

Supplementary (online only) data for:

**Mortality in a cohort of US firefighters from San Francisco, Chicago, and Philadelphia: An update**

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Supplemental Table 1. Cause-specific mortality (1950-2016, US referent rates\*)

Minor ID	Underlying cause	All			SFFD		CFD		PFD	
		Obs <sup>†</sup>	SMR	95% CI	SMR	95% CI	SMR	95% CI	SMR	95% CI
1-92	All causes	14,057	0.97	0.95 to 0.98	0.80	0.77 to 0.83	1.02	1.00 to 1.05	0.99	0.97 to 1.02
1-2	Tuberculosis	11	0.18	0.09 to 0.32	0.16	0.02 to 0.59	0.15	0.04 to 0.37	0.22	0.07 to 0.51
3-6	MN buccal cavity & pharynx	NR	1.35	1.11 to 1.63	1.50	0.95 to 2.25	1.26	0.92 to 1.67	1.40	0.98 to 1.94
3	MN lip	<5	0.67	0.02 to 3.71	3.07	0.08 to 17.1	NC	NC	NC	NC
4	MN tongue	26	1.42	0.93 to 2.08	1.96	0.79 to 4.03	1.15	0.55 to 2.12	1.48	0.68 to 2.81
5	MN other buccal	30	1.50	1.01 to 2.14	1.26	0.41 to 2.93	1.27	0.66 to 2.22	1.98	1.05 to 3.39
6	MN pharynx	49	1.27	0.94 to 1.68	1.34	0.64 to 2.47	1.34	0.87 to 1.98	1.12	0.61 to 1.87
7-13	MN digestive & peritoneum	1,089	1.22	1.15 to 1.30	1.09	0.94 to 1.26	1.32	1.21 to 1.43	1.17	1.05 to 1.30
7	MN esophagus	133	1.31	1.10 to 1.55	1.31	0.86 to 1.92	1.39	1.08 to 1.77	1.18	0.84 to 1.62
8	MN stomach	124	1.06	0.88 to 1.27	1.13	0.75 to 1.65	1.15	0.88 to 1.48	0.90	0.62 to 1.25
9	MN intestine	370	1.27	1.14 to 1.40	0.99	0.75 to 1.27	1.37	1.19 to 1.58	1.28	1.07 to 1.53
10	MN rectum	97	1.32	1.07 to 1.61	1.33	0.81 to 2.06	1.53	1.14 to 2.01	1.02	0.66 to 1.51
11	MN biliary, liver, gallbladder	150	1.36	1.15 to 1.60	1.15	0.75 to 1.70	1.46	1.15 to 1.82	1.34	0.99 to 1.78
12	MN pancreas	194	1.06	0.91 to 1.22	0.95	0.66 to 1.32	1.12	0.91 to 1.36	1.04	0.80 to 1.33
13	MN peritoneum, other & unspecified	21	1.64	1.02 to 2.51	1.53	0.42 to 3.92	1.35	0.58 to 2.65	2.13	0.97 to 4.04
14-17	MN respiratory system	NR	1.09	1.03 to 1.15	0.70	0.60 to 0.82	1.21	1.12 to 1.30	1.14	1.03 to 1.25
14	MN larynx	49	1.21	0.89 to 1.59	0.38	0.08 to 1.10	1.55	1.04 to 2.21	1.21	0.69 to 1.96
15	MN trachea, bronchus, lung	1,197	1.08	1.02 to 1.15	0.71	0.60 to 0.83	1.20	1.11 to 1.30	1.14	1.03 to 1.26
16	MN pleura	<5	0.78	0.09 to 2.83	NC	NC	1.65	0.20 to 5.98	NC	NC
17	MN other respiratory sites	6	0.87	0.32 to 1.90	2.25	0.46 to 6.58	0.30	0.01 to 1.68	0.89	0.11 to 3.23
18	MN breast	10	1.24	0.59 to 2.27	2.11	0.58 to 5.41	1.16	0.38 to 2.71	0.53	0.01 to 2.94
19-22	MN of female genital organs	<5	0.50	0.01 to 2.78	NC	NC	0.80	0.02 to 4.47	NC	NC
19	MN cervix	0	NC	NC	NC	NC	NC	NC	NC	NC
20	MN other parts of uterus	0	NC	NC	NC	NC	NC	NC	NC	NC
21	MN ovary, fallopian tube, & broad ligament	<5	1.18	0.03 to 6.56	NC	NC	1.86	0.05 to 10.3	NC	NC
22	MN other female genital	0	NC	NC	NC	NC	NC	NC	NC	NC
23-24	MN male genital organs	NR	1.06	0.95 to 1.18	0.88	0.68 to 1.14	1.19	1.02 to 1.38	0.99	0.80 to 1.20
23	MN prostate	334	1.08	0.97 to 1.20	0.89	0.68 to 1.15	1.23	1.05 to 1.42	0.99	0.81 to 1.21
24	MN other male genital	<5	0.39	0.11 to 1.00	0.52	0.01 to 2.90	NC	NC	0.85	0.18 to 2.49
25-26	MN urinary	212	1.09	0.95 to 1.24	0.94	0.67 to 1.29	1.25	1.03 to 1.50	0.95	0.72 to 1.22
25	MN kidney	108	1.22	1.00 to 1.47	0.85	0.48 to 1.40	1.57	1.22 to 2.00	0.93	0.61 to 1.36
26	MN bladder & other urinary	104	0.98	0.80 to 1.18	1.01	0.64 to 1.52	0.98	0.72 to 1.30	0.96	0.66 to 1.34
27-34	MN other and unspecified sites	NR	1.04	0.95 to 1.14	1.15	0.94 to 1.39	1.03	0.90 to 1.18	0.98	0.83 to 1.15
27	MN skin	78	1.05	0.83 to 1.31	1.21	0.72 to 1.92	1.00	0.70 to 1.39	1.02	0.66 to 1.51
28	Mesothelioma	18	1.86	1.10 to 2.94	2.00	0.54 to 5.12	2.14	1.03 to 3.93	1.33	0.36 to 3.40
29	MN eye	<5	2.00	0.54 to 5.11	NC	NC	4.31	1.17 to 11.0	NC	NC
30	MN brain and other parts of the nervous system	86	0.99	0.79 to 1.23	1.21	0.74 to 1.87	0.89	0.63 to 1.23	1.01	0.68 to 1.45
31	MN thyroid	<5	0.45	0.09 to 1.31	0.75	0.02 to 4.16	0.31	0.01 to 1.75	0.46	0.01 to 2.56
32	MN bone	9	1.03	0.47 to 1.95	0.58	0.01 to 3.22	1.46	0.54 to 3.19	0.68	0.08 to 2.47
33	MN connective tissue	14	0.77	0.42 to 1.29	0.84	0.17 to 2.47	0.57	0.18 to 1.33	1.03	0.38 to 2.24

