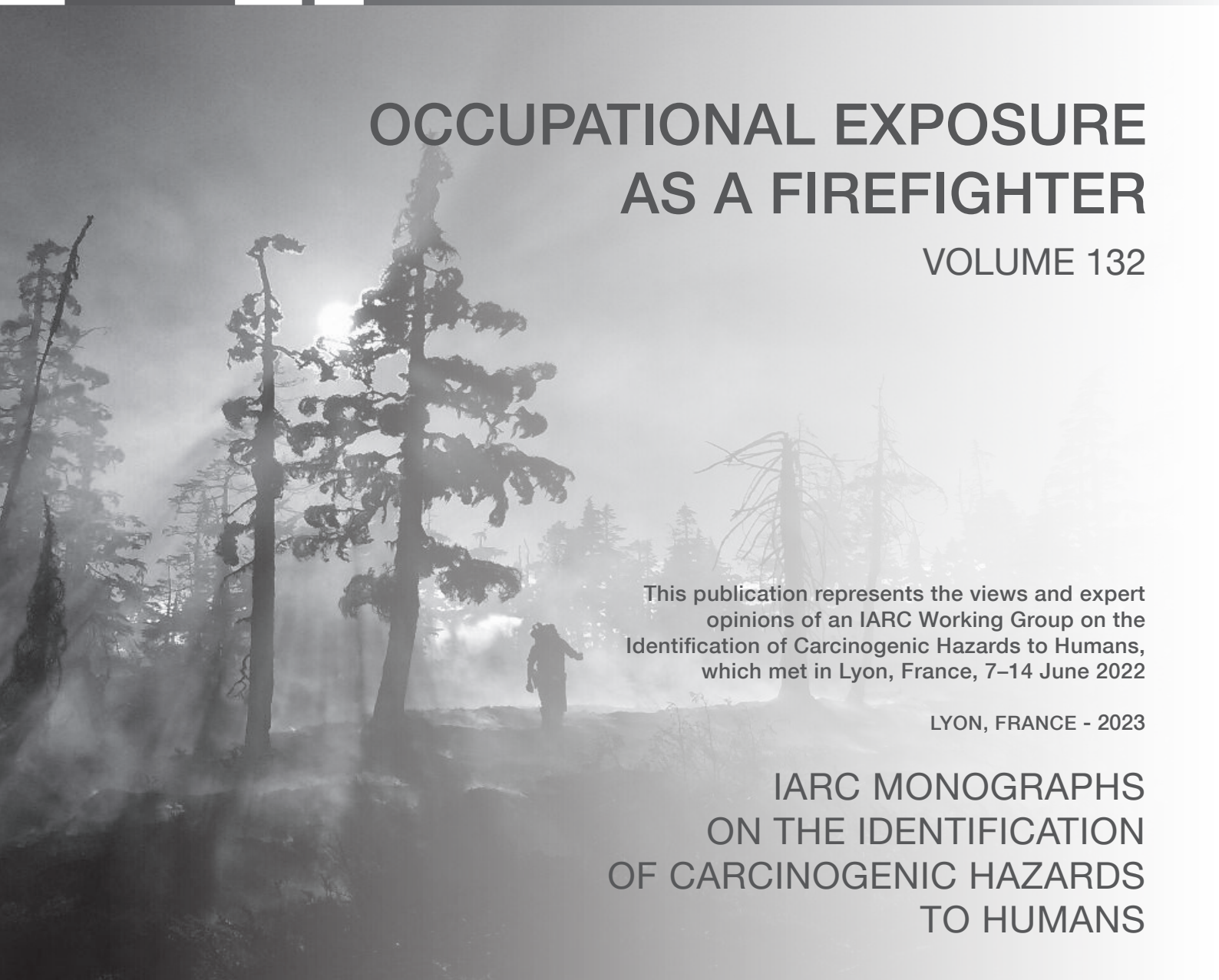
IARC MONOGRAPHS



OCCUPATIONAL EXPOSURE AS A FIREFIGHTER

VOLUME 132

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IARC MONOGRAPHS ON THE IDENTIFICATION OF CARCINOGENIC HAZARDS TO HUMANS

