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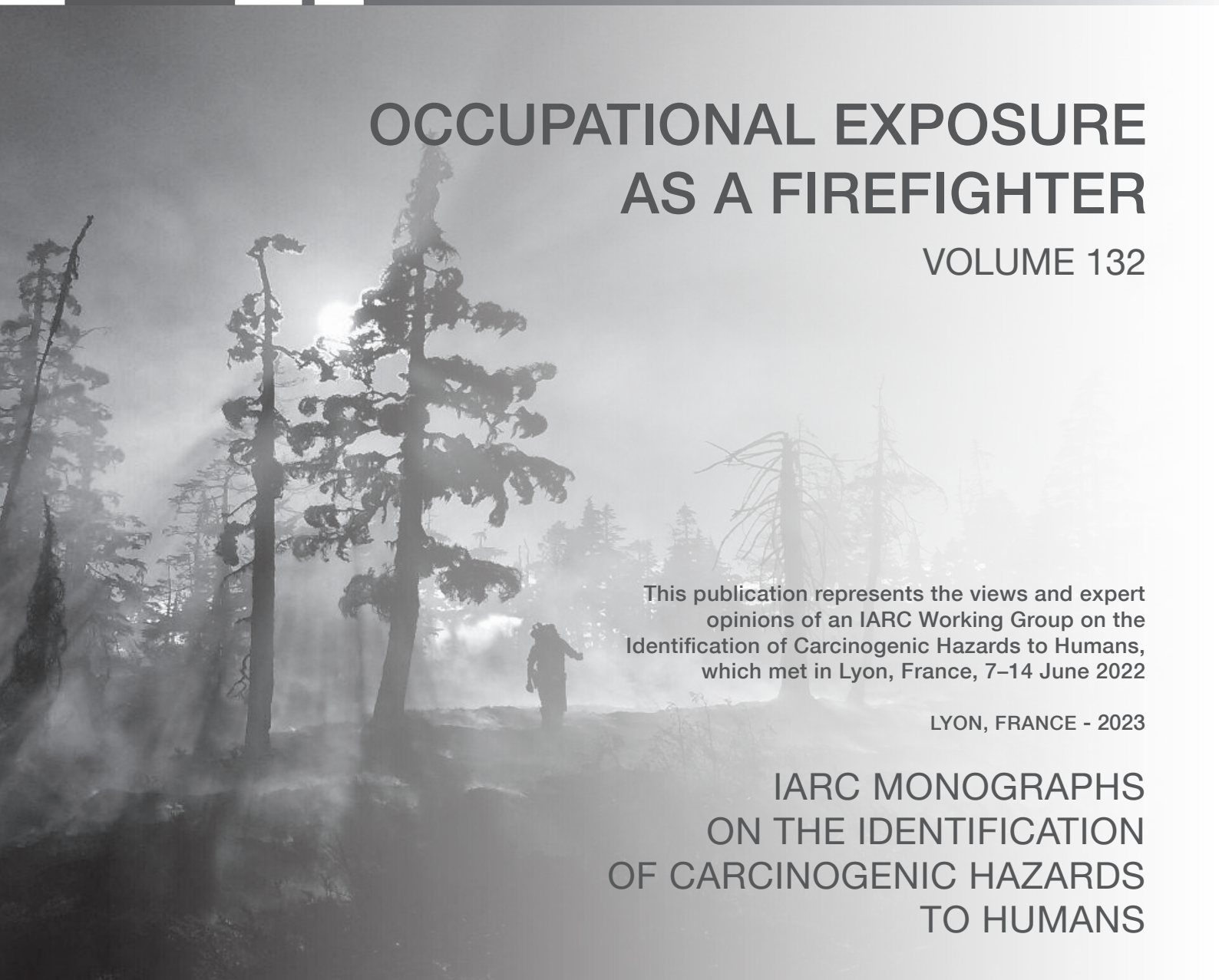

OCCUPATIONAL EXPOSURE AS A FIREFIGHTER

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 S2.6 Cohort and case–control studies only reporting having ever worked as a firefighter and cancers of lymphatic and haematopoietic tissues

