Supplementary (online only) data for:

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

Lynne E. Pinkerton, MD MPH, Stephen Bertke, PhD, James H. Yiin, PhD, Matthew M. Dahm, PhD, Travis L. Kubale, PhD, Thomas R. Hales, MD MPH, Mark P. Purdue, PhD, James J. Beaumont, PhD MSPH, Robert D. Daniels, PhD

1Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, Cincinnati, Ohio, USA
2World Trade Center Health Program, National Institute for Occupational Safety and Health, Washington, District of Columbia, USA
3Division of Safety Research, National Institute for Occupational Safety and Health, Denver, Colorado, USA
4Division of Cancer Epidemiology and Genetics, National Cancer Institute, Rockville, Maryland, USA
5Department of Public Health Sciences, University of California Davis, Davis, California, USA
6Education and Information Division, National Institute for Occupational Safety and Health, Cincinnati, Ohio, USA

*Corresponding author; NIOSH, DFSE, FRB, 1090 Tusculum Avenue, Mailstop R-15, Cincinnati, OH 45226. Email: jcy5@cdc.gov; Phone: (513) 841-4271, Fax: (513) 841-4486
### Supplementary Table 1. Cause-specific mortality (1950-2016, US referent rates’)

| Minor ID | Underlying cause | All Cases | SFFD | CFD | PFD |
|----------|------------------|-----------|------|-----|-----|
| 1-92     | All causes       | 14,057    | 0.97 | 0.95 | 0.98 |
| 1-2      | Tuberculosis     | 11        | 0.18 | 0.09 | 0.32 |
| 3-6      | MN buccal cavity & pharynx | NR     | 1.35 | 1.11 | 1.63 |
| 3        | MN lip           | ≤5        | 0.67 | 0.02 | 3.71 |
| 4        | MN tongue        | 26        | 1.42 | 0.93 | 2.08 |
| 5        | MN other buccal  | 30        | 1.50 | 1.01 | 2.14 |
| 6        | MN pharynx       | 49        | 1.27 | 0.94 | 1.68 |
| 7-13     | MN digestive & peritoneum | 1,089   | 1.22 | 1.15 | 1.30 |
| 7        | MN esophagus     | 133       | 1.31 | 1.10 | 1.55 |
| 8        | MN stomach       | 124       | 1.06 | 0.88 | 1.27 |
| 9        | MN intestine     | 370       | 1.27 | 1.14 | 1.40 |
| 10       | MN rectum        | 97        | 1.32 | 1.07 | 1.61 |
| 11       | MN biliary, liver, gallbladder | 150   | 1.36 | 1.15 | 1.60 |
| 12       | MN pancreas      | 194       | 1.06 | 0.91 | 1.22 |
| 13       | MN peritoneum, other & unspecified | 21    | 1.64 | 1.02 | 2.51 |
| 14-17    | MN respiratory system | NR     | 1.09 | 1.03 | 1.15 |
| 14       | MN larynx        | 49        | 1.21 | 0.89 | 1.59 |
| 15       | MN trachea, bronchus, lung | 1,197  | 1.08 | 1.02 | 1.15 |
| 16       | MN pleura        | ≤5        | 0.78 | 0.09 | 2.83 |
| 17       | MN other respiratory sites | 6     | 0.80 | 0.32 | 1.90 |
| 18       | MN breast        | 10        | 1.24 | 0.59 | 2.27 |
| 19-22    | MN of female genital organs | ≤5 | 0.50 | 0.01 | 2.78 |
| 19       | MN cervix        | 0         | NC   | NC   | NC   |
| 20       | MN other parts of uterus | 0     | NC   | NC   | NC   |
| 21       | MN ovary, fallopian tube, & broad ligament | ≤5 | 1.18 | 0.03 | 6.56 |
| 22       | MN other female genital | 0     | NC   | NC   | NC   |
| 23-24    | MN male genital organs | NR | 1.06 | 0.95 | 1.18 |
| 23       | MN prostate      | 334       | 1.08 | 0.97 | 1.20 |
| 24       | MN other male genital | ≤5 | 0.39 | 0.11 | 1.00 |
| 25-26    | MN urinary       | 212       | 1.09 | 0.95 | 1.24 |
| 25       | MN kidney        | 108       | 1.22 | 1.00 | 1.47 |
| 26       | MN bladder & other urinary | 104  | 0.98 | 0.80 | 1.18 |
| 27-34    | MN other and unspecified sites | NR | 1.04 | 0.95 | 1.14 |
| 27       | MN skin          | 78        | 1.05 | 0.83 | 1.31 |
| 28       | Mesothelioma     | 18        | 1.86 | 1.10 | 2.94 |
| 29       | MN eye           | ≤5        | 2.00 | 0.54 | 5.11 |
| 30       | MN brain and other parts of the nervous system | 86 | 0.99 | 0.79 | 1.23 |
| 31       | MN thyroid       | ≤5        | 0.45 | 0.09 | 1.31 |
| 32       | MN bone          | 9         | 1.03 | 0.47 | 1.95 |
| 33       | MN connective tissue | 14     | 0.77 | 0.42 | 1.29 |
| Minor ID | Underlying cause | All | CFD | SFFD | PFD |
|---------|------------------|-----|-----|------|-----|
| 34      | MN of other & unspecified sites | Obs1  | SMR  | 95% CI | SMR  | 95% CI | SMR  | 95% CI |
| 35-38   | MN lymphatic & hematopoietic    |     |     |       |     |       |     |       |
| 35      | NHL                           |     |     |       |     |       |     |       |
| 36      | Hodgkin disease               |     |     |       |     |       |     |       |
| 37      | Leukemia & aleukemia          |     |     |       |     |       |     |       |
| 38      | Multiple myeloma              |     |     |       |     |       |     |       |
| 39-41   | Benign & unspecified neoplasms |     |     |       |     |       |     |       |
| 39      | Benign neoplasm of the eye, brain, & other parts of the nervous system |     |     |       |     |       |     |       |
| 41      | Other benign & unspecified nature neoplasm |     |     |       |     |       |     |       |
| 42      | Diabetes mellitus             |     |     |       |     |       |     |       |
| 43-46   | Diseases of the blood & blood forming organs |     |     |       |     |       |     |       |
| 43      | Pernicious anemia             |     |     |       |     |       |     |       |
| 44      | Other & unspecified anemia    |     |     |       |     |       |     |       |
| 45      | Coagulation defects, purpura, & other hemorrhagic conditions |     |     |       |     |       |     |       |
| 46      | Other diseases of blood forming organs |     |     |       |     |       |     |       |
| 47-48   | Mental, psychoneurotic, & personality disorders |     |     |       |     |       |     |       |
| 48      | Other mental disorders        |     |     |       |     |       |     |       |
| 49-50   | Disorders of the nervous system |     |     |       |     |       |     |       |
| 49      | Multiple sclerosis            |     |     |       |     |       |     |       |
| 50      | Other nervous system diseases |     |     |       |     |       |     |       |
| 51-55   | Diseases of the heart         |     |     |       |     |       |     |       |
| 51      | Rheumatic heart disease       |     |     |       |     |       |     |       |
| 52      | Ischemic heart disease        |     |     |       |     |       |     |       |
| 53      | Chronic disease of endocardium |     |     |       |     |       |     |       |
| 54      | Hypertension with heart disease |     |     |       |     |       |     |       |
| 55      | Other diseases of the heart   |     |     |       |     |       |     |       |
| 56-58   | Other diseases of the circulatory system |     |     |       |     |       |     |       |
| 59      | Diseases of the respiratory system |     |     |       |     |       |     |       |
| 60      | Influenza                     |     |     |       |     |       |     |       |
| 61      | Pneumonia                     |     |     |       |     |       |     |       |
| 62      | COPD                          |     |     |       |     |       |     |       |