Minor ID	Underlying cause	All			SFFD		CFD		PFD	
		Obs <sup>†</sup>	SMR	95% CI	SMR	95% CI	SMR	95% CI	SMR	95% CI
34	MN of other and unspecified sites	255	1.05	0.92 to 1.18	1.14	0.86 to 1.48	1.06	0.88 to 1.27	0.97	0.77 to 1.22
35-38	MN lymphatic & hematopoietic	366	1.09	0.98 to 1.21	1.03	0.81 to 1.31	1.08	0.93 to 1.26	1.15	0.95 to 1.37
35	NHL	151	1.21	1.03 to 1.42	1.19	0.80 to 1.70	1.11	0.86 to 1.41	1.37	1.03 to 1.78
36	Hodgkin disease	11	0.65	0.32 to 1.15	0.62	0.07 to 2.23	0.87	0.35 to 1.79	0.35	0.04 to 1.26
37	Leukemia & aleukemia	150	1.11	0.94 to 1.31	0.94	0.62 to 1.38	1.18	0.93 to 1.48	1.12	0.83 to 1.48
38	Multiple myeloma	54	0.93	0.70 to 1.21	1.03	0.53 to 1.79	0.86	0.55 to 1.27	0.97	0.58 to 1.54
39-41	Benign & unspecified neoplasms	46	1.00	0.73 to 1.34	1.18	0.59 to 2.10	0.88	0.53 to 1.37	1.07	0.61 to 1.74
39	Benign neoplasm of the eye, brain, and other parts of the nervous system	5	0.94	0.30 to 2.19	0.94	0.02 to 5.22	0.80	0.10 to 2.89	1.14	0.14 to 4.11
40	Neoplasms of unspecified nature of eye, brain, and other parts of the nervous system	16	0.92	0.53 to 1.50	1.46	0.47 to 3.41	0.61	0.20 to 1.42	1.06	0.39 to 2.30
41	Other benign and unspecified nature neoplasm	25	1.07	0.69 to 1.58	1.03	0.33 to 2.40	1.09	0.56 to 1.91	1.07	0.46 to 2.11
42	Diabetes mellitus	227	0.73	0.64 to 0.83	0.43	0.28 to 0.62	0.73	0.60 to 0.88	0.92	0.74 to 1.13
43-46	Diseases of the blood & blood forming organs	67	1.14	0.88 to 1.44	0.96	0.49 to 1.67	1.22	0.84 to 1.70	1.14	0.70 to 1.74
43	Pernicious anemia	0	NC	NC	NC	NC	NC	NC	NC	NC
44	Other & unspecified anemia	20	1.02	0.62 to 1.57	0.47	0.06 to 1.71	1.29	0.67 to 2.26	0.98	0.36 to 2.14
45	Coagulation defects, purpura, & other hemorrhagic conditions	8	0.71	0.31 to 1.40	0.44	0.01 to 2.46	0.92	0.30 to 2.15	0.56	0.07 to 2.04
46	Other diseases of blood forming organs	39	1.43	1.02 to 1.96	1.53	0.70 to 2.91	1.32	0.77 to 2.11	1.53	0.81 to 2.61
47-48	Mental, psychoneurotic, & personality disorders	200	0.84	0.73 to 0.97	0.63	0.44 to 0.89	0.87	0.70 to 1.06	0.96	0.75 to 1.22
47	Alcoholism	39	0.64	0.45 to 0.87	0.37	0.10 to 0.94	0.72	0.45 to 1.09	0.67	0.35 to 1.14
48	Other mental disorders	161	0.91	0.78 to 1.07	0.70	0.47 to 1.01	0.92	0.73 to 1.15	1.07	0.81 to 1.40
49-50	Disorders of the nervous system	305	0.89	0.80 to 1.00	1.04	0.82 to 1.30	0.79	0.66 to 0.94	0.95	0.77 to 1.15
49	Multiple sclerosis	8	0.58	0.25 to 1.14	0.38	0.01 to 2.11	0.92	0.34 to 2.01	0.22	0.01 to 1.20
50	Other nervous system diseases	297	0.91	0.81 to 1.02	1.07	0.84 to 1.33	0.78	0.65 to 0.93	0.98	0.80 to 1.20
51-55	Diseases of the heart	4,807	0.97	0.94 to 0.99	0.76	0.71 to 0.82	1.05	1.01 to 1.09	0.98	0.93 to 1.03
51	Rheumatic heart disease	51	0.76	0.57 to 1.00	0.53	0.21 to 1.09	0.81	0.53 to 1.20	0.82	0.50 to 1.29
52	Ischemic heart disease	3,945	0.98	0.95 to 1.01	0.76	0.70 to 0.82	1.08	1.04 to 1.13	0.98	0.93 to 1.03
53	Chronic disease of endocardium	73	0.94	0.74 to 1.18	1.04	0.62 to 1.65	0.90	0.61 to 1.27	0.93	0.59 to 1.39
54	Hypertension with heart disease	159	0.92	0.78 to 1.08	1.01	0.71 to 1.40	0.90	0.70 to 1.13	0.90	0.67 to 1.19
55	Other diseases of the heart	579	0.90	0.83 to 0.97	0.68	0.55 to 0.83	0.91	0.81 to 1.03	1.02	0.89 to 1.17
56-58	Other diseases of the circulatory system	1,107	0.90	0.85 to 0.96	0.85	0.74 to 0.97	0.91	0.83 to 0.99	0.93	0.83 to 1.03
56	Hypertension without heart disease	67	0.89	0.69 to 1.13	0.94	0.53 to 1.55	1.03	0.73 to 1.42	0.65	0.36 to 1.07
57	Cerebrovascular disease	725	0.90	0.83 to 0.97	0.83	0.70 to 0.97	0.93	0.84 to 1.04	0.90	0.79 to 1.02
58	Diseases of the arteries, veins, & pulmonary circulation	315	0.91	0.81 to 1.02	0.88	0.68 to 1.12	0.83	0.69 to 0.98	1.04	0.86 to 1.25
59-64	Diseases of the respiratory system	NR	0.81	0.76 to 0.86	0.64	0.55 to 0.75	0.90	0.82 to 0.98	0.80	0.71 to 0.89
59	Acute respiratory infections except influenza & pneumonia	0	NC	NC	NC	NC	NC	NC	NC	NC
60	Influenza	<5	0.16	0.02 to 0.59	0.37	0.01 to 2.08	0.19	0.00 to 1.03	NC	NC
61	Pneumonia	306	0.87	0.77 to 0.97	0.84	0.65 to 1.08	0.93	0.78 to 1.09	0.80	0.65 to 0.98
62	COPD	491	0.78	0.71 to 0.85	0.54	0.43 to 0.68	0.91	0.80 to 1.03	0.75	0.64 to 0.88

