (0.10–6.09)	0.05
Knitters	755	23/16	3.04 (1.43–6.46)	16/14	2.42 (0.63–9.21)	7/2	66.6 [***]	0.01
Butchers and meat preparers	773	187/151	1.61 (1.24–2.10)	87/81	1.73 (0.94–3.18)	98/63	1.81 (0.72–4.53)	0.001
Toolmakers- metal patternmakers and metal markers	832	79/84	1.99 (1.36–2.91)	45/48	2.36 (1.44–3.87)	34/36	2.02 (0.53–7.63)	0.02
Machine-tool operators	834	248/291	1.37 (1.10–1.70)	166/185	1.39 (0.99–1.95)	82/101	0.81 (0.34–1.95)	0.25
Blacksmiths- toolmakers and machine-tool operators not elsewhere classified	839	340/296	1.28 (1.01–1.63)	291/237	1.2 (0.89–1.61)	45/37	1.67 (0.47–5.99)	0.18
Machinery fitters and machine assemblers	841	289/454	1.45 (1.18–1.77)	188/300	1.42 (1.08–1.86)	99/144	1.13 (0.50–2.58)	0.01
Motor vehicle mechanics	843	365/400	1.39 (1.15–1.67)	195/225	1.21 (0.90–1.62)	159/157	0.68 (0.33–1.42)	0.03
Plumbers and pipe fitters	871	224/197	1.63 (1.27–2.08)	108/106	0.81 (0.47–1.40)	116/91	1.12 (0.50–2.53)	0.001
Welders and flame-cutters	872	256/219	1.51 (1.20–1.90)	128/137	1.08 (0.68–1.71)	127/68	0.86 (0.33–2.26)	<0.001
Structural metal preparers and erectors	874	97/99	1.75 (1.24–2.46)	62/72	1.55 (0.85–2.80)	35/27	1.77 (0.34–9.31)	0.01
Painters- construction	931	235/157	1.82 (1.42–2.35)	117/83	1.98 (1.35–2.90)	115/71	2.87 (1.15–7.16)	0.002
Painters not elsewhere classified	939	138/108	1.36 (1.00–1.85)	64/66	1.31 (0.69–2.49)	74/40	1.32 (0.36–4.79)	0.14
Bricklayers- stonemasons and tile setters	951	509/356	1.29 (1.08–1.55)	207/128	1.19 (0.88–1.62)	300/171	0.64 (0.36–1.15)	0.06
Reinforced-concreters- cement finishers and terrazzo workers	952	107/71	2.08 (1.45–2.97)	63/42	1.7 (0.80–3.63)	44/29	1.3 (0.33–5.12)	0.003
Roofers	953	50/30	2.27 (1.35–3.80)	22/15	1.29 (0.41–4.01)	28/12	3.16 (0.53–18.92)	0.003
Carpenters- joiners and parquetry workers	954	292/306	1.52 (1.23–1.87)	156/175	1.81 (1.31–2.50)	129/112	0.98 (0.46–2.09)	0.01
Plasterers	955	70/40	2.45 (1.57–3.85)	30/21	2.08 (1.07–4.03)	40/19	1.98 (0.32–12.15)	<0.001