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	Lymphatic and haematopoietic, mortality	SMR (French population referent): Firefighters	42	0.89 (0.64–1.20)	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.
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	Lymphatic and haematopoietic, incidence	SIR (Florida population referent): Male firefighters	78	0.68 (0.54–0.85)	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.
			Female firefighters	6	2.62 (0.96–5.70)		
		NHL, incidence	SIR (Florida population referent): Male firefighters	15	1.09 (0.61–1.80)		
			Female firefighters	1	33.30 (0.44–185.00)		

Table S2.6 (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) (cont.)		Hodgkin lymphoma, incidence	SIR (Florida population referent):			Age, calendar year	
			Male firefighters	11	0.77 (0.38–1.38)		
			Female firefighters	3	6.25 (1.26–18.3)		
		Leukaemia, incidence	SIR (Florida population referent):				
			Male firefighters	20	0.77 (0.47–1.19)		
			Female firefighters	0	0 (NR)		
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	Lymphatic and haematopoietic, 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	42	0.77 (0.56–1.05)		
			Female firefighters	1	1.25 (0.02–6.95)		
		Lymphosarcoma-reticulosarcoma, mortality	SMR (Florida population referent):				
			Male firefighters	3	0.65 (0.13–1.90)		
			Female firefighters	0	0 (NR)		
		Hodgkin lymphoma, mortality	SMR (Florida population referent):				
			Male firefighters	1	0.23 (0–1.30)		
			Female firefighters	0	0 (NR)		
		Leukaemia, mortality	SMR (Florida population referent):				
			Male firefighters	14	0.84 (0.46–1.42)		
			Female firefighters	0	0 (NR)		

Table S2.6 (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
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: death certificate coding of usual occupation	Lymphatic and haematopoietic (ICD-9, 200–209), mortality	PMR (state population referent): All firefighters Caucasian [White] firefighters Hawaiian firefighters	 [4] [1] [2]	 0.95 (0.36–2.50) 0.66 (0.09–4.63) 0.97 (0.24–3.84)	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.
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	Lymphatic and haematopoietic (ICD-7, 200–205), mortality	SMR (Massachusetts population referent): Firefighters	 22	 [0.63 (0.41–0.94)]	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.

Table S2.6 (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
Bates et al. (2001) New Zealand Enrolment, 1977 through June 1995/follow-up, 1977–1995 (mortality), 1977–1996 (incidence) Cohort	4305; all male (4221) and female (84) firefighters (paid [career] and volunteer) employed as a career firefighter for ≥ 1 yr and who also worked as a career firefighter for ≥ 1 day between 1977 and 1995; all analyses limited to men due to small numbers of women Exposure assessment method: ever employed and categorical duration of employment (years) from employment records	Lymphatic and haematopoietic (ICD-9, 200–208), mortality Leukaemia (myeloid; ICD-9, 205), incidence	SMR: Employment as firefighter SIR: Employment as firefighter	4 4	0.72 (0.2–1.8) 1.81 (0.5–4.6)	Age, calendar period	*Exposure assessment critique*: Satisfactory quality. Heterogeneity of direct firefighter exposure within job title. May include municipal and rural firefighters. *Strengths*: assesses cancer incidence as well as mortality; relatively large cohort (men). *Limitations*: lack of information on potential confounders.
Giles et al. (1993) Melbourne, 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	NHL (ICD, 200, 202), incidence Leukaemia (ICD, 204–208), incidence	SIR (Victoria population referent): Firefighters SIR (Victoria population referent): Firefighters	4 0	1.85 (0.50–4.74) 0 (0.00–3.56)	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 S2.6 (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
Eliopulos et al. (1984) Western Australia Follow-up, 1939–1978 Cohort	990; all men employed as permanent full-time firefighters by the Western Australian Fire Brigade between October 1939 and December 1978 Exposure assessment method: ever employed as a permanent full-time firefighter, and categorical employment duration (years) as firefighters from employment records	Lymphatic and haematopoietic, mortality	PMR (Western Australia referent): Employment as firefighter	3	1.88 (0.39–5.50)	Age, calendar period	*Exposure assessment critique*: Satisfactory quality. Unsure if permanent full-time status was maintained throughout study period. Municipal firefighters. *Strengths*: long follow-up time; low loss to follow-up. *Limitations*: probable healthy worker selection bias; small study size; no personal information on exposure or potential confounders.
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: records; employed as firefighter in week before census	Lymphoma (type not specified; (ICD-10, C81–C83), mortality Hodgkin lymphoma (ICD-10, C81), mortality Leukaemia (ICD-10, C91–C95), mortality	Occupation (MRR): All other occupations Firefighters Occupation (MRR): All other occupations Firefighters Occupation (MRR): All other occupations Firefighters	3246 11 365 2 2935 7	1 1.29 (0.69–2.34) 1 1.41 (0.34–5.85) 1 0.90 (0.40–2.01)	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.

