APPENDIX A

Table S1: PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3-4
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	4
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	5
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	5
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	5
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	5
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	6
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	6
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	6

Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	6
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	7
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	7
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	7
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	7
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	8
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	8
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	9
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	9
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	9
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	9
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	9-10
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	10
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	11
Conclusions	26	Provide a general interpretation of the results in the context	12-13

		of other evidence, and implications for future research.	
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	15

Table S2: Literature search strategies

PUBMED:	(((("firefighter"[mesh] OR "firefighter"[tiab] OR "firefighter"[ot] OR "fire"[mesh] OR "fire"[tiab] OR "fire"[ot] OR"firefighting"[mesh] OR "firefighting"[tiab] OR "firefighting"[ot] OR "first responder"[mesh] OR "first responder"[tiab] OR "first responder"[ot]) AND (("cancer"[mesh] OR "cancer"[tiab] OR "cancer"[ot] OR "lymphoma"[mesh] OR "lymphoma"[tiab] OR "lymphoma"[ot] OR "mesothelioma"[mesh] OR "mesothelioma"[tiab] OR "mesothelioma"[ot] OR "myeloma"[mesh] OR "myeloma"[tiab] OR "myeloma"[ot] OR "melanoma"[mesh] OR "melanoma"[tiab] OR "melanoma"[ot] OR "leukemia"[mesh] OR "leukemia"[tiab] OR "leukemia"[ot] OR "malignancy"[mesh] OR "malignancy"[tiab] OR "malignancy"[ot] OR "malignant"[mesh] OR "malignant"[tiab] OR "malignant"[ot] OR "tumor "[mesh] OR "tumor "[tiab] OR "tumor "[ot] OR "carcinoma"[mesh] OR "carcinoma"[tiab] OR "carcinoma"[ot])) AND (("2009/01/01"[PDAT] : "2020/04/30"[PDAT])) AND (English[lang])
NIOSHTIC-2:	fire OR firefighter OR firefighting AND cancer OR lymphoma OR mesothelioma OR myeloma OR melanoma OR leukemia OR malignancy OR malignant OR tumor OR carcinoma AND (2009/01/01 to 2020/04/30)
GOOGLE SCHOLAR:	fire OR firefighter OR firefighting OR 'First Responder' AND cancer OR lymphoma OR mesothelioma OR myeloma OR melanoma OR leukemia OR malignancy OR malignant OR tumor OR carcinoma AND (2009/01/01 to 2020/04/30)

Table S3: Cancer types extracted from the studies included in the meta-analysis based on the ICD-10

Code	Cancer Type
C00-C97	All cancers
C00-C14	Buccal cavity and pharynx
C15	Esophagus
C16	Stomach
C17	Small Intestine
C18	Large intestine
C17-C18$^{\pm}$	Colon
C19-C21	Rectum
C22-C23	Liver/Gallbladder
C25	Pancreas
C32	Larynx
C33-C34	Lung
C40-C41	Bone
C43	Malignant Melanoma
C44	Skin
C45	Pleura (mesothelioma)
C49	Soft tissue sarcoma
C50	Breast
C60, C63	Other male genital organs
C61	Prostate
C62	Testis
C64-C66	Kidney
C67	Bladder
C69	Eye
C47, C70-C72	Brain
C73	Thyroid
C46.3, C82-C85, C88.0, C88.3, C91.4, C96	Non-Hodgkin's lymphoma
C81	Hodgkin's Disease
C88.7, C88.9, C90	Multiple Myeloma
C91.0-C91.3, C91.5-C91.9, C92-C95	Leukemia

$^{\pm}$If not specified as either large (C18) or small (C17) intestine

Table S4: Extracted estimates on cancer incidence from case-control and cohort studies