Minor ID	Underlying cause	All			SFFD		CFD		PFD	
		Obs <sup>†</sup>	SMR	95% CI	SMR	95% CI	SMR	95% CI	SMR	95% CI
63	Asthma	7	0.32	0.13 to 0.65	0.45	0.05 to 1.61	0.48	0.16 to 1.12	NC	NC
64	Pneumoconiosis & other respiratory diseases	183	0.91	0.78 to 1.05	0.63	0.41 to 0.91	0.90	0.72 to 1.12	1.12	0.87 to 1.41
65-68	Diseases of the digestive system	634	1.05	0.97 to 1.13	1.04	0.86 to 1.24	1.06	0.95 to 1.19	1.03	0.89 to 1.18
65	Diseases of the stomach & duodenum	65	1.01	0.78 to 1.29	0.90	0.46 to 1.57	1.03	0.70 to 1.47	1.04	0.66 to 1.57
66	Hernia & intestinal obstruction	26	0.73	0.48 to 1.07	0.26	0.03 to 0.93	0.75	0.38 to 1.30	1.02	0.53 to 1.78
67	Cirrhosis & other chronic liver disease	321	1.16	1.03 to 1.29	1.37	1.07 to 1.73	1.16	0.98 to 1.35	1.03	0.84 to 1.27
68	Other diseases of digestive system	222	0.97	0.85 to 1.11	0.83	0.59 to 1.14	1.00	0.82 to 1.21	1.01	0.80 to 1.27
69-77	Diseases of the genitourinary system	261	1.00	0.88 to 1.13	0.69	0.49 to 0.95	0.99	0.82 to 1.18	1.23	1.00 to 1.49
69	Acute glomerulonephritis, nephrotic syndrome, & acute renal failure	38	1.33	0.94 to 1.83	1.14	0.46 to 2.36	1.41	0.85 to 2.20	1.34	0.69 to 2.34
70	Chronic & unspecified nephritis & renal failure & other renal sclerosis	142	0.98	0.83 to 1.16	0.32	0.16 to 0.60	1.03	0.81 to 1.30	1.35	1.03 to 1.73
71	Infection of kidney	9	0.68	0.31 to 1.29	1.04	0.21 to 3.04	0.70	0.19 to 1.79	0.43	0.05 to 1.56
72	Calculi of urinary system	5	1.26	0.41 to 2.94	1.18	0.03 to 6.57	0.58	0.01 to 3.22	2.16	0.44 to 6.30
73	Hyperplasia of prostate	12	1.18	0.61 to 2.06	1.56	0.42 to 3.99	1.53	0.56 to 3.33	0.54	0.07 to 1.95
74	Other diseases of male genital organs	0	NC	NC	NC	NC	NC	NC	NC	NC
75	Diseases of the breast	0	NC	NC	NC	NC	NC	NC	NC	NC
76	Diseases of the female genital organs	0	NC	NC	NC	NC	NC	NC	NC	NC
77	Other genitourinary system organs	55	0.96	0.73 to 1.26	1.13	0.62 to 1.89	0.71	0.43 to 1.12	1.22	0.77 to 1.85
78-79	Diseases of skin & subcutaneous tissue	16	1.15	0.66 to 1.87	1.39	0.38 to 3.57	0.91	0.33 to 1.98	1.36	0.50 to 2.97
80-82	Diseases musculoskeletal & connective tissue	21	0.59	0.36 to 0.90	0.54	0.15 to 1.38	0.59	0.28 to 1.08	0.62	0.25 to 1.27
80	Arthritis & spondylitis	5	0.38	0.12 to 0.88	0.36	0.01 to 1.98	0.32	0.04 to 1.17	0.46	0.06 to 1.67
81	Osteomyelitis & periostitis	5	1.00	0.32 to 2.33	0.95	0.02 to 5.31	0.83	0.10 to 2.99	1.29	0.16 to 4.65
82	Other diseases musculoskeletal	11	0.63	0.32 to 1.13	0.56	0.07 to 2.03	0.72	0.26 to 1.56	0.55	0.11 to 1.61
83	Symptoms & ill-defined conditions	177	1.18	1.01 to 1.36	0.07	0.01 to 0.24	0.86	0.66 to 1.10	2.34	1.93 to 2.81
84-88	Accidents	600	0.81	0.74 to 0.87	0.73	0.59 to 0.88	0.92	0.82 to 1.02	0.69	0.59 to 0.80
84	Transportation accidents	174	0.52	0.45 to 0.61	0.55	0.38 to 0.77	0.62	0.50 to 0.75	0.38	0.27 to 0.51
85	Accidental poisoning	66	0.90	0.70 to 1.15	0.73	0.34 to 1.39	0.98	0.69 to 1.35	0.86	0.52 to 1.35
86	Accidental falls	136	1.18	0.99 to 1.40	1.26	0.86 to 1.79	1.38	1.09 to 1.74	0.84	0.57 to 1.19
87	Other accidents	213	1.03	0.90 to 1.18	0.70	0.46 to 1.02	1.17	0.96 to 1.40	1.02	0.80 to 1.29
88	Medical complications & misadventure	11	0.68	0.34 to 1.21	0.31	0.01 to 1.71	0.52	0.14 to 1.32	1.15	0.42 to 2.50
89-91	Violence	299	0.80	0.71 to 0.89	0.94	0.72 to 1.20	0.76	0.64 to 0.90	0.77	0.62 to 0.95
89	Suicide	240	0.91	0.80 to 1.03	1.16	0.87 to 1.50	0.84	0.69 to 1.01	0.87	0.69 to 1.09
90	Homicide	59	0.54	0.41 to 0.69	0.38	0.15 to 0.78	0.60	0.42 to 0.83	0.51	0.30 to 0.82
91	Terrorism	0	NC	NC	NC	NC	NC	NC	NC	NC
92	Other & unspecified causes	447	1.06	0.97 to 1.16	0.61	0.45 to 0.80	1.04	0.91 to 1.19	1.38	1.18 to 1.59

