

Table 2.10 Case–control studies on cancers of the head, neck, and upper aerodigestive tract and welding/welding fumes (web only)

Reference, location, enrolment/follow-up period	Population size, description, exposure assessment method	Organ site	Exposure category or level	Exposed cases/deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Hernberg et al. (1983) Denmark, Finland, Sweden 1977–1980	Cases: 167; new patients with primary malignant tumours of the nasal cavity and paranasal sinuses (ICD 160.00–160.99) Controls: 167; colorectal cancer cases Exposure assessment method: Expert judgement; occupational history (excluding the past 10 years before diagnosis), and details on occupational exposure to chemicals, followed by expert assessment	Nasal cavity & sinuses	Welding, flame cutting and soldering	17	2.8 (1.2–6.9)	.	
			Welding, flame cutting and soldering, but only those with exposure to chromium and/or nickel	13	3.3 (1.1–9.4)		
Olsen et al. (1984) Denmark 1980–1982	Cases: 271; newly diagnosed larynx cancer patients under 75 year of age, 176 Glottic; 79 Supraglottic; Subglottic Controls: 971; four controls were identified for each cases, and were matched to cases according to residence, sex and closest possible birth date Exposure assessment method: Questionnaire	Larynx: glottic, supraglottic and subglottic combined	Men only: Welding fumes	42	1.3 (0.9–2)	Age, alcohol consumption, tobacco consumption	
			Welding dust from stainless steel	12	1.3 (0.7–2.7)		
		Larynx: glottic	Men only: Welding fumes	23	1.1 (0.7–1.8)	Age, alcohol consumption, tobacco consumption	
			Welding dust from stainless steel	8	1.3 (0.6–3.1)		
		Larynx: supraglottic	Men only: Welding fumes	13	1.5 (0.8–2.9)	Age, alcohol consumption, tobacco consumption	
			Welding dust from stainless steel	2	0.7 (0.2–3.2)		
Larynx: subglottic	Men only: Welding fumes	5	6.3 (1.8–21.6)	Age, alcohol consumption, tobacco consumption			
	Welding dust from stainless steel	2	6.7 (1–33.3)				

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Magnani et al. (1987) United Kingdom, 3 English counties	Cases: 244; men aged 18–54 and resident in the study area who died from one of the five cancers under investigation Controls: 935; Each case was assigned two controls who had died in the same year from other causes and who were matched to the case for sex, county of residence and as closely as possible for age at death. A second set of controls was selected according to similar criteria but with residence matched by local authority instead of by county. Exposure assessment method: Expert judgement	Oesophagus	Welding fumes	NR	1.2 (0.5–1.9)	None	
Brown et al. (1988) USA (Texas) 1975–1980	Cases: 183; primary laryngeal cancer cases among white males aged 30–79 from 6 counties Controls: 250; population controls, white males frequency matched by age (5 years), vital status, ethnicity, county of residence Exposure assessment method: Questionnaire; full occupational history was collected (name employer, job title, duties for each job held 6 months or longer, held after 1939). Welders/cutters was a job title designated as high risk, among others.	Larynx: ICD-9 161.X, 231.0	Welders/cutters	18	1.46 (0.71–3.01)	Smoking, alcohol	Strengths: full occupational history Limitations: small size

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Vaughan (1989) USA, western Washington State 1979–1983	Cases: 231; oro- and hypopharyngeal: 183 cases; nasopharyngeal: 21; sinonasal: 27 Controls: 552; general population, random digit dialling, by frequency matching on age and sex so that at least twice as many controls were available in each 5-year age and sex category. For categories with fewer cases (e.g. young or female), the control-to-case ratio was increased to approximately five. Exposure assessment method: Questionnaire; full occupational history	Oral/Pharyngeal combined	Welders, cutters Welders cutters (1–9 years) Welders, cutters (10+ years) Trend-test <i>P</i> value: 0.37	6 NR NR	0.8 (0.2–2.4) 0.9 0.3	Age, sex, tobacco, alcohol	Limitations: small size
Ahrens et al. (1991) Germany, Bremen 1984–1987	Cases: 85; histologically confirmed male cases of primary cancer of the larynx, from 1 hospital in Bremen. Controls: 100; hospital controls from the same hospital (excluding cancer and smoking related reasons for hospitalization), frequency matched on age Exposure assessment method: Questionnaire; lifetime occupational history and exposure checklist (among which welding/burning)	Larynx	Welding/burning	NR	0.6 (0.3–1.4)	Age, smoking, alcohol consumption	Strengths: full occupational history Limitations: small size