First author, year	C00-C97	C00-C14	C15	C16	C17	C18	C17-C18	C19-C21	C22-C23	C25	C32	C33-C34	C40-C41	C43	C44	C45	C49	C50	C60, C63	C61	C62	C64-C66	C67-C68	C69	C47, C70-C72	C73	C46.3, C82-C85, C88.0, C88.3, C91.4, C96	C81	C88.7, C88.9, C90	C91.0-C91.3, C91.5-C91.9, C92-95	Other Cancer
Case-Control																															
Kang, 2008		✓	✓	✓			✓	✓	✓	✓	✓	✓			✓		✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Corbin, 2011												✓																			
Villeneuve, 2011												✓																			
Karami, 2012																						✓									
Paget-Bailly, 2013																															✓
Tsai, 2015		✓	✓	✓			✓	✓	✓		✓	✓		✓			✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Bigert, 2016												✓																			✓
Lee, 2019		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Langevin, 2020		✓																													
Cohort																															
Ahn, 2012	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓							✓		✓	✓		✓	✓	✓		✓	✓	
Daniels, 2014*	✓	✓	✓	✓	✓	✓	✓	✓				✓				✓			✓	✓	✓	✓	✓		✓		✓		✓	✓	
Pukkala, 2014	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓				✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓
Glass, 2016*	✓	✓	✓				✓	✓	✓	✓	✓	✓			✓		✓		✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
Kullberg, 2017	✓	✓	✓	✓			✓	✓	✓					✓	✓	✓	✓			✓		✓	✓		✓		✓	✓	✓	✓	✓
Petersen, 2017	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sritharan, 2018																	✓												
Harris, 2018	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓ ✓

*Reported cancer incidence and mortality.

Table S5: Extracted estimates on cancer mortality from case-control and cohort studies

First author, year	International Classification of Disease Code (IDC)-10																														
	C00-C97	C00-C14	C15	C16	C17	C18	C17-C18	C19-C21	C22-C23	C25	C32	C33-C34	C40-C41	C43	C44	C45	C49	C50	C60, C63	C61	C62	C64-C66	C67-C68	C69	C47, C70-C72	C73	C46.3, C82-C85, C88.0, C88.3, C91.4, C96	C81	C88.7, C88.9, C90	C91.0-C91.3, C91.5-C91.9, C92-95	Other Cancer
Case-Control																															
Muegge, 2018	✓	✓								✓							✓					✓			✓						✓
Cohort																															
Daniels, 2014*	✓	✓	✓	✓	✓	✓	✓	✓				✓				✓		✓		✓	✓	✓	✓	✓	✓		✓		✓	✓	
Brice, 2015	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓			✓			✓			✓	✓		✓	✓						✓
Ahn, 2015	✓			✓			✓		✓			✓																	✓	✓	
Glass, 2016*	✓																														
Petersen, 2018				✓			✓	✓													✓										✓
Pinkerton, 2020	✓		✓	✓			✓	✓				✓			✓	✓		✓		✓	✓	✓	✓	✓	✓		✓		✓	✓	

*Reported cancer incidence and mortality.

Table S6: Characteristics of studies reporting on firefighting and cancer incidence

First Author, Year – Country*	Time period	Sample size	Study design	Source of cancer data	Source of occupation data	Occupational focus	Exposure categories	Occupation identifier	Type of measure	Covariates
Kang, 2008 – US	1986-2003	2125	Case-Control	Tumor registry	Tumor registry	Multiple occupations	AS, OT	Tumor registry	SMORs	Age, smoking status
Corbin, 2011 – New Zealand	2007-2008	3	Case-Control	Tumor registry	Interview	Multiple occupations	AS, DoE, OT	New Zealand Standard Classification of Occupations	OR	Age, gender, Māori ethnicity, smoking status
Villeneuve, 2011 – Canada	1994-1997	22	Case-Control	Tumor registry	Questionnaire	Multiple occupations	AS, CP, DoE, OT, TADE	Canadian Standard Occupational Classification, Canada Standard Industrial Classification	OR	Age, province, cigarette pack-years, exposure to secondhand smoke, exposure to silica and asbestos
Karami, 2012 – US	2002-2007	8	Case-Control	Tumor registry, Hospital records	Interview	Multiple occupations	AS, DoE, OT	Standard Industry Classification, Standard Occupational Classification	OR	Age, geographic area, alcohol consumption, tobacco consumption, smoking status
Paget-Bailly, 2013 – France	2001-2007	25	Case-Control	Tumor registry	Questionnaire information	Multiple occupations	DoE	ISCO, The Nomenclature	OR	
Tsai, 2015 – US	1988-2007	3,996	Case-Control	Tumor registry	Tumor registry	Firefighters	OT	Code of Census Population	OR	Age, year of diagnosis, race