CI, confidence interval; CFD, Chicago Fire Department; COPD, chronic obstructive pulmonary disease; MN, malignancy; NC, not calculated (no observed deaths); NHL, non-Hodgkin lymphoma; NR, not reported to avoid disclosing numbers less than 5; Obs, observed; PFD, Philadelphia Fire Department; SFFD, San Francisco Fire Department; SMR, standardized mortality ratio

\* Stratified by age (5-year intervals), gender, race (white/other), and calendar period (5-year intervals)

† Observed number by department is not reported so that numbers less than 5 cannot be derived.

**Supplemental Table 2. Mortality from outcomes of interest by race (1950-2016, US referent rates\*)**

Underlying cause (ICD-10 codes)	Race					
	White			Other		
	Obs	SMR	95% CI	Obs	SMR	95% CI
All causes	13,417	0.99	0.97 to 1.00	640	0.68	0.63 to 0.74
All cancers <sup>C00-C97</sup>	3,684	1.14	1.10 to 1.18	159	0.79	0.68 to 0.93
MN esophagus <sup>C15</sup>	>128	1.38	1.15 to 1.64	<5	0.50	0.14 to 1.28
MN stomach <sup>C16</sup>	118	1.09	0.91 to 1.31	6	0.68	0.25 to 1.48
MN intestine <sup>C17-C18</sup>	359	1.30	1.17 to 1.44	11	0.67	0.34 to 1.21
MN rectum <sup>C19-C21</sup>	>92	1.36	1.10 to 1.66	<5	0.72	0.15 to 2.11
MN lung <sup>C33-C34</sup>	1,163	1.11	1.05 to 1.18	34	0.57	0.39 to 0.80
MN breast <sup>C50</sup>	>5	1.24	0.54 to 2.45	<5	1.20	0.15 to 4.33
MN prostate <sup>C61</sup>	314	1.07	0.96 to 1.20	20	1.26	0.77 to 1.95
MN other male genital <sup>C60, C62-C63</sup>	<5	0.41	0.11 to 1.05	0	NC	NC
MN kidney <sup>C64-C66</sup>	101	1.20	0.98 to 1.46	7	1.55	0.62 to 3.19
MN bladder <sup>C67-C68</sup>	98	0.95	0.77 to 1.15	6	2.16	0.79 to 4.70
MN skin <sup>C43-C44, C46.0, C46.9</sup>	>73	1.06	0.83 to 1.32	<5	0.72	0.02 to 4.02
Mesothelioma <sup>C45</sup>	18	1.91	1.13 to 3.03	0	NC	NC
MN brain <sup>C47, C70-C72</sup>	86	1.03	0.83 to 1.28	0	NC	NC
NHL <sup>C46.3, C82-C85, C88.0, C88.3, C91.4, C96</sup>	146	1.23	1.04 to 1.44	5	0.88	0.29 to 2.06
Leukemia <sup>C91.0-C91.3, C91.5-C91.9, C92-C95</sup>	141	1.09	0.92 to 1.29	9	1.55	0.71 to 2.95
Multiple myeloma <sup>C88.7, C88.9, C90</sup>	>49	0.95	0.71 to 1.25	<5	0.66	0.14 to 1.92
Ischemic heart disease <sup>I20- I22, I24-I25, I51.3, I51.6</sup>	3,832	0.99	0.96 to 1.02	113	0.79	0.65 to 0.95
Cerebrovascular disease <sup>G45.0-G45.2, G45.4-G45.9, I60-I69</sup>	704	0.93	0.86 to 1.00	21	0.43	0.27 to 0.66
COPD <sup>J40-J44</sup>	481	0.79	0.72 to 0.86	10	0.60	0.29 to 1.10
Cirrhosis & other chronic liver disease <sup>K70, K73-K74, K76.0</sup>	310	1.22	1.09 to 1.36	11	0.46	0.23 to 0.83

CI, confidence interval; COPD, chronic obstructive pulmonary disease; ICD, International Classification of Diseases; MN, malignancy; NC, not calculated; NHL, non-Hodgkin lymphoma; Obs, observed; SMR, standardized mortality ratio  
 \* Stratified by age (5-year intervals), gender, race (white/other), and calendar period (5-year intervals)