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Merletti et al. (1991) Italy, Turin 1980–1984	Cases: 86; incident cases of oral and oropharyngeal cancers, only men Controls: 373; population controls Exposure assessment method: Questionnaire; occupational history. A JEM was also applied but not for welding fumes	Oral/Pharyngeal combined	Welders and flame-cutters	5	1.3 (0.4–3.7)	Age, education, area of birth, tobacco, alcohol	Limitations: very small size
Siemiatycki (1991) Canada, Montreal 1979–1985	Cases: 99; male resident in the Montreal metropolitan area, with histologically confirmed incident oesophagus cancer, age 35–70. Controls: 2546; study subjects with other cancers Exposure assessment method: Expert judgement	Oesophagus	Men: Welders and flame cutters (any)	2	0.8 (0.3–2.8)	Age, family income, cigarette index, alcohol index	Strengths: expert assessment Limitations: cancer controls, limited study power
			Arc welding fumes (any)	7	0.6 (0.3–1.2)		
			Arc welding fumes (substantial)	2	0.6 (0.2–1.9)		
			Gas welding fumes (any)	6	0.5 (0.3–1.1)		
			Gas welding fumes (substantial)	2	0.4 (0.1–1.4)		
Huebner et al. (1992) USA 1984–1985	Cases: 1114; incident and histologically confirmed oral and pharyngeal cancer cases, male and female, white and black, age 18–79 Controls: 1268; population controls, random digit dialling, frequency matched on sex, race, age (5 years), area Exposure assessment method: Questionnaire; full occupational history	Oral/Pharyngeal combined	Males: Welder/solderer	24	0.65 (0.34–1.24)	Age, race, smoking, alcohol, location	Strengths: large size
		Oral/Pharyngeal combined	Females: Welder/solderer	10	1.13 (0.35–3.52)	Age, race, smoking, alcohol, location	

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Wortley et al. (1992) USA, western Washington State 1983–1987	Cases: 235; incident laryngeal cancer cases, age 20–74 Controls: 547; population controls, random digit dialling selected to be similar in age and sex distribution with cases Exposure assessment method: Questionnaire; lifetime occupational history	Larynx	Welders, cutters	6	0.7 (0.2–2.4)	Smoking, alcohol, age, education	Strengths: full occupational history Limitations: small size
			Welders, cutters (< 10 y)	NR	0.4		
			Welders, cutters ≥ 10 years)	NR	2		
Luce et al. (1993) France 1986–1988	Cases: 207; patients with primary malignancies of the nasal cavity and paranasal sinuses Controls: 409; hospital controls diagnosed with cancer, frequency matched on age and sex (<i>n</i> = 323). A second control group (<i>n</i> = 86) based on cases' acquaintances (colleagues excluded). Exposure assessment method: Expert judgement	Nasal cavity & sinuses: Squamous cell carcinoma	Men only: Welding fumes	5	0.5 (0.2–1.4)	Age	Included in Leclerc et al. (1997)
		Nasal cavity & sinuses: Adenocarcinoma	Men only: Welding fumes	10	0.8 (0.4–1.6)	Age	
		Nasal cavity & sinuses: Other	Men only: Welding fumes	4	0.9 (0.3–3)	Age	
Goldberg et al. (1997) France 1989–1991	Cases: 528; males diagnosed with primary cancer of the hypopharynx and larynx, from 15 participating hospitals Controls: 305; hospital controls with other cancers selected by frequency matching for age, with a control to case ratio of about 1:1 Exposure assessment method: Questionnaire; lifetime occupational history and task descriptions	Larynx: plus hypopharynx	Welders, flame cutters	24	1.9 (0.7–5)	Age, alcohol, tobacco, education	Strengths: large size Limitations: hospital controls diagnosed with other cancers