Table S2.6 (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) 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	NHL (ICD-10, C82–C85, C96), incidence	SIR (national referent): Firefighters	82	1.04 (0.83–1.29)	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.
		NHL (ICD-10, C82–C85, C96), incidence	Country (SIR): Denmark Finland Iceland Norway Sweden	 6 20 1 14 41	 1.23 (0.45–2.67) 0.99 (0.60–1.52) 1.18 (0.03–6.56) 1.07 (0.58–1.79) 1.04 (0.74–1.41)	Age, calendar period	
		NHL (ICD-10, C82–C85, C96), incidence	Age at follow-up (SIR): 30–49 yr 50–69 yr ≥ 70 yr	 11 38 33	 0.82 (0.41–1.46) 0.95 (0.67–1.31) 1.30 (0.89–1.83)	Country, age, calendar period	
		NHL (ICD-10, C82–C85, C96), incidence	Follow-up period (SIR): 1961–1975 1976–1990 1991–2005	 1 26 55	 0.23 (0.01–1.29) 1.12 (0.73–1.64) 1.08 (0.81–1.40)		
		Multiple myeloma (ICD-10, C90), incidence	SIR (national referent): Firefighters	41	1.13 (0.81–1.53)		
		Multiple myeloma (ICD-10, C90), incidence	Country (SIR): Denmark Finland Iceland Norway Sweden	 3 6 0 9 23	 1.08 (0.22–3.16) 0.96 (0.35–2.1) 0 (0.00–9.8) 0.96 (0.44–1.82) 1.32 (0.83–1.97)	Age, calendar period	
		Multiple myeloma (ICD-10, C90), incidence	Age at follow-up (SIR): 30–49 yr 50–69 yr ≥ 70 yr	 0 17 24	 0 (0.00–1.16) 0.90 (0.53–1.45) 1.69 (1.08–2.51)	Country, age, calendar period	

Table S2.6 (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.)		Multiple myeloma (ICD-10, C90), incidence	Follow-up period (SIR):			Country, age, calendar period	
			1961–1975	4	1.17 (0.32–2.99)		
			1976–1990	11	0.87 (0.44–1.57)		
			1991–2005	26	1.28 (0.84–1.88)		
		Leukaemia (ICD-10, C91–C95), incidence	Firefighters	56	0.94 (0.71–1.22)		
		Leukaemia (AML), incidence	SIR (national referent):				
			Firefighters	21	1.27 (0.79–1.94)		
Sritharan et al. (2022) Ontario, Canada Enrolment, 1983–2019/follow-up, 1983–2020 Cohort	2 368 226 (firefighters 13 642; police 22 595); 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: records; employed as firefighter at time of workers' compensation claim	Hodgkin lymphoma (ICD-10, C81), incidence	Referent (HR):			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.
			Firefighters vs all other workers	10	1.27 (0.68–2.37)		
			Firefighters vs police	10	1.33 (0.57–3.12)		
		NHL (ICD-10, C82), incidence	Referent (HR):				
			Firefighters vs all other workers	104	1.35 (1.11–1.64)		
			Firefighters vs police	104	1.21 (0.92–1.58)		
		Multiple myeloma (ICD-10, C90), incidence	Referent (HR):				
			Firefighters vs all other workers	29	1.18 (0.82–1.70)		
			Firefighters vs police	29	0.94 (0.57–1.53)		