**Supplemental Table 3. Mortality from outcomes of interest by age (1950-2016, US referent rates\*)**

Underlying cause (ICD-10 codes)	Age <65			Age 65+			Heterogeneity
	Obs	SMR	95% CI	Obs	SMR	95% CI	p-value
All causes	4,680	0.82	0.79 to 0.84	9,377	1.07	1.05 to 1.09	<0.01
All cancers <sup>C00-C97</sup>	1,237	0.96	0.90 to 1.01	2,606	1.22	1.17 to 1.27	<0.01
MN esophagus <sup>C15</sup>	54	1.26	0.94 to 1.64	79	1.35	1.07 to 1.68	0.70
MN stomach <sup>C16</sup>	40	0.74	0.53 to 1.01	84	1.34	1.07 to 1.65	<0.01
MN intestine <sup>C17-C18</sup>	104	1.01	0.82 to 1.22	266	1.40	1.24 to 1.58	<0.01
MN rectum <sup>C19-C21</sup>	40	1.21	0.87 to 1.65	57	1.41	1.07 to 1.83	0.46
MN lung <sup>C33-C34</sup>	402	0.94	0.85 to 1.03	795	1.18	1.10 to 1.26	<0.01
MN breast <sup>C50</sup>	>5	1.34	0.54 to 2.75	<5	1.05	0.22 to 3.07	0.73
MN prostate <sup>C61</sup>	41	1.04	0.74 to 1.41	293	1.09	0.97 to 1.22	0.77
MN other male genital <sup>C60, C62-C63</sup>	<5	0.53	0.14 to 1.35	0	NC	NC	0.24
MN kidney <sup>C64-C66</sup>	51	1.35	1.00 to 1.77	57	1.12	0.85 to 1.45	0.34
MN bladder <sup>C67-C68</sup>	20	0.81	0.49 to 1.25	84	1.03	0.82 to 1.27	0.33
MN skin <sup>C43-C44, C46.0, C46.9</sup>	27	0.81	0.54 to 1.18	51	1.24	0.93 to 1.63	0.07
Mesothelioma <sup>C45</sup>	<5	0.68	0.02 to 3.76	>13	2.07	1.21 to 3.32	0.25
MN brain <sup>C47, C70-C72</sup>	41	0.81	0.58 to 1.10	45	1.25	0.91 to 1.68	0.04
NHL <sup>C46.3, C82-C85, C88.0, C88.3, C91.4, C96</sup>	40	0.87	0.62 to 1.18	111	1.41	1.16 to 1.70	<0.01
Leukemia <sup>C91.0-C91.3, C91.5-C91.9, C92-C95</sup>	47	0.98	0.72 to 1.31	103	1.18	0.97 to 1.44	0.29
Multiple myeloma <sup>C88.7, C88.9, C90</sup>	16	0.86	0.49 to 1.40	38	0.96	0.68 to 1.32	0.71
Ischemic heart disease <sup>I20-I22, I24-I25, I51.3, I51.6</sup>	1,365	0.89	0.84 to 0.93	2,580	1.04	1.00 to 1.08	<0.01
Cerebrovascular disease <sup>G45.0-G45.2, G45.4-G45.9, I60-I69</sup>	144	0.64	0.54 to 0.75	581	1.00	0.92 to 1.08	<0.01
COPD <sup>J40-J44</sup>	64	0.56	0.43 to 0.71	427	0.83	0.76 to 0.92	<0.01
Cirrhosis & other chronic liver disease <sup>K70, K73-K74, K76.0</sup>	220	1.10	0.96 to 1.26	101	1.30	1.06 to 1.58	0.16

CI, confidence interval; COPD, chronic obstructive pulmonary disease; ICD, International Classification of Diseases; MN, malignancy; NC, not calculated; NHL, non-Hodgkin lymphoma;

Obs, observed; SMR, standardized mortality ratio

\* Stratified by age (5-year intervals), gender, race (white/other), and calendar period (5-year intervals)

**Supplemental Table 4. Mortality from outcomes of interest in the full cohort and by department (1950-2016, state referent rates\*)**