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Leclerc et al. (1997) USA, Europe, China (pooled reanalysis of 12 studies) 1968–1990	Cases: 930; pooled data of 12 studies, 680 men, 250 women Controls: 3136; pooled data of 12 studies, 2349 men, 787 women Exposure assessment method: Questionnaire; occupational history available for all cases and controls. Welders were among the list of a priori suspected occupations and industries	Nasal cavity & sinuses: squamous cell carcinoma	Men welders: Ever < 10 years ≥ 10 years	6 NR NR	0.92 (0.38–2.22) 0.69 1.33	Study, age	Luce et al. (2002) reports on occupational exposures based on the same pooled data set, but does not report on welding fumes Strengths: pooled analysis with large size, including 12 case–control studies from 7 countries Limitations: only reports an OR for welders for squamous cell carcinoma (330 male cases, 102 female cases)
Teschke et al. (1997) Canada, British Columbia 1990–1992	Cases: 48; incident cases with histologically confirmed primary malignant tumours of the nasal cavity and sinuses Controls: 159; population controls randomly selected from 5-year age and sex strata of the provincial voters list. Exposure assessment method: Questionnaire	Nasal cavity & sinuses	Men: Welders (ever)	2	3.5 (0.2–53.7)	Sex, age, cigarette smoking	Limitations: small size

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De Stefani et al. (1998) Uruguay 1993–1995	Cases: 112; histologically confirmed laryngeal cancer cases, males age 30–75, 5 hospitals in Montevideo Controls: 509; hospital controls with cancers not related to tobacco or alcohol exposures Exposure assessment method: Questionnaire; complete occupational history, plus extra questions on specific exposures	Larynx	Welder (all laryngeal)	5	1 (0.4–3.1)	Age, residence, urban/rural, education, income, smoking, alcohol	Strengths: full occupational history Limitations: small size
			Welder (supraglottic)	NR	0.6 (0.1–5.2)		
			Welder (glottic)	NR	2 (0.2–17.6)		
Gustavsson et al. (1998) Sweden 1988–1991	Cases: 545; male incident cases of squamous cell carcinoma of the oral cavity, oropharynx, and hypopharynx, larynx, and oesophagus (age 40–79) Controls: 641; population controls, frequency matched to cases on region and age group Exposure assessment method: Expert judgement	Oral cavity	Welding fumes (ever)	18	0.88 (0.48–1.6)	Region, age, alcohol consumption, smoking habits	Strengths: expert assessment Limitations: relatively large size
		Pharynx	Welding fumes (ever)	28	1.57 (0.91–2.71)		
		Larynx	Welding fumes (1–8 years)	NR	1.12 (0.53–2.35)	Region, age, alcohol consumption, smoking habits	
			Welding fumes (> 8 years)	NR	2.26 (1.09–4.68)		
			Trend-test <i>P</i> value: 0.04				
			Welding fumes (ever)	32	1.56 (0.97–2.53)		
			Welding fumes (1–8 years)	NR	1.25 (0.65–2.42)		
Welding fumes (> 8 years)	NR	1.95 (1.03–3.69)	Region, age, alcohol consumption, smoking habits				
Trend-test <i>P</i> value: 0.04							