Table S2.6 (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) (cont.)		Leukaemia (ICD-10, C91), incidence	Referent (HR) Firefighters vs all other workers Firefighters vs police	 64 64	 1.35 (1.05–1.73) 1.15 (0.81–1.62)	Age at start of follow-up, birth year, sex	
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: ever employed as firefighter data from census records	Hodgkin lymphoma, incidence NHL, incidence Multiple myeloma, incidence Leukaemia, incidence	Occupation (HR): Non-firefighters Firefighters Occupation (HR): Non-firefighters Firefighters Occupation (HR): Non-firefighters Firefighters Occupation (HR): Non-firefighters Firefighters	 NR 5 NR 30 NR 10 NR 15	 1 2.89 (1.29–6.46) 1 1.00 (0.71–1.41) 1 1.52 (0.82–2.84) 1 0.93 (0.55–1.58)	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.

Table S2.6 (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: NR (varies 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	Hodgkin lymphoma, 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	32	0.85 (0.60–1.21)		
			Women	< 10	1.68 (0.62–4.56)		
		Hodgkin lymphoma, incidence	Tumour stage, men (OR for firefighters vs non-firefighters):				
			Early-stage	< 10	0.47 (0.18–1.27)		
			Late-stage	23	1.13 (0.74–1.72)		
		Hodgkin lymphoma, incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters):				
			< 50 yr	< 10	0.95 (0.64–1.40)		
			≥ 50 yr	< 10	0.68 (0.30–1.51)		
		NHL, incidence	Group (OR for firefighters vs non-firefighters):				
			Men	168	0.88 (0.75–1.03)		
			Women	< 10	0.98 (0.43–2.21)		
		NHL, incidence	Tumour stage, men (OR for firefighters vs non-firefighters):				
			Early-stage	53	1.02 (0.77–1.34)		
			Late-stage	90	1.00 (0.81–1.24)		
		NHL, incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters):				
			< 50 yr	63	0.79 (0.61–1.02)		
			≥ 50 yr	105	0.95 (0.78–1.15)		
		Multiple myeloma, incidence	Group (OR for firefighters vs non-firefighters):				
			Men	40	0.80 (0.59–1.10)		
			Women	< 10	1.32 (0.33–5.32)		
		Multiple myeloma, incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters):				
			< 50 yr	13	1.19 (0.69–2.06)		
			≥ 50 yr	27	0.68 (0.47–1.00)		

Table S2.6 (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.)		Leukaemia (myeloid), incidence	Group (OR for firefighters vs non-firefighters):			Age, year of diagnosis	
			Men	34	0.61 (0.44–0.86)		
			Women	< 10	0.51 (0.07–3.57)		
		Leukaemia (myeloid), incidence	Age at diagnosis, men (OR for firefighters vs non-firefighters):				
			< 50 yr	13	0.58 (0.34–1.01)		
			≥ 50 yr	21	0.65 (0.42–1.00)		
		Leukaemia (AML), incidence	Group (OR for firefighters vs non-firefighters):				
			Men	21	0.63 (0.41–0.96)		
			Women	< 10	0.80 (0.11–5.68)		
		Acute monocytic leukaemia, incidence	Group (OR for firefighters vs non-firefighters):				
			Men	NR	0.48 (0.07–3.41)		
			Women	0	0 (NR)		
		Leukaemia (ALL), incidence	Group (OR for firefighters vs non-firefighters):				
			Men	< 10	0.69 (0.33–1.45)		
			Women	0	0 (NR)		
		NHL (CLL), incidence	Group (OR for firefighters vs non-firefighters):				
			Men	38	0.89 (0.65–1.23)		
			Women	< 10	2.33 (0.58–9.41)		
		Leukaemia (CML), incidence	Group (OR for firefighters vs non-firefighters):				
			Men	NR	0.55 (0.30–1.02)		
			Women	0	0 (NR)		