Underlying cause (ICD-10 codes)	All			SFFD			CFD			PFD			Heterogeneity
	Obs	SMR	95% CI	Obs	SMR	95% CI	Obs	SMR	95% CI	Obs	SMR	95% CI	p-value
All causes	14,057	0.94	0.88 to 1.01	2,391	0.86	0.83 to 0.90	6,972	1.00	0.98 to 1.03	4,694	0.96	0.93 to 0.98	<0.01
All cancers <sup>C00-C97</sup>	3,843	1.08	1.01 to 1.15	655	1.02	0.94 to 1.10	1,960	1.16	1.11 to 1.21	1,228	1.05	1.00 to 1.11	<0.01
MN esophagus <sup>C15</sup>	133	1.21	1.02 to 1.43	26	1.44	0.94 to 2.11	68	1.25	0.97 to 1.59	39	1.04	0.74 to 1.42	0.41
MN stomach <sup>C16</sup>	124	1.04	0.87 to 1.24	27	1.13	0.74 to 1.64	62	1.12	0.86 to 1.44	35	0.87	0.61 to 1.21	0.44
MN intestine <sup>C17-C18</sup>	370	1.17	1.06 to 1.30	59	1.11	0.84 to 1.43	189	1.22	1.05 to 1.41	122	1.13	0.94 to 1.35	0.70
MN rectum <sup>C19-C21</sup>	97	1.21	0.96 to 1.51	20	1.41	0.86 to 2.18	52	1.37	1.02 to 1.80	25	0.90	0.58 to 1.33	0.17
MN lung <sup>C33C34</sup>	1,197	1.03	0.88 to 1.22	154	0.82	0.70 to 0.96	638	1.16	1.07 to 1.25	405	1.11	1.01 to 1.23	<0.01
MN breast <sup>C50</sup>	10	1.22	0.66 to 2.27	NR	2.39	0.65 to 6.12	NR	1.11	0.36 to 2.60	NR	0.50	0.01 to 2.77	0.25
MN prostate <sup>C61</sup>	334	1.05	0.89 to 1.23	60	0.89	0.68 to 1.14	176	1.22	1.04 to 1.41	98	0.98	0.80 to 1.20	0.05
MN other male genital <sup>C60, C62-C63</sup>	<5	0.34	0.08 to 1.39	<5	0.53	0.01 to 2.94	0	NC	NC	<5	0.85	0.18 to 2.48	0.14
MN kidney <sup>C64-C66</sup>	108	1.14	0.85 to 1.52	15	0.91	0.51 to 1.50	66	1.47	1.13 to 1.86	27	0.94	0.62 to 1.36	0.06
MN bladder <sup>C67-C68</sup>	104	0.95	0.78 to 1.15	23	1.05	0.67 to 1.58	48	0.95	0.70 to 1.26	33	0.88	0.61 to 1.24	0.80
MN skin <sup>C43-C44, C46.0, C46.9</sup>	78	1.11	0.89 to 1.39	18	1.11	0.66 to 1.75	35	1.15	0.80 to 1.61	25	1.06	0.69 to 1.57	0.95
Mesothelioma <sup>C45</sup>	18	1.59	1.00 to 2.53	<5	2.05	0.56 to 5.24	10	1.81	0.87 to 3.32	<5	1.05	0.29 to 2.70	0.58
MN brain <sup>C47, C70-C72</sup>	86	1.02	0.82 to 1.26	20	1.16	0.71 to 1.79	37	0.91	0.64 to 1.26	29	1.08	0.72 to 1.55	0.65
NHL <sup>C46.3, C82-C85, C88.0, C88.3, C91.4, C96</sup>	151	1.13	0.97 to 1.33	30	1.17	0.79 to 1.67	66	1.03	0.79 to 1.31	55	1.27	0.96 to 1.65	0.50
Leukemia <sup>C91.0-C91.3, C91.5-C91.9, C92-C95</sup>	150	1.08	0.92 to 1.27	26	0.99	0.65 to 1.45	75	1.11	0.87 to 1.39	49	1.09	0.80 to 1.44	0.88
Multiple myeloma <sup>C88.7, C88.9, C90</sup>	54	0.92	0.70 to 1.21	12	1.04	0.54 to 1.81	24	0.87	0.56 to 1.30	18	0.98	0.58 to 1.55	0.86
Ischemic heart disease <sup>I20-I22, I24-I25, I51.3, I51.6</sup>	3,945	0.91	0.82 to 1.01	640	0.80	0.74 to 0.86	2,003	1.01	0.96 to 1.05	1,302	0.92	0.87 to 0.97	<0.01
Cerebrovascular disease <sup>G45.0-G45.2, G45.4-G45.9, I60-I69</sup>	725	0.90	0.84 to 0.97	145	0.86	0.73 to 1.01	341	0.91	0.81 to 1.01	239	0.91	0.80 to 1.04	0.83
COPD <sup>J40-J44</sup>	491	0.78	0.60 to 1.00	72	0.56	0.44 to 0.71	268	0.98	0.86 to 1.10	151	0.81	0.69 to 0.96	<0.01
Cirrhosis & other chronic liver disease <sup>K70, K73-K74, K76.0</sup>	321	1.07	0.96 to 1.19	71	0.93	0.73 to 1.18	156	1.11	0.94 to 1.30	94	1.11	0.90 to 1.36	0.43

CI, confidence interval; CFD, Chicago Fire Department; COPD, chronic obstructive pulmonary disease; ICD, International Classification of Diseases; MN, malignancy; NC, not calculated; NHL, non-Hodgkin lymphoma; NR, not reported to avoid disclosing numbers less than 5; Obs, observed; PFD, Philadelphia Fire Department; SFFD, San Francisco Fire Department; SMR, standardized mortality ratio

\* Stratified by age (5-year intervals), gender, race (white/other), and calendar period (5-year intervals)