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Gustavsson et al. (1998) Sweden 1988–1991	Cases: 545; male incident cases of squamous cell carcinoma of the oral cavity, oropharynx, and hypopharynx, larynx, and oesophagus (age 40–79) Controls: 641; population controls, frequency matched to cases on region and age group Exposure assessment method: Expert judgement	Oesophagus	Welding fumes (ever)	19	1.15 (0.62–2.12)	Region, age, alcohol consumption, smoking habits	
Elci et al. (2001) Turkey 1979–1984	Cases: 940; laryngeal cancer patients, men only Controls: 1519; hospital controls with other cancers (not thought to share etiologic factors with laryngeal cancer) and non-cancer patients Exposure assessment method: Questionnaire; occupational history	Larynx	Welder	7	0.5 (0.2–1.3)	Age, smoking, alcohol	Strengths: large size Limitations: hospital controls, including cancer controls
Engel et al. (2002) USA, New Jersey 1993–1995	Cases: 542; 283 oesophageal adenocarcinomas, 259 gastric cardia adenocarcinomas Controls: 689; population-based controls obtained through random digit dialling, for those under 65 years of age and from Health Care Financing Administration records for those 65 years of age or older. Exposure assessment method: Questionnaire	Oesophagus (Adenocarcinoma)	Welders, solderers	4	0.7 (0.2–2.4)	Age, sex, race, study centre, respondent type, smoking, BMI	

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Shangina et al. (2006) central and eastern Europe 1999–2002	Cases: 350; male cases (34 hypopharyngeal, 316 laryngeal), incident cases age 15–79, histologically confirmed Controls: 728; hospital controls. Controls were frequency-matched to cases by age (± 3 years). Exposure assessment method: Questionnaire; full occupational history, including tasks and specific exposures, including arc welding and gas welding	Larynx: plus hypopharynx	Arc welding fumes	56	0.78 (0.54–1.14)	Age, country, tobacco, alcohol	Strengths: high exposure prevalence in this population Limitations: hospital controls
			Gas welding fumes	42	0.89 (0.58–1.37)		
			Arc welding fumes (only hypopharynx)	14	1.55 (0.72–3.34)		
d’Errico et al. (2009) Italy, Piedmont region 1996–2000	Cases: 113; incident histologically confirmed cases of sino-nasal epithelial cancers. (53 adenocarcinomas, 37 squamous cell carcinomas, 23 other histologies) Controls: 336; hospital controls from departments of ear/nose/throat and orthopaedics, frequency matched to cases by age (10 year), sex and province of residence Exposure assessment method: Expert judgement	Nasal cavity & sinuses: all sino-nasal epithelial cancer	Welding fumes (ever)	17	2 (1–3.82)	Age, sex	Strengths: detailed analyses by duration and level of exposure Limitations: small size
			Welding fumes (ever)	17	2.7 (1.31–5.45)	Age, sex, wood dust	
			Welding fumes (1–10 years)	NR	2.4 (0.92–6.38)	Age, sex, wood dust	
			Welding fumes (> 10 years)	NR	3 (1.13–8)		
			Welding fumes (low)	NR	3.3 (1.47–7.26)	Age, sex, wood dust, leather dust,	
			Welding fumes (high)	NR	1.6 (0.34–7.75)	solvent vapours, arsenic	
Nasal cavity & sinuses: Squamous cell carcinoma	Welding fumes (ever)	9	4.1 (1.66–10.13)	Age, sex			