International Agency for Research on Cancer

World Health Organization

Table S2.8 Cohort and case–control studies only reporting having ever worked as a firefighter and cancers of the skin, thyroid, and brain

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Amadeo et al. (2015) France Enrolment, 1 January 1979/ follow-up, 1979–2008 Cohort	10 829 male professional [career] firefighters employed in France on 1 January 1979, identified from 89 French administrative departments (93% of population) Exposure assessment method: ever employed as firefighter from employment records	Skin, mortality	SMR (French population referent): Firefighters	5	0.65 (0.21–1.51)	Age, calendar year	*Exposure assessment critique*: Minimal quality. Exposure assessment at only one point in time. Employed as any type of paid [career] firefighter. May include municipal and rural firefighters. *Strengths*: cohort coverage at the national level; relatively large cohort with long follow-up; robust linkages. *Limitations*: probable healthy-worker selection bias; includes only the 16% who were career civilian firefighters (79% were volunteers and 5% were military); lack of information on exposure and potential confounders (sun exposures; radiation; diet; refrigeration); small numbers of cases for skin cancer.

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Ma et al. (2006) Florida, USA Enrolment, 1972–1999/ follow-up, 1981–1999 Cohort	36 813; all male (34 796) and female (2017) professional [career] firefighters certified in Florida from 1972 to 1999; the certification date was considered to be the date of first exposure Exposure assessment method: ever career firefighter from professional certification records	Skin (non-melanoma), incidence	SIR (Florida population referent):			Age, calendar year	*Exposure assessment critique*: Minimal quality. Only one point in time measure of exposure, no indication when exposure stopped. May include municipal and rural firefighters. *Strengths*: assesses cancer incidence; includes female firefighters; large male cohort. *Limitations*: probable healthy-worker selection bias; small female cohort; young age at end of follow-up; lacks information on exposure and potential confounders.
			Male firefighters	99	1.17 (0.95–1.42)		
			Female firefighters	5	3.01 (0.97–7.03)		
		Brain/CNS, incidence	SIR (Florida population referent):				
			Male firefighters	14	0.58 (0.31–0.97)		
			Female firefighters	0	0 (NR)		
		Thyroid, incidence	SIR (Florida population referent):				
			Male firefighters	20	1.77 (1.08–2.73)		
			Female firefighters	6	3.97 (1.45–8.65)		
Ma et al. (2005) Florida, USA Enrolment, 1972–1999/ follow-up, 1972–1999 Cohort	36 813; all male (34 796) and female (2017) professional [career] firefighters certified in Florida from 1972 to 1999 Exposure assessment method: ever career firefighter from professional certification records	Skin [probably includes melanoma and non-melanoma], mortality	SMR (Florida population referent):			Age, calendar period	*Exposure assessment critique*: Minimal quality. Only one point in time measure of exposure, no indication when exposure stopped. May include municipal and rural firefighters. *Strengths*: includes female firefighters; large male cohort; multiple linkages to assess vital status; conducted a sensitivity analysis among firefighters with longest tenure (certified 1972–1976). *Limitations*: probable healthy-worker selection bias; small female cohort; young age at end of follow-up; lacks information on exposure and potential confounders.
			Male firefighters	17	0.89 (0.52–1.42)		
			Male firefighters certified 1972–1976	15	1.21 (0.68–2.00)		
			Female firefighters	0	0 (NR)		
		Brain/CNS, mortality	SMR (Florida population referent):				
			Male firefighters	13	0.66 (0.35–1.13)		
			Male firefighters certified 1972–1976	8	0.62 (0.27–1.23)		
			Female firefighters	0	0 (NR)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Ma et al. (2005) (cont.)		Thyroid, mortality	SMR (Florida population referent):			Age, calendar period	
			Male firefighters	4	4.82 (1.30–12.3)		
			Male firefighters certified 1972–1976	3	4.76 (0.96–13.9)		
			Female firefighters	0	0 (NR)		
Grimes et al. (1991) Honolulu, Hawaii, USA 1969–1988 Cohort	205 deaths; all male firefighters with ≥ 1 yr of service in the City of Honolulu Fire Department Exposure assessment method: records; death certificate coding of usual occupation	Brain and other nervous system (ICD-9, 191, 192), mortality	PMR (state population referent):			NR	*Exposure assessment critique*: Minimal quality. Crude, relying on knowledge of usual occupation by death certifier. Possible differential misclassification from missing occupation on death certificates. May include municipal and rural firefighters. *Strengths*: Long follow-up; examined risk by ethnic group (White/Hawaiian). *Limitations*: Probable healthy-worker selection bias; unclear if underlying assumption that PMR will estimate an SMR is valid in this cohort; PMRs were not standardized by age or calendar period; no information on exposure and potential confounders. *Other comments*: number of deaths calculated by the Working Group.
			All firefighters	[3]	3.78 (1.22–11.71)		
			Caucasian [White] firefighters	[2]	4.15 (1.04–16.51)		
			Hawaiian firefighters	[1]	3.60 (0.49–26.46)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Musk et al. (1978) Boston, Massachusetts, USA 1915–1975 Cohort	5655 male professional [career] firefighters employed by the Boston Fire Department for ≥ 3 yr since 1915 Exposure assessment method: employed as municipal firefighter for ≥ 3 yr from employment records	Brain and other nervous system (ICD-7, 193), mortality	SMR: Firefighters vs Massachusetts male population Firefighters vs US White male population	8 8	[1.03 (0.48–1.95)] [1.13 (0.52–2.14)]	Age, calendar period	*Exposure assessment critique*: Satisfactory quality. Ever employed as municipal firefighter. *Strengths*: long follow-up. *Limitations*: probable healthy-worker selection bias; lack of information on cause for a proportion of deaths; lack of information on exposure and potential confounders.
Giles et al. (1993) Melbourne, Victoria, Australia Enrolment, 1917–1989/ follow-up, 1980–1989 Cohort	2865 operational active male firefighters employed between 1917 and 1989 by the Metropolitan Fire Brigade in Melbourne, Australia Exposure assessment method: ever employed from employment records	Melanoma, incidence	SIR (Victoria population referent): Firefighters	5	1.08 (0.35–2.53)	Age, calendar period	*Exposure assessment critique*: Minimal quality. Only ever municipal firefighter exposure. *Strengths*: assesses cancer incidence. *Limitations*: probable healthy-worker selection bias; small cohort size; no description of registry linkage methods; lack of information on exposure and potential confounders.