Table S2.6 (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
McClure et al. (2021) Florida, USA 1981–2014 Case–control	Cases: firefighters, 3760; non-firefighters, NR; male cancer patients identified via linkage of FCDS and FMO records on firefighter certification and employment Controls: varies by cancer site; control patients are all other cancer types except the cancer of interest Exposure assessment method: employment as firefighter from cancer registry records and employment and professional certification records	Leukaemia, incidence	Occupation (OR): Non-firefighters Firefighters, FMO employment certification records Firefighters, FCDS occupational data	 NR 87 61	 1 0.66 (0.53–0.81) 0.92 (0.71–1.19)	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*: probable healthy-worker selection bias; 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.
		Leukaemia (myeloid including monocytic leukaemias), incidence	Occupation (OR): Non-firefighters Firefighters, FMO employment certification records Firefighters, FCDS occupational data	 NR 34 23	 1 0.61 (0.44–0.86) 0.86 (0.57–1.30)		

Table S2.6 (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
McClure et al. (2021) (cont.)		Lymphoma (type not specified), incidence	Occupation (OR):			Age, year of diagnosis	
			Non-firefighters	NR	1		
			Firefighters, FMO employment certification records	200	0.86 (0.75–0.99)		
			Firefighters, FCDS occupational data	109	1.10 (0.90–1.34)		
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: employment as firefighter, coded as longest job held from cancer registry records	Hodgkin lymphoma, 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 cancer, with subtypes reported for leukaemia; 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	25	1.07 (0.63–1.80)		
			Other	4	2.50 (0.76–8.28)		
			Overall	29	1.15 (0.72–1.83)		
		NHL, incidence	Race (OR, firefighters vs non-firefighters):				
			White	159	1.16 (0.94–1.45)		
			Other	24	2.17 (1.20–3.92)		
			Overall	183	1.22 (1.00–1.50):		
		Multiple myeloma, incidence	Race (OR, firefighters vs non-firefighters):				
			White	42	1.17 (0.84–1.64)		
			Other	13	3.77 (1.91–7.44)		
			Overall	55	1.35 (1.00–1.82)		
		Leukaemia, incidence	Race (OR, firefighters vs non-firefighters):				
			White	101	1.17 (0.91–1.49)		
			Other	20	3.64 (1.96–6.74)		
			Overall	122	1.32 (1.05–1.66)		
		NHL (CLL), incidence	Race (OR, firefighters vs non-firefighters):				
			White	36	1.17 (0.82–1.67)		
			Other	7	7.04 (2.99–16.56)		
			Overall	43	1.34 (0.96–1.87)		

Table S2.6 (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) (cont.)		Leukaemia (AML), incidence	Race (OR, firefighters vs non-firefighters):			Age, year of diagnosis, race	
			White	40	1.46 (1.03–2.08)		
			Other	2	1.12 (0.26–4.76)		
			Overall	42	1.44 (1.02–2.02)		
		Leukaemia (CML), incidence	Race (OR, firefighters vs non-firefighters):				
			White	14	1.14 (0.66–1.99)		
			Other	6	4.91 (1.84–13.12)		
			Overall	21	1.51 (0.95–2.40)		
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 with 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	Leukaemia (ICD-O-3, 9800–9948), 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 (police referent):	46	0.72 (0.43–1.20)		
			Firefighters (all other occupations referent):	46	0.98 (0.69–1.39)		
		Leukaemia (ICD-O-3, 9800–9948), incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	1.83 (0.66–5.08)		
			55–74 yr	NR	0.43 (0.20–0.96)		
			≥ 75 yr	NR	0.49 (0.17–1.44)		
		NHL (ICD-O-3, 9590–9640, 9670–9700, 9720, 9750–9760), incidence	Referent (SMBOR):				
			Firefighters (police referent)	13	0.77 (0.31–1.92)		
			Firefighters (all other occupations referent)	13	1.10 (0.58–2.09)		
		NHL, incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	1.18 (0.26–5.36)		
			55–74 yr	NR	0.83 (0.23–2.96)		