Bigert, 2016 – Europe, Canada, New Zealand, China	1985-2010	190	Case-Control	Previous study	Previous study	Firefighters	DoE, OT	ISCO	OR	Smoking status, work duration, cancer subtype
Lee, 2019 – US	1982-2014	3,928	Case-Control	Tumor registry, department information, LexisNexis	Employment records, Florida State Fire Marshall's Office, LexisNexis	Firefighters	AS	Florida State Fire Marshall's Office	OR	Age and year at cancer diagnosis
Langevin, 2020 – US	1999-2011	25	Case-Control	Tumor registry, hospital records	Questionnaire	Firefighters	AS, DoE	Questionnaire	OR	Age, race, smoking status, alcohol consumption, education
Ahn, 2012 – South Korea	1980-2007	29,498	Cohort	Tumor registry, Death certificate	Employment records	Multiple occupations	OT, DoE	Organizational classification	SIR, SRR	Age, calendar period
Daniels, 2014 – US	1950-2009	29,993	Cohort	Tumor registry, death certificate, employment records, previous study	Employment records, previous study	Firefighters	DoE	Employment records	SIR, SMR	Age, gender, race, calendar period
Pukkala, 2014 – Denmark, Finland,	1961-2005	16,422	Cohort	Tumor registry	Census information	Firefighters	AS, CP, TADE	ISCO, National nomenclature	SIR	Age, calendar period

Iceland, Norway, Sweden									
Glass, 2016 – Australian	1980-2011	30,057	Cohort	Tumor registry, death certificate	Department information	Firefighters	DoE, TADE, TSE	Employment records	SIR, SMR	Age, calendar period
Kullberg, 2017 – Sweden	1931-1958	1,080	Cohort	Tumor registry	Employment records	Firefighters	AS, CP, DoE	Employment records	SIR	Age
Petersen, 2017 - Denmark	1968-2014	9,061	Cohort	Tumor registry	Employment records, Danish Supplementary Pension Fund Register	Firefighters	AS, DoE, TADE, TSE	Registration systems	SMR	Age, calendar period
Sritharan, 2018 – Canada	1991-2010	NA	Cohort	Tumor registry, mortality database	Census info	Multiple occupations	OT	NSCO	HR	Age, province, ethnicity, education, marital status
Harris, 2018 – Canada	1992-2010	4,535	Cohort	Tumor registry	Census info	Multiple occupations	OT	NSCO	HR	Age, region, education

Abbreviations: AS = age-specific; CP = calendar period; DoE = duration of employment; HR = Hazard rate ratio; ISCO = International Standard Classification of Occupations; NSCO = National Institute for Occupational Safety and Health; OR = Odds ratio; OT = occupational title; RR = Risk ratio; SIR = Standard incidence ratio; SMR = Standard mortality ratio; TADE = task or activity during employment; TSE = time since employment

Table S7: Characteristics of studies reporting on firefighting and cancer mortality