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Zhao et al. (2020) Spain Enrolment, 2001/follow-up, 2001–2011 Cohort	9 579 759 (27 365 firefighters); men identified as residing in Spain on 1 November 2001, employed on the census date, and aged 20–64 yr; followed for mortality using a national death registry Exposure assessment method: questionnaire; employed as firefighter in week before census	Melanoma, mortality Brain and other CNS (ICD-10, C70–C72), mortality Thyroid, mortality	Occupation (MRR): All other occupations Firefighters Occupation (MRR): All other occupations Firefighters Occupation (MRR): All other occupations Firefighters	 1456 3 5138 17 253 2	 1 0.63 (0.19–2.10) 1 1.07 (0.63–1.81) 1 2.34 (0.53–10.29)	Age	*Exposure assessment critique*: Minimal quality. Firefighting self-reported at one point in time. Years of firefighting. May include municipal and rural firefighters. *Strengths*: large study size; low loss to follow-up; cohort coverage at the national level. *Limitations*: occupation determined by self-report at baseline; short follow-up and young cohort age; lack of information on exposure and potential confounders.
Pukkala et al. (2014) Denmark, Finland, Iceland, Norway, Sweden 1961–2005 Cohort	16 422 male professional [career] firefighters in the NOCCA cohort (a registry-based cohort study of Nordic country residents who participated in any computerized population census, 1960, 1970, 1980/81, or 1990) and were followed up through linkage to national cancer registries), aged 30–64 yr, alive, and in the country in the year following census participation Exposure assessment method: records; employed as firefighter at time of census	Non-melanoma skin cancer, incidence Non-melanoma skin cancer, incidence Non-melanoma skin cancer, incidence Non-melanoma skin cancer, incidence	SIR, excluding Denmark (national referent): Firefighters Country (SIR): Finland Iceland Norway Sweden Age at follow-up, excluding Denmark (SIR): 30–49 yr 50–69 yr ≥ 70 yr Follow-up period, excluding Denmark (SIR): 1961–1975 1976–1990 1991–2005	 117 12 1 31 73 4 38 75 2 27 88	 1.33 (1.10–1.59) 0.94 (0.49–1.65) 1.42 (0.04–7.93) 1.32 (0.90–1.87) 1.43 (1.12–1.79) 0.80 (0.22–2.04) 1.28 (0.91–1.76) 1.40 (1.10–1.76) 0.55 (0.07–1.98) 1.28 (0.84–1.86) 1.39 (1.11–1.71)	Country, age, calendar period Age, calendar period Country, age, calendar period	*Exposure assessment critique*: Satisfactory quality. Self-reported firefighter as current job. Includes municipal and rural firefighters. *Strengths*: large study size; long follow-up time; assesses cancer incidence using high-quality outcome data; contrasts by country, observation period, and age; multiple sensitivity analyses. *Limitations*: probable healthy-worker selection bias; lack of information on exposure and potential confounders.