**Supplemental Table 5. Hazard ratios (HRs) for outcomes of interest with fire-runs by time since exposure\***

Underlying cause of death	Exposure windows for time since exposure (years)								LRT <i>p</i> -value
	Loglinear model		Lag to <20		20 to <30		30+		
	HR @ 8800 vs 2100 runs	95%CI	HR @ 8800 vs 2100 runs	95% CI	HR @ 8800 vs 2100 runs	95% CI	HR @ 8800 vs 2100 runs	95% CI	
All cancers <sup>C00-C97</sup>	1.02	0.94 to 1.11	1.12	0.88 to 1.42	1.02	0.84 to 1.24	0.98	0.86 to 1.12	0.61
MN esophagus <sup>C15</sup>	1.10	0.75 to 1.58	1.10	0.36 to 3.05	0.92	0.37 to 2.12	1.26	0.69 to 2.15	0.84
MN stomach <sup>C16</sup>	1.25	0.76 to 1.95	1.45	0.42 to 4.31	1.69	0.55 to 4.67	0.92	0.38 to 1.93	0.61
MN colon <sup>C18</sup>	0.89	0.66 to 1.18	0.64	0.26 to 1.48	0.76	0.36 to 1.49	1.13	0.71 to 1.73	0.37
MN rectum <sup>C19-C21</sup>	0.36	0.16 to 0.75	0.18	0.02 to 1.51	0.80	0.15 to 3.30	0.24	0.06 to 0.80	0.54
MN lung <sup>C33-C34</sup>	1.21	1.05 to 1.38	1.53	1.04 to 2.21	1.28	0.94 to 1.73	1.04	0.82 to 1.30	0.16
MN prostate <sup>C61</sup>	0.92	0.67 to 1.25	0.72	0.17 to 2.69	0.73	0.31 to 1.63	1.05	0.68 to 1.58	0.64
MN kidney <sup>C64-C66</sup>	0.94	0.59 to 1.46	0.89	0.29 to 2.53	1.03	0.35 to 2.67	0.90	0.37 to 1.96	0.98
MN skin <sup>C43-C44, C46.0, C46.9</sup>	0.94	0.54 to 1.54	0.98	0.15 to 4.66	1.42	0.33 to 4.99	0.76	0.33 to 1.56	0.74
MN brain <sup>C47, C70-C72</sup>	0.99	0.53 to 1.76	0.85	0.15 to 4.06	0.72	0.15 to 2.96	1.29	0.48 to 3.01	0.78
NHL <sup>C46.3, C82-C85, C88.0, C88.3, C91.4, C96</sup>	0.74	0.47 to 1.12	0.75	0.21 to 2.35	0.76	0.25 to 2.09	0.72	0.36 to 1.34	1.00
Leukemia <sup>C91.0-C91.3, C91.5-C91.9, C92-C95</sup>	1.15	0.77 to 1.67	2.56	1.04 to 5.75	0.58	0.19 to 1.58	1.12	0.57 to 2.08	0.15
Ischemic heart disease <sup>I20-I22, I24-I25, I51.3, I51.6</sup>	1.01	0.91 to 1.13	0.92	0.68 to 1.23	1.01	0.78 to 1.30	1.05	0.89 to 1.24	0.71
Cerebrovascular disease <sup>G45.0-G45.2, G45.4-G45.9, I60-I69</sup>	0.94	0.72 to 1.20	1.32	0.56 to 2.90	0.81	0.41 to 1.53	0.92	0.62 to 1.32	0.70
COPD <sup>J40-J44</sup>	1.05	0.84 to 1.31	0.53	0.19 to 1.41	1.66	0.92 to 2.89	0.95	0.69 to 1.29	0.21
Cirrhosis & other chronic liver disease <sup>K70, K73-K74, K76.0</sup>	1.04	0.72 to 1.48	1.01	0.48 to 2.00	0.83	0.37 to 1.76	1.41	0.67 to 2.70	0.63

CI, confidence interval; COPD, chronic obstructive pulmonary disease; ICD, International Classification of Diseases; HR, hazard ratio; LRT, likelihood ratio test; MN, malignancy; NHL, non-Hodgkin lymphoma

\* All models were adjusted by age (time scale); race, birth date (within 5 years) and fire department by matching; and employment duration (<10, 10-<20, 20-<30, 30+ years) by including variables in the model for four categories (0-10, 10-20, 20-30, 30+).

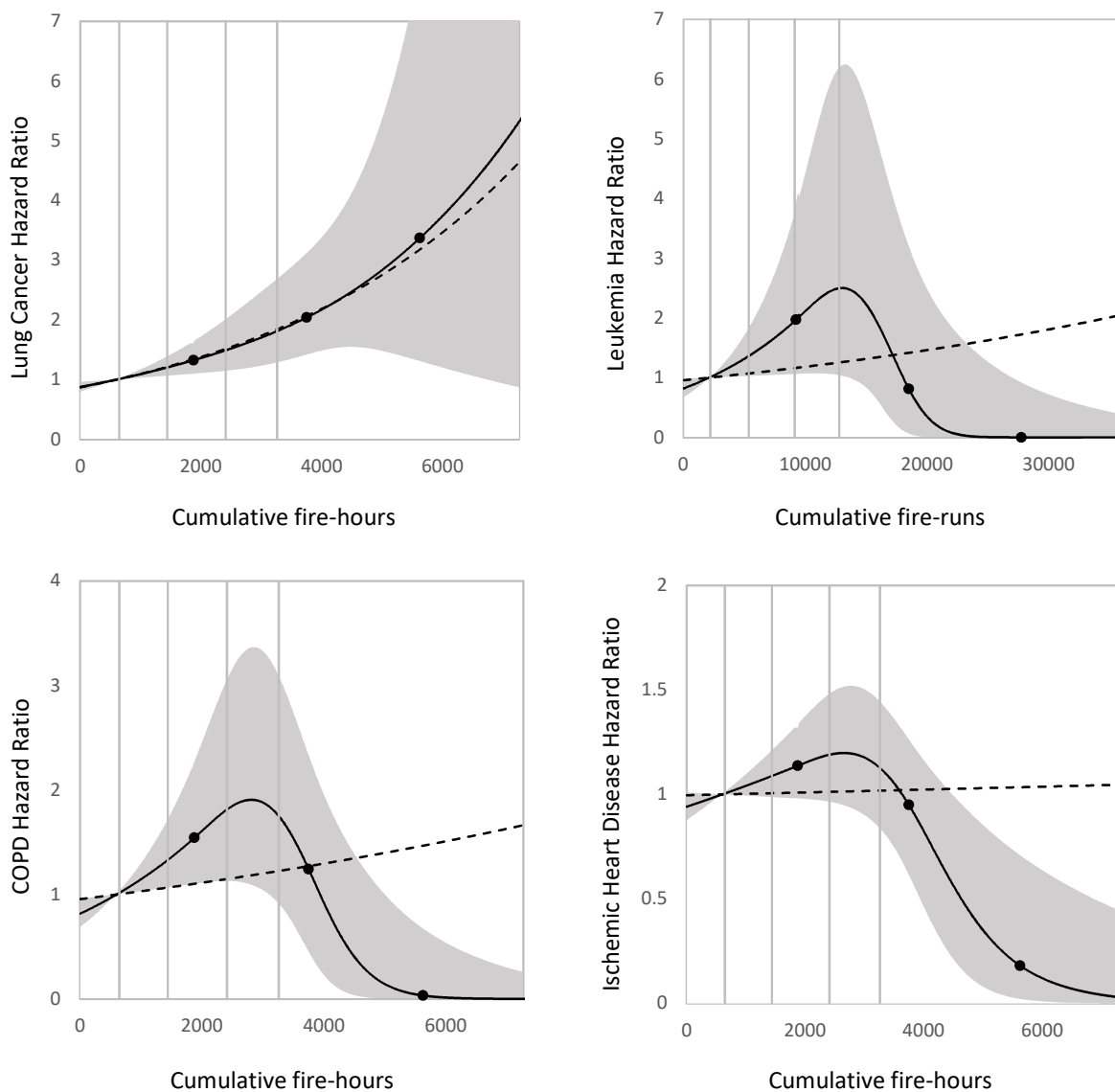


**Supplemental Table 6. Hazard ratios (HRs) for outcomes of interest with fire-runs by age at exposure and exposure period\***