Table S2.6 (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) (cont.)		Hodgkin lymphoma (ICD-O-3, 9650–9667), incidence	Referent (SMBOR):			Age, smoking status	
			Firefighters (police as referent)	8	1.81 (0.72–4.53)		
			Firefighters (all other occupations referent)	8	1.56 (0.71–3.43)		
		Hodgkin lymphoma (ICD-O-3, 9650–9667), incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	2.86 (0.76–10.74)		
			55–74 yr	NR	1.27 (0.30–5.47)		
			≥ 75 yr	NR	0.91 (0.06–15.21)		
		Multiple myeloma (ICD-O-3, 9731, 9732), incidence	Referent (SMBOR):				
			Firefighters (police referent):	29	0.76 (0.39–1.48)		
			Firefighters (all other occupations referent):	29	0.92 (0.58–1.47)		
		Multiple myeloma (ICD-O-3, 9731, 9732), incidence	Age at diagnosis (SMBOR, firefighters vs police):				
			18–54 yr	NR	0.68 (0.13–3.54)		
			55–74 yr	NR	0.75 (0.32–1.74)		
			≥ 75 yr	NR	0.76 (0.17–3.36)		

Table S2.6 (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: employment as firefighter or fire chief from cancer registry records	NHL (ICD-O histology, 959–964, 967–970, 972, 975–976), incidence Leukaemia (ICD-O histology, 980–994, excluding 984), incidence	Referent (SMBOR): Firefighters (police referent): Firefighters (state referent): Referent (SMBOR): Firefighters (police referent) Firefighters (state referent)	 14 14 6 6	 3.27 (1.19–8.98) 1.59 (0.89–2.84) 2.67 (0.62–11.54) 1.12 (0.48–2.59)	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.
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	NHL, mortality Hodgkin lymphoma, mortality	Group (MOR): White firefighters Black firefighters Group (MOR): White firefighters Black firefighters	 76 1 13 0	 1.4 (1.1–1.7) 0.8 (NR) 2.4 (1.4–4.1) 0 (NR)	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.

Table S2.6 (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) (cont.)		Multiple myeloma, mortality	Group (MOR):			Year of death, age at death	*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	28	1.1 (0.8–1.6)		
			Black firefighters	1	0.8 (NR)		
		Leukaemia, mortality	Group (MOR):				
			White firefighters	60	1.1 (0.8–1.4)		
			Black firefighters	0	0 (NR)		
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	Lymphatic and haematopoietic (ICD-9, 200–208), 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	169	1.30 (1.11–1.51)		
			Firefighters, age < 65 yr at death	85	1.61 (1.29–1.99)		
		NHL (ICD-9, 200, 202), mortality	Group (PMR)				
			Firefighters	66	1.32 (1.02–1.67)		
			Firefighters, age < 65 yr at death	35	1.61 (1.12–2.24)		
		Multiple myeloma (ICD-9, 203), mortality	Group (PMR):				
			Firefighters	34	1.48 (1.02–2.07)		
			Firefighters, age < 65 yr at death	11	1.36 (0.68–2.43)		

Table S2.6 (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) (cont.)		Leukaemia (ICD-9, 204–208), mortality	Group (PMR):			Age	
			Firefighters	61	1.19 (0.91–1.53)		
			Firefighters, age < 65 yr at death	33	1.71 (1.18–2.40)		

ALL, acute lymphoblastic/lymphocytic leukaemia; AML, acute myeloid leukaemia; BMI, body mass index; CanCHEC, Canadian Census Health and Environment Cohort; CI, confidence interval; CLL, chronic lymphocytic leukaemia; CML, chronic myeloid leukaemia; FCDS, Florida Cancer Data System; FMO, Office of the Florida State Marshal; HR, hazard ratio; ICD, International Classification of Diseases; ICD-O, International Classification of Diseases for Oncology; MCR, Massachusetts Cancer Registry; MOR, mortality odds ratio; MRR, mortality rate ratio; NHL, non-Hodgkin lymphoma; 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; SMBOR, standardized morbidity odds ratio; SMR, standardized mortality ratio; SIR, standardized incidence ratio; vs, versus; yr, year.

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