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Pukkala et al. (2014) (cont.)		Melanoma, incidence	SIR (national referent):			Country, age, calendar period	
			Firefighters	109	1.25 (1.03–1.51)		
		Melanoma, incidence	Country (SIR):			Age, calendar period	
			Denmark	5	1.08 (0.35–2.52)		
			Finland	20	1.16 (0.71–1.79)		
			Iceland	1	1.83 (0.05–10.21)		
			Norway	32	1.61 (1.10–2.28)		
			Sweden	51	1.14 (0.85–1.50)		
		Melanoma, incidence	Age at follow-up (SIR):			Country, age, calendar period	
			30–49 yr	37	1.62 (1.14–2.23)		
			50–69 yr	54	1.22 (0.92–1.60)		
			≥ 70 yr	18	0.90 (0.53–1.42)		
		Melanoma, incidence	Follow-up period (SIR):				
			1961–1975	12	1.94 (1.00–3.39)		
			1976–1990	37	1.39 (0.98–1.92)		
			1991–2005	60	1.11 (0.84–1.42)		
		Brain, incidence	SIR (national referent):				
			Firefighters	64	0.86 (0.66–1.10)		
		Brain (glioma), incidence	SIR (national referent):				
			Firefighters	33	0.92 (0.64–1.30)		
		Thyroid, incidence	SIR (national referent):				
			Firefighters	17	1.28 (0.75–2.05)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Sritharan et al. (2022) Ontario, Canada Enrolment, 1983–2019/ follow-up, 1983–2020 Cohort	2 368 226 (13 642 firefighters, 22 595 police); workers aged ≥ 15 yr who submitted lost-time workers' compensation injury and disease claims to the Workplace Safety and Insurance Board with known sex, birth date, claim date, and occupation and industry information; incident cases identified using the Ontario Cancer registry Exposure assessment method: other; employed as firefighter at time of workers' compensation claim	Melanoma, incidence	Referent (HR): Firefighters vs all other workers Firefighters vs police	 125 125	 2.38 (1.99–2.84) 1.01 (0.80–1.28)	Age at start of follow-up, birth year, sex	*Exposure assessment critique*: Minimal quality. Duration of firefighter work unclear. May include full-time, part-time, municipal and rural firefighters. *Strengths*: large study size; long follow-up time; includes female firefighters; working population used as referent; assesses cancer incidence. *Limitations*: potential selection bias into claims database, as compensation claims used to identify the cohort may differ by occupation; lack of information on exposure and potential confounders.
		Brain, incidence	Referent (HR): Firefighters vs all other workers Firefighters vs police	 37 37	 1.26 (0.91–1.74) 1.05 (0.68–1.62)		
		Thyroid, incidence	Referent (HR): Firefighters vs all other workers Firefighters vs police	 27 27	 1.11 (0.76–1.62) 0.75 (0.47–1.20)		
Harris et al. (2018) Canada Enrolment, 1991/follow-up, 1992–2010 Cohort	CanCHEC: 1 108 410 (4535 firefighters); men participating in the long-form Canadian census in 1991, employed with a valid occupation and aged 25–74 yr at cohort entry; incident cancers identified using a national cancer registry Exposure assessment method: questionnaire; ever employed as firefighter data from census	Melanoma, incidence	Occupation (HR): Non-firefighters Firefighters	 NR 30	 1 1.67 (1.17–2.37)	Age, region, education	*Exposure assessment critique*: Minimal quality. Self-reported firefighter as current or longest job. Includes municipal and rural firefighters. *Strengths*: study size; long follow-up time; national coverage of working population; assesses cancer incidence. *Limitations*: occupation determined at 1991 census based on self-report. Lack of information on exposure and potential confounders.
		Brain, incidence	Occupation (HR): Non-firefighters Firefighters	 NR 10	 1 1.11 (0.61–2.01)		
		Thyroid, incidence	Occupation (HR): Non-firefighters Firefighters	 NR 5	 1 1.35 (0.61–3.02)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Lee et al. (2020) Florida, USA 1981–2014 Case–control	Cases: firefighters, 3760 men, 168 women; non-firefighters, NR; cancer patients identified via linkage of FCDS and FMO records on firefighter certification and employment Controls: varied by cancer site; control patients are all other cancer types except the cancer of interest Exposure assessment method: employment as firefighter from employment and professional certification records	Melanoma, incidence	Group (OR for firefighters vs non-firefighters):			Age, year of diagnosis	*Exposure assessment critique*: Satisfactory quality. Ever firefighter exposure only. May include municipal and rural firefighters. *Strengths*: large study size (male firefighters); reliable information on firefighting status; includes female firefighters; assesses cancer incidence including tumour staging. *Limitations*: few female firefighters; cancer cases selected as controls (numerator-based analysis); limited information on exposure and potential confounders.