First Author, Year – Country*	Time period	Sample size	Study design	Source of cancer data	Source of occupation data	Occupational focus	Exposure categories	Occupation identifier	Type of measure	Covariates
Muegge, 2018 – US	1982-2013	2,818	Case-Control	Death certificate	Death certificate	Firefighters	OT	NSCO	OR	Age, gender, race/ethnicity
Daniels, 2014 – US	1950-2009	29,993	Cohort	SIR, SMR	Employment records, previous study	Firefighters	DoE	Employment records	SIR, SMR	Age, gender, race, calendar period
Brice, 2015 – Frace	1979-2008	10,829	Cohort	Death certificate	Department information	Firefighters	OT	Employment records, Registration systems	SMR	Age, calendar period
Ahn, 2015 – South Korea	1980-2007	29,453	Cohort	Death certificate	Employment records	Multiple occupations	OT, DoE	Organizational classification	SMR	Age, calendar period
Glass, 2016 – Australia	1980-2011	30,057	Cohort	Tumor registry, death certificate	Department information	Firefighters	DoE, TSE, TADE	Employment records	SIR, SMR	Age, calendar period
Petersen, 2018 – Denmark	1970-2014	11,775	Cohort	Death certificate	Employment records, Danish Civil Registration system	Firefighters	DoE	Registration systems	SMR	Age, calendar period
Pinkerton, 2020 – US	1950-2016	29,992	Cohort	Tumor registry, death certificate, employment records, previous study	Employment records, previous study	Firefighters	OT, DoE, TADE (included exposed-days, fire-runs, fire-hours, department location)	Organizational classification	SMR	Age, gender, race, calendar period

Abbreviations: AS = age-specific; CP = calendar period; DoE = duration of employment; HR = Hazard rate ratio; ISCO = International Standard Classification of Occupations; NSCO = National Institute for Occupational Safety and Health; OR = Odds ratio; OT = occupational title; RR = Risk ratio; SIR = Standard incidence ratio; SMR = Standard mortality ratio; TADE = task or activity during employment; TSE = time since employment

Table S8: Quality assessment of 22 individual studies on cancer incidence and mortality among firefighters

First author, Year	Selection	Comparability	Exposure or outcome	Total Score	Quality
Incidence					
Kang, 2008	✳✳✳	✳✳	✳✳	7	Good
Corbin, 2011	✳✳✳	✳✳	✳✳	7	Good
Villeneuve, 2011	✳✳	✳✳	✳✳✳	7	Good
Karami, 2012	✳✳	✳✳	✳	5	Fair
Paget-Bailly, 2013	✳✳✳	✳✳	✳✳	7	Good
Tsai, 2015	✳✳✳	✳✳	✳✳	7	Good
Bigert, 2016		✳✳		2	Poor
Lee, 2019	✳✳✳	✳✳	✳✳	7	Good
Langevin, 2020	✳✳✳✳	✳✳	✳	7	Good
Ahn, 2012	✳✳✳✳	✳✳	✳✳✳	9	Good
Daniels, 2014*	✳✳✳	✳✳	✳✳	7	Good
Pukkala, 2014	✳✳✳✳	✳✳	✳✳	8	Good
Glass, 2016*	✳✳✳✳	✳✳	✳✳	8	Good
Kullberg, 2017	✳✳✳	✳✳	✳✳	7	Good
Petersen, 2017	✳✳✳✳	✳✳	✳✳	8	Good
Sritharan, 2018	✳✳✳✳	✳✳	✳✳	8	Good
Harris, 2018	✳✳✳✳	✳✳	✳✳✳	9	Good
Mortality					
Muegge, 2018	✳✳✳	✳✳	✳✳	7	Good
Daniels, 2014*	✳✳✳	✳✳	✳✳	7	Good
Brice, 2015	✳✳	✳✳	✳✳	6	Good
Ahn, 2015	✳✳✳✳	✳✳	✳✳	8	Good
Glass, 2016*	✳✳✳✳	✳✳	✳✳	8	Good
Petersen, 2018	✳✳✳✳	✳✳	✳✳	8	Good
Pinkerton, 2020	✳✳✳✳	✳✳	✳✳	8	Good

*Reported cancer incidence and mortality.