		Overall		Duration of employment<=10years		Duration of employment>10 years		Test for linear trend
Occupation	**ISCO-68**	**Ca/Co**	**OR (95% CI)****	**Ca/Co**	**OR (95% CI)****	**Ca/Co**	**OR (95% CI)****	**P- value**
Construction workers not elsewhere classified	959	450/463	1.25 (1.05–1.50)	258/251	1.24 (0.90–1.70)	187/197	0.99 (0.53–1.85)	0.33
Dockers and freight handlers	971	392/421	1.33 (1.11–1.60)	274/330	0.82 (0.60–1.11)	115/83	1.43 (0.57–3.58)	0.002
Crane and hoist operators	973	63/60	1.68 (1.09–2.59)	38/29	1.38 (0.66–2.90)	25/24	0.47 (0.07–3.18)	0.05
Earth-moving and related machinery operators	974	132/107	1.5 (1.10–2.04)	67/65	0.96 (0.48–1.90)	65/42	2.21 (0.69–7.07)	0.01
Material-handling equipment operators not elsewhere classified	979	121/117	1.75 (1.28–2.40)	66/81	0.85 (0.45–1.63)	55/36	3.21 (0.84–12.25)	<0.001
Motor vehicle drivers	985	1082/1064	1.27 (1.12–1.44)	433/492	1.29 (1.07–1.55)	629/508	0.97 (0.65–1.46)	0.03
Laborers not elsewhere classified	999	713/703	1.37 (1.18–1.60)	505/568	1.23 (1.01–1.50)	206/129	1.42 (0.73–2.76)	<.0001

* Reference category for estimate of a given occupation is never having worked in all of the a priori occupations.

** Adjusted for age, sex, level of education-, race, study, region, alcohol and tobacco consumption.

*** sample size inadequate.

Reference category: For overall analysis: Cases- 2810, Control- 6540. For analysis by duration: Cases- 2640, Control- 5354. NYMC is not included in the analysis by duration.

Table 3a.

Risk of head and neck cancer for selected occupations (three- digit ISCO code)- by cancer subsite (oral cavity, pharynx, oropharynx)*

		Oral cavity		Pharynx		Oropharynx	
Occupation	**ISCO code**	**Ca/Co**	**OR (95% CL)****	**Ca/Co**	**OR (95% CL)****	**Ca/Co**	**OR (95% CL)****
Cooks	531	41/319	1.49 (0.99–2.24)	74/319	1.40 (0.98–2.01)	45/319	1.51 (1.00–2.28)
Waiters- bartenders and related workers	532	48/303	1.67 (1.13–2.48)	72/303	1.38 (0.96–1.97)	47/303	1.44 (0.96–2.17)
Charworkers- cleaners and related workers	552	50/375	1.10 (0.76–1.59)	82/375	1.33 (0.96–1.85)	50/375	1.17 (0.80–1.72)
Metal casters	724	3/13	3.43 (0.67–17.60)	7/13	3.02 (0.96–9.52)	4/13	5.43 (1.24–23.82)
Fibre preparers	751	2/12	2.09 (0.33–13.29)	5/12	9.67 (2.04–45.77)	1/12	3.43 (0.35–34.09)