			Men	301	1.56 (1.39–1.76)		
			Women	14	1.68 (0.97–2.90)		
		Melanoma, incidence	Tumour stage, men (OR for firefighters vs non-firefighters):				
			Early-stage	226	1.37 (1.19–1.57)		
			Late-stage	33	1.21 (0.86–1.71)		
		Melanoma, incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters):				
			< 50 yr	126	1.87 (1.55–2.26)		
			≥ 50 yr	175	1.42 (1.22–1.66)		
		Brain, incidence	Group (OR for firefighters vs non-firefighters):				
			Men	72	1.03 (0.82–1.31)		
			Women	< 10	2.54 (1.19–5.42)		
		Brain, incidence	Tumour stage, men (OR for firefighters vs non-firefighters):				
			Early-stage	57	0.92 (0.7–1.20)		
			Late-stage	12	1.16 (0.65–2.04)		
		Brain, incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters):				
			< 50 yr	34	0.94 (0.67–1.33)		
			≥ 50 yr	38	1.16 (0.84–1.60)		
		Thyroid, incidence	Group (OR for firefighters vs non-firefighters):				
			Men	99	2.17 (1.78–2.66)		
			Women	25	2.42 (1.56–3.74)		
		Thyroid, incidence	Tumour stage, men (OR for firefighters vs non-firefighters):				
			Early-stage	61	1.78 (1.38–2.31)		
			Late-stage	37	2.70 (1.94–3.76)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Lee et al. (2020) (cont.)		Thyroid, incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters)			Age, year of diagnosis	
			< 50 yr	62	2.55 (1.96–3.31)		
			≥ 50 yr	37	1.69 (1.22–2.34)		
McClure et al. (2021) Florida, USA 1981–2014 Case–control	Cases: firefighters, 3760; non-firefighters, NR; cancer patients identified via linkage of FCDS and FMO records on firefighter certification and employment Controls: varied by cancer site; control patients were all other cancer types except the cancer of interest Exposure assessment method: employment as firefighter from cancer registry records and from employment and professional certification records	All skin cancer, incidence	Occupation (OR):			Age, year of diagnosis	*Exposure assessment critique*: Minimal quality. Ever firefighter exposure only. Incorporation of employment and certification records improvement for method 2. May include municipal and rural firefighters. *Strengths*: large study size; assesses cancer incidence. *Limitations*: cancer cases selected as controls (numerator-based analysis); minimal information on exposure and potential confounders; completeness of occupation data (from registry records) varied by sociodemographic and diagnostic characteristics.
			Non-firefighters	NR	1		
			Firefighters, FMO employment certification records	316	1.54 (1.37–1.73)		
			Firefighters, FCDS occupational data	109	1.06 (0.87–1.29)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Muegge et al. (2018) Indiana, USA 1985–2013 Case–control	Cases: firefighters, 857; non-firefighters, 11 272; cancer as the underlying cause of death in state death registry among registrants with complete information on year of death, age at time of death, sex, race, ethnicity, industry code, and occupation code; all firefighter cancers were included, but non-firefighter cancers only observed among non-firefighter decedents matched 4:1 to firefighter decedents on age at death, sex, race, ethnicity, and year of death Controls: varied by cancer site; decedents with a cause of death other than the one under study among all firefighter decedents and a sample of non-firefighter decedents matched 4:1 to firefighter decedents on age at death, sex, race, ethnicity, and year of death Exposure assessment method: records; death certificate coding of usual occupation	Brain and other nervous system, mortality	Death certificate occupation (OR): Non-firefighter Firefighter	 61 30	 1 1.98 (1.23–3.12)	Sex, race, ethnicity, age at death, year of death	*Exposure assessment critique*: Minimal quality. Crude, relying on knowledge of usual occupation by death certifier. Possible differential misclassification from missing occupation on death certificates. May include municipal and rural firefighters. *Strengths*: large study size. *Limitations*: deaths used as controls (numerator-based analysis); lack of information on exposure and potential confounders.