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Paget-Bailly et al. (2013) France (10 departments) 2001–2007	Cases: 1833; Incident primary histologically confirmed cases with malignant neoplasms of the lip, oral cavity, pharynx, sinonasal and larynx, age 18–75 at diagnosis. Controls: 2747; general population, list-assisted random digit dialling, frequency matched to cases by sex, age, residence area, based on the distribution of all cases (including a parallel group of lung cancer cases) Exposure assessment method: Questionnaire; face to face interview, collecting complete occupational history, with a detailed description of each job of > 1 month. In addition there were 20 job/task-specific questionnaires.	Nasal cavity & sinuses: Squamous cell carcinoma	Welding fumes (1–10 years)	NR	2.6 (0.69–9.46)	Age, sex	ICARE study. Men only (results for women see Carton et al., 2014) Strengths: Large size, detailed job history information collected through face to face interviews	
			Welding fumes (> 10 years)	NR	5.4 (1.87–15.33)			
		Nasal cavity & sinuses: Squamous cell carcinoma	Welding fumes (low)	NR	3.5 (1.31–9.6)	Age, sex, arsenic		
			Welding fumes (high)	NR	4.3 (1.01–18.1)			
		Nasal cavity & sinuses: Adenocarcinomas	Welding fumes (ever)	6	1.3 (0.52–3.52)	Age, sex		
		Nasal cavity & sinuses: other than squamous cell and adenocarcinomas	Welding fumes (ever)	2	1 (0.22–4.66)	Age, sex		
		Other (specify): head and neck cancers	In years					Age, study centre, alcohol consumption, tobacco consumption
			Men welders and flame-cutters: Ever	109	1.9 (1.3–2.8)			
			≤ 10 years	NR	1.8 (1.1–3)			
			> 10 years	NR	2 (1–3.9)			
			Trend-test p-value: 0.01					
Other (specify): head and neck cancers	Men: Gas and electric welder (general)	44	3.2 (1.6–6.3)	Age, study centre, alcohol consumption, tobacco consumption				
	Electric arc welder	36	1.9 (1–3.6)					
Oral cavity	Men: Welders and flame-cutters (ever)	21	1.9 (1.1–3.3)	Age, study centre, alcohol consumption, tobacco consumption				

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		Pharynx (Oropharynx)	Men: Welders and flame-cutters (ever)	26	1.5 (0.9–2.5)	Age, study centre, alcohol consumption, tobacco consumption	
		Oral/Pharyngeal combined: unspecified	Men: Welders and flame-cutters (ever)	7	1.7 (0.7–3.9)	Age, study centre, alcohol consumption, tobacco consumption	
		Pharynx (Hypopharynx)	Men: Welders and flame-cutters (ever)	25	2.1 (1.2–3.6)	Age, study centre, alcohol consumption, tobacco consumption	
		Larynx	Men: Welders and flame-cutters (ever)	33	2.4 (1.5–4)	Age, study centre, alcohol consumption, tobacco consumption	

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Carton et al. (2014) France (10 departments) 2001–2007	Cases: 296; Incident primary histologically confirmed cases with malignant neoplasms of the lip, oral cavity, pharynx, sinonasal and larynx, age 18–75 at diagnosis. Controls: 775; general population, list-assisted random digit dialling, frequency matched to cases by sex, age, residence area, based on the distribution of all cases (including a parallel group of lung cancer cases) Exposure assessment method: Questionnaire; face to face interview, collecting complete occupational history, with a detailed description of each job of > 1 month. In addition there were 20 job/task-specific questionnaires	Other (specify): head and neck cancers	Women: Welders and flame-cutters (ever)	4	2.18 (0.33–14.4)	Age, study centre, alcohol consumption, tobacco consumption, education	ICARE study. Women only (results for men see Paget-Bailly et al., 2013) Strengths: Includes almost 300 female cases, detailed job history information collected through face to face interviews
			Welders and flame-cutters (≤ 10 years)	1	0.18 (0.01–3.13)		
			Welders and flame-cutters (> 10 years)	3	21.7 (1.54–304)		
				Trend-test p-value: 0.05			
Xie et al. (2017) Hong Kong Special Administrative Region 2010–2012	Cases: 352; histologically confirmed primary nasopharyngeal carcinoma cases, age 20–75 Controls: 410; hospital controls: outpatients from multiple disease units of the same hospital with no history of cancer, frequency matched by age (5-year groups), sex, residence district. Exposure assessment method: Questionnaire; self-report of exposure in each job in the occupational history	Pharynx (Nasopharynx): nasopharyngeal carcinoma (93% non-keratinizing carcinoma)	Welding fumes	7	9.18 (1.05–80.35)	Sex, age, tobacco, family history of NPC, intake of dark vegetables, intake of fruits	Strengths: full occupational history was collected and questionnaire asked about welding fumes. Limitations: number of exposed cases and controls was too small for analysis by duration

BMI, body mass index; CI, confidence interval; ICD, International Classification of Diseases; NPC, nasopharyngeal cancer; NR, not reported; OR, odds ratio

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