Spinners and winders	752	9/60	1.00 (0.45–2.18)	12/60	0.74 (0.35–1.57)	3/60	0.36 (0.11–1.26)
Weavers and related workers	754	9/60	1.12 (0.50–2.49)	14/60	0.94 (0.46–1.94)	9/60	1.19 (0.51–2.76)
Knitters	755	2/16	0.97 (0.19–4.91)	4/16	1.34 (0.35–5.08)	2/16	1.25 (0.25–6.35)
Butchers and meat preparers	773	37/142	1.78 (1.13–2.80)	69/142	1.60 (1.10–2.34)	42/142	1.72 (1.10–2.68)
Toolmakers- metal patternmakers and metal markers	832	10/65	1.15 (0.52–2.55)	20/65	1.29 (0.69–2.44)	8/65	0.80 (0.34–1.87)
Machine-tool operators	834	60/284	1.55 (1.08–2.23)	72/284	1.09 (0.78–1.53)	41/284	1.05 (0.70–1.57)
Blacksmiths- toolmakers and machine-tool operators not elsewhere classified	839	19/291	1.17 (0.66–2.08)	141/291	1.58 (1.11–2.24)	25/291	1.04 (0.62–1.76)
Machinery fitters and machine assemblers	841	34/365	1.38 (0.89–2.15)	79/365	1.53 (1.09–2.16)	45/365	1.49 (1.00–2.24)
Motor vehicle mechanics	843	56/367	1.22 (0.85–1.76)	106/367	1.13 (0.84–1.53)	60/367	1.06 (0.74–1.51)
Plumbers and pipe fitters	871	46/175	2.30 (1.51–3.51)	80/175	1.75 (1.21–2.52)	48/175	1.71 (1.13–2.60)
Welders and flame-cutters	872	39/208	1.36 (0.90–2.06)	84/208	1.42 (1.01–1.99)	45/208	1.32 (0.87–1.98)
Structural metal preparers and erectors	874	18/78	2.60 (1.38–4.88)	38/78	2.34 (1.40–3.90)	25/78	2.69 (1.49–4.87)
Painters- construction	931	41/146	1.92 (1.24–2.97)	75/146	1.51 (1.03–2.19)	44/146	1.47 (0.95–2.28)
Painters not elsewhere classified	939	39/100	1.78 (1.11–2.85)	41/100	1.07 (0.67–1.70)	21/100	0.82 (0.46–1.47)
Bricklayers- stonemasons and tile setters	951	108/328	1.37 (1.02–1.86)	160/328	1.48 (1.13–1.95)	83/328	1.38 (0.99–1.91)
Reinforced-concreters- cement finishers and terrazzo workers	952	18/59	2.90 (1.50–5.59)	33/59	1.92 (1.11–3.31)	17/59	1.72 (0.88–3.36)
Roofers	953	8/30	2.36 (0.88–6.33)	18/30	1.89 (0.88–4.03)	8/30	1.61 (0.61–4.23)
Carpenters- joiners and parquetry workers	954	55/296	1.55 (1.07–2.25)	93/296	1.44 (1.04–1.99)	48/296	1.3 (0.88–1.93)
Plasterers	955	11/36	2.25 (1.01–5.00)	21/36	1.74 (0.89–3.40)	10/36	1.57 (0.69–3.56)
Construction workers not elsewhere classified	959	70/420	1.21 (0.87–1.68)	158/420	1.29 (0.99–1.68)	101/420	1.34 (0.99–1.82)
Dockers and freight handlers	971	59/395	1.18 (0.84–1.67)	137/395	1.20 (0.91–1.58)	81/395	1.13 (0.82–1.57)
Crane and hoist operators	973	7/55	1.41 (0.56–3.60)	24/55	1.95 (1.01–3.8)	7/55	1.13 (0.43–2.98)