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Tsai et al. (2015) California, USA 1988–2007 Case–control	Cases: 678 132 (all cancers); all first malignant primary cancers in the registry restricted to adult male participants (aged 18–97 yr) with industry and occupation information available; sites must have ≥ 10 firefighters among the cases to be analysed Controls: 48 725; cancers of the pharynx, stomach, liver, and pancreas in the registry restricted to adult male participants (aged 18–97 yr) with industry and occupation information available Exposure assessment method: records; employment as firefighter, coded as longest job held from cancer registry	Melanoma, incidence	Race (OR, firefighters vs non-firefighters):			Age, year of diagnosis, race	*Exposure assessment critique*: Minimal quality. Ever firefighter exposure only. May include municipal and rural firefighters. *Strengths*: large study size; assesses incident cancers; findings stratified by race/ ethnicity. *Limitations*: no information on the population at risk (numerator-based analysis); occupation missing from nearly 50% of registry cases and more likely for people who were older or of Hispanic ethnicity; lack of information on exposure and potential confounders.
			White	254	1.71 (1.40–2.09)		
			Other	7	4.51 (1.85–10.97)		
			Overall	265	1.75 (1.44–2.13)		
		Brain, incidence	Race (OR, firefighters vs non-firefighters):				
			White	76	1.41 (1.07–1.87)		
			Other	10	3.58 (1.65–7.74)		
			Overall	87	1.54 (1.19–2.00)		
		Thyroid, incidence	Race (OR, firefighters vs non-firefighters):				
			White	36	1.21 (0.81–1.80)		
			Other	5	1.92 (0.66–5.60)		
			Overall	41	1.27 (0.88–1.84)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Kang et al. (2008) Massachusetts, USA 1987–2003 Case–control	Cases: NR overall (firefighters, 1881; non-firefighters, NR); White male residents of Massachusetts aged ≥ 18 yr with complete information on "usual occupation" and a diagnosis of one of 25 "cancers of concern" in the MCR Controls: NR overall (firefighters, 244; non-firefighters, NR); White male residents of Massachusetts aged ≥ 18 yr with complete information on "usual occupation" and a cancer diagnosis not on the list of 25 "cancers of concern" in the MCR Exposure assessment method: employment as firefighter coded from longest job held from cancer registry records	Melanoma, incidence	Referent (SMBOR):			Age, smoking status	*Exposure assessment critique*: Minimal quality. Ever firefighter exposure only. May include municipal and rural firefighters. *Strengths*: large size; long study period; assesses incident cancers; smoking information available. *Limitations*: cancer cases used as controls (numerator-based analysis); incomplete information on occupation (38% missing); lack of information on exposure and potential confounders.
			Firefighters vs police	78	0.65 (0.44–0.97)		
			Firefighters vs all other occupations	78	1.04 (0.77–1.42)		
		Melanoma, incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	0.97 (0.51–1.88)		
			55–74 yr	NR	0.61 (0.33–1.13)		
			≥ 75 yr	NR	0.35 (0.13–0.91)		
		Brain, incidence	Referent (SMBOR):				
			Firefighters vs police	28	1.90 (1.10–3.26)		
			Firefighters vs all other occupations	28	1.36 (0.87–2.12)		
		Brain, incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	2.03 (0.79–5.25)		