Underlying cause of death	Loglinear model		Exposure windows for age at exposure					Exposure windows for exposure period				
			< 40 years		40+ years		LRT	<1970		1970+		LRT
	HR	95% CI	HR	95% CI	HR	95% CI	<i>p</i> -value	HR	95% CI	HR	95% CI	<i>p</i> -value
All cancers <sup>C00-C97</sup>	1.02	0.94 to 1.11	1.00	0.87 to 1.15	1.04	0.91 to 1.18	0.76	0.99	0.84 to 1.16	1.03	0.93 to 1.14	0.67
MN esophagus <sup>C15</sup>	1.10	0.75 to 1.58	1.25	0.69 to 2.15	0.96	0.50 to 1.76	0.58	2.00	1.01 to 3.69	0.81	0.49 to 1.30	0.04
MN stomach <sup>C16</sup>	1.25	0.76 to 1.95	0.82	0.33 to 1.82	1.79	0.84 to 3.62	0.22	1.00	0.38 to 2.29	1.40	0.74 to 2.51	0.55
MN colon <sup>C18</sup>	0.89	0.66 to 1.18	1.29	0.79 to 2.02	0.64	0.39 to 1.00	0.06	0.77	0.42 to 1.32	0.96	0.65 to 1.40	0.54
MN rectum <sup>C19-C21</sup>	0.36	0.16 to 0.75	0.28	0.08 to 0.91	0.44	0.13 to 1.27	0.63	0.27	0.05 to 1.14	0.40	0.15 to 0.93	0.67
MN lung <sup>C33-C34</sup>	1.21	1.05 to 1.38	1.05	0.83 to 1.31	1.37	1.11 to 1.69	0.13	1.24	0.95 to 1.61	1.19	1.00 to 1.41	0.79
MN prostate <sup>C61</sup>	0.92	0.67 to 1.25	0.86	0.48 to 1.48	0.96	0.61 to 1.47	0.78	0.86	0.46 to 1.54	0.95	0.64 to 1.39	0.80
MN kidney <sup>C64-C66</sup>	0.94	0.59 to 1.46	0.77	0.35 to 1.59	1.17	0.53 to 2.44	0.50	0.62	0.22 to 1.51	1.13	0.63 to 1.94	0.31
MN skin <sup>C43-C44, C46.0, C46.9</sup>	0.94	0.54 to 1.54	0.76	0.28 to 1.75	1.13	0.48 to 2.49	0.56	0.69	0.20 to 1.95	1.07	0.54 to 2.01	0.53
MN brain <sup>C47, C70-C72</sup>	0.99	0.53 to 1.76	0.43	0.14 to 1.18	2.29	0.84 to 5.48	0.04	0.62	0.12 to 2.28	1.13	0.55 to 2.23	0.47
NHL <sup>C46.3, C82-C85, C88.0, C88.3, C91.4, C96</sup>	0.74	0.47 to 1.12	0.77	0.37 to 1.51	0.71	0.36 to 1.34	0.88	0.51	0.18 to 1.26	0.84	0.49 to 1.38	0.39
Leukemia <sup>C91.0-C91.3, C91.5-C91.9, C92-C95</sup>	1.15	0.77 to 1.67	1.42	0.72 to 2.63	0.96	0.51 to 1.73	0.44	0.97	0.42 to 2.06	1.24	0.75 to 2.01	0.63
Ischemic heart disease <sup>I20-I22, I24-I25, I51.3, I51.6</sup>	1.01	0.91 to 1.13	1.08	0.90 to 1.28	0.95	0.80 to 1.13	0.38	1.20	0.99 to 1.44	0.91	0.79 to 1.06	0.04
Cerebrovascular disease <sup>G45.0-G45.2, G45.4-G45.9, I60-I69</sup>	0.94	0.72 to 1.20	0.91	0.57 to 1.41	0.95	0.65 to 1.38	0.89	0.92	0.55 to 1.46	0.95	0.68 to 1.30	0.91
COPD <sup>J40-J44</sup>	1.05	0.84 to 1.31	1.08	0.73 to 1.56	1.03	0.73 to 1.44	0.87	1.37	0.89 to 2.06	0.93	0.69 to 1.23	0.16
Cirrhosis & other chronic liver disease <sup>K70, K73-K74, K76.0</sup>	1.04	0.72 to 1.48	1.13	0.66 to 1.87	0.93	0.47 to 1.75	0.67	0.88	0.42 to 1.69	1.13	0.72 to 1.72	0.56

CI, confidence interval; COPD, chronic obstructive pulmonary disease; ICD, International Classification of Diseases; HR, hazard ratio; LRT, likelihood ratio test; MN, malignancy; NHL, non-Hodgkin lymphoma

\* All models were adjusted by age (time scale); race, birth date (within 5 years) and fire department by matching; and employment duration (<10, 10-<20, 20-<30, 30+ years) by including variables in the model.

**Supplemental Figure 1. Hazard ratios from the loglinear and restricted cubic spline models**

Dashed line: loglinear model; solid curve and shaded area: restricted cubic spline and 95% confidence interval. Vertical lines represent the 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> percentiles of the exposure distribution. Models were adjusted by age (time scale); race, birth date (within 5 years) and fire department by matching; and employment duration (<10, 10-<20, 20-<30, 30+ years) by including variables in the model. COPD: chronic obstructive pulmonary disease.