		Oral cavity		Pharynx		Oropharynx	
Occupation	**ISCO code**	**Ca/Co**	**OR (95% CL)****	**Ca/Co**	**OR (95% CL)****	**Ca/Co**	**OR (95% CL)****
Earth-moving and related machinery operators	974	15/102	0.9 (0.48–1.66)	38/102	1.13 (0.70–1.81)	18/102	0.80 (0.44–1.45)
Material-handling equipment operators not elsewhere classified	979	19/115	1.97 (1.08–3.62)	47/115	2.00 (1.24–3.21)	31/115	2.02 (1.18–3.46)
Motor vehicle drivers	985	194/994	1.23 (0.98–1.54)	305/994	1.07 (0.87–1.31)	187/994	1.16 (0.91–1.46)
Laborers not elsewhere classified	999	111/686	1.41 (1.06–1.87)	199/686	1.29 (1.00–1.66)	96/686	1.08 (0.79–1.47)

*Reference category for each estimate of a given occupation is never having worked in all of the a priori occupations.

**Adjusted for age, sex, level of education, race, study, region, alcohol and tobacco consumption.

Reference category: Cases- 2810, Control- 6540

Table 3b.

Risk of head and neck cancer for selected occupations (three- digit ISCO code)- by cancer subsite (hypopharynx, larynx)*

		Hypopharynx		Larynx	
Occupation	**ISCO code**	**Ca/Co**	**OR (95% CL)****	**Ca/Co**	**OR (95% CL)****
Cooks	531	29/319	1.21 (0.70–2.10)	115/315	1.40 (1.06–1.84)
Waiters- bartenders and related workers	532	25/303	1.24 (0.71–2.17)	112/299	1.44 (1.09–1.90)
Charworkers- cleaners and related workers	552	31/375	1.50 (0.91–2.46)	128/371	1.56 (1.20–2.03)
Metal casters	724	3/13	1.80 (0.38–8.61)	15/15	2.23 (0.99–5.05)
Fibre preparers	751	4/12	32.79 (4.01–268.29)	10/13	2.51 (0.93–6.74)
Spinners and winders	752	9/60	1.35 (0.55–3.32)	42/61	2.68 (1.65–4.35)
Weavers and related workers	754	5/60	0.64 (0.21–1.95)	37/60	2.00 (1.20–3.31)
Knitters	755	2/16	1.20 (0.19–7.36)	13/16	4.72 (1.94–11.50)
Butchers and meat preparers	773	27/142	1.37 (0.79–2.36)	67/146	1.38 (0.97–1.96)
Toolmakers- metal patternmakers and metal markers	832	12/65	2.35 (1.04–5.31)	43/84	2.30 (1.47–3.60)
Machine-tool operators	834	31/284	1.01 (0.61–1.68)	104/288	1.33 (1.00–1.76)
Blacksmiths- toolmakers and machine-tool operators not elsewhere classified	839	115/291	1.90 (1.23–2.93)	173/282	1.07 (0.79–1.44)
Machinery fitters and machine assemblers	841	33/365	1.37 (0.83–2.28)	164/447	1.28 (1.00–1.63)
Motor vehicle mechanics	843	45/367	1.13 (0.74–1.73)	178/392	1.41 (1.11–1.78)
Plumbers and pipe fitters	871	32/175	1.79 (1.06–3.03)	86/197	1.22 (0.89–1.68)
Welders and flame-cutters	872	39/208	1.50 (0.94–2.39)	118/212	1.52 (1.14–2.02)
Structural metal preparers and erectors	874	13/78	2.31 (1.07–5.00)	38/99	1.19 (0.76–1.85)
Painters- construction	931	28/146	1.32 (0.77–2.25)	104/154	1.80 (1.32–2.46)
Painters not elsewhere classified	939	21/100	1.43 (0.78–2.59)	47/106	1.12 (0.74–1.70)
Bricklayers- stonemasons and tile setters	951	77/328	1.56 (1.07–2.27)	212/352	1.22 (0.97–1.53)
Reinforced-concreters- cement finishers and terrazzo workers	952	16/59	2.29 (1.10–4.76)	47/71	1.88 (1.21–2.91)
Roofers	953	10/30	2.38 (0.93–6.07)	22/29	1.96 (1.04–3.68)
Carpenters- joiners and parquetry workers	954	45/296	1.56 (1.01–2.43)	127/295	1.35 (1.04–1.76)
Plasterers	955	11/36	1.67 (0.68–4.14)	33/40	2.78 (1.61–4.79)
Construction workers not elsewhere classified	959	57/420	1.23 (0.83–1.82)	182/451	1.16 (0.92–1.45)
Dockers and freight handlers	971	55/395	1.19 (0.79–1.77)	169/416	1.32 (1.04–1.67)
Crane and hoist operators	973	17/55	2.16 (2.13–2.2)	27/56	1.35 (0.79–2.31)
Earth-moving and related machinery operators	974	20/102	1.57 (0.85–2.91)	70/107	1.61 (1.12–2.33)
Material-handling equipment operators not elsewhere classified	979	16/115	1.78 (0.88–3.58)	47/117	1.39 (0.92–2.1)
Motor vehicle drivers	985	118/994	0.89 (0.66–1.21)	504/1024	1.22 (1.04–1.44)
Laborers not elsewhere classified	999	103/686	1.50 (1.05–2.14)	354/699	1.30 (1.07–1.57)

*Reference category for each estimate of a given occupation is never having worked in all of the a priori occupations.

** Adjusted for age, sex, level of education, race, study, region, alcohol and tobacco consumption.

Reference category: Cases- 2810, Control- 6540