			55–74 yr	NR	1.70 (0.80–3.60)		
			≥ 75 yr	NR	2.78 (0.64–12.04)		
		Thyroid, incidence	Referent (SMBOR):				
			Firefighters vs police	10	0.71 (0.30–1.70)		
			Firefighters vs all other occupations	28	0.81 (0.41–1.59)		
		Thyroid, incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	0.56 (0.18–1.71)		
			55–74 yr	NR	1.66 (0.36–7.64)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Sama et al. (1990) Massachusetts, USA 1982–1986 Case–control	Cases: NR; White men aged ≥ 18 yr with information on usual occupation and a diagnosis with one of nine cancers of concern in the MCR Controls: NR; White men aged ≥ 18 yr with information on usual occupation and a cancer diagnosis for all other cancers, except those of the organ systems of concern (digestive, respiratory, and lymphatic/haematopoietic) Exposure assessment method: records; employment as firefighter or fire chief from cancer registry records	Melanoma, incidence	Referent (SMBOR):			Age	*Exposure assessment critique*: Minimal quality. Ever firefighter exposure only. Use of secondary data sources confirmed occupation for some firefighters. May include municipal and rural firefighters. *Strengths*: assesses incident cancers; smoking information available. *Limitations*: small study; cancer cases used as controls (numerator-based analysis); incomplete information on occupation; crude smoking status information; no smoking adjustment; lack of information on exposure and potential confounders.
			Firefighters vs police	18	1.38 (0.60–3.19)		
			Firefighters vs state	18	2.92 (1.70–5.03)		
		Melanoma, incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	5	0.55 (0.16–1.96)		
			55–74 yr	11	5.13 (1.50–17.50)		
			≥ 75 yr	2	1.10 (0.13–9.34)		
		Brain and other nervous system, incidence	Referent (SMBOR):				
			Firefighters vs police	5	1.52 (0.39–5.92)		
			Firefighters vs state	5	0.86 (0.34–2.15)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Ma et al. (1998) USA 1984–1993 Case–control	Cases: NR; all male cancer deaths with coded industry and occupation on death certificates from 24 states captured in a NIOSH database Controls: NR; all male non-cancer deaths in the NIOSH database Exposure assessment method: questionnaire; death certificate coding of usual occupation	Melanoma, mortality	Group (MOR):			Year of death, age at death	*Exposure assessment critique*: Minimal quality. Crude, relying on knowledge of usual occupation by death certifier. Possible differential misclassification from missing occupation on death certificates. May include municipal and rural firefighters. *Strengths*: large study size (includes 6607 male firefighter deaths); broad geographical population coverage. *Limitations*: small number of cancer deaths among Black firefighters; non-cancer deaths used as controls (numerator-based analysis); lack of information on exposure and potential confounders.
			White firefighters	35	1.4 (1.0–1.9)		
			Black firefighters	0	0 (NR)		
		Non-melanoma skin cancer, mortality	Group (MOR):				
			White firefighters	9	1.0 (0.5–1.9)		
			Black firefighters	0	0 (NR)		
		Brain and CNS, mortality	Group (MOR):				
			White firefighters	41	1.0 (0.8–1.4)		
			Black firefighters	5	6.9 (3.0–16.0)		
		Thyroid, mortality	Group (MOR):				
			White firefighters	3	1.3 (NR)		
			Black firefighters	0	0 (NR)		

Table S2.8 (continued)

Reference, location, enrolment/ follow-up period, study design	Population size, description, exposure assessment method	Cancer type (histopathology), incidence or mortality	Exposure category or level	Exposed cases or deaths	Risk estimate (95% CI)	Covariates controlled	Comments
Burnett et al. (1994) USA 1984–1990 Mortality surveillance	5744 deaths; White male firefighters identified by evaluation of coded occupation on death certificates from 27 states Exposure assessment method: records; death certificate coding of usual occupation	Melanoma, mortality	Group (PMR):			Age	*Exposure assessment critique*: Minimal quality. Crude, relying on knowledge of usual occupation by death certifier. Possible differential misclassification from missing occupation on death certificates. May include municipal and rural firefighters. *Strengths*: large number of deaths; broad geographical population coverage. *Limitations*: numerator-only (PMR) analysis; errors in death-certificate occupation; lack of information on exposure or potential confounders.
			Firefighters	38	1.63 (1.15–2.23)		
			Firefighters, age < 65 yr at death	24	1.67 (1.07–2.48)		
		Brain and nervous system cancer (ICD-9, 191, 192), mortality	Group (PMR):				
			Firefighters	38	1.03 (0.73–1.41)		
			Firefighters, age < 65 yr at death	19	0.85 (0.52–1.34)		

CanCHEC, Canadian Census Health and Environment Cohort; CI, confidence interval; CNS, central nervous system; FCDS, Florida Cancer Data System; FMO, office of the Florida State Marshal; HR, hazard ratio; HWE, healthy-worker effect; ICD, International Classification of Diseases; MCR, Massachusetts Cancer Registry; MOR, mortality odds ratio; MRR, mortality rate ratio; NIOSH, National Institute for Occupational Safety and Health; NOCCA, Nordic Occupational Cancer study; NR, not reported; OR, odds ratio; PMR, proportionate mortality ratio; SCC, squamous cell carcinoma; SIR, standardized incidence ratio; SMBOR, standardized morbidity odds ratio; SMR, standardized mortality ratio; vs, versus; yr, year.

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