Notes:
- Obs: Observations
- SMR: Standardized Mortality Ratio
- 95% CI: 95% Confidence Interval
- NR: Not Recorded

*P* values were calculated using the two-sided *t*-test and are presented as follows:
- *< 0.05*
- *0.05 < * < 0.1*
- *0.1 < * < 0.2*
- *> 0.2*

Pinkerton L, et al. Occup Environ Med 2020; 77:84–93. doi: 10.1136/oemed-2019-105962
| Minor ID | Underlying cause                                      | All Obs | SMR 95% CI | SFFD SMR 95% CI | CFD SMR 95% CI | PFD SMR 95% CI |
|--------|-------------------------------------------------------|---------|-------------|-----------------|----------------|----------------|
| 63     | Asthma                                                | 7       | 0.32        | 0.13 to 0.65    | 0.45           | 0.05 to 1.61   |
| 64     | Pneumoniosis & other respiratory diseases             | 183     | 0.91        | 0.78 to 1.05    | 0.63           | 0.41 to 0.91   |
| 65-68  | Diseases of the digestive system                      | 634     | 1.05        | 0.97 to 1.13    | 1.04           | 0.86 to 1.24   |
| 65     | Diseases of the stomach & duodenum                    | 65      | 1.01        | 0.78 to 1.29    | 0.90           | 0.46 to 1.57   |
| 66     | Hernia & intestinal obstruction                       | 26      | 0.73        | 0.48 to 1.07    | 0.26           | 0.03 to 0.93   |
| 67     | Cirrhosis & other chronic liver disease               | 321     | 1.16        | 1.03 to 1.29    | 1.37           | 1.07 to 1.73   |
| 68     | Other diseases of digestive system                    | 222     | 0.97        | 0.85 to 1.11    | 0.87           | 0.59 to 1.14   |
| 69-77  | Diseases of the genitourinary system                  | 261     | 1.00        | 0.88 to 1.13    | 0.69           | 0.49 to 0.95   |
| 69     | Acute glomerulonephritis, nephrotic syndrome, & acute renal failure | 38      | 1.33        | 0.94 to 1.83    | 1.14           | 0.46 to 2.36   |
| 70     | Chronic & unspecified nephritis & renal failure & other renal sclerosis | 142     | 0.98        | 0.83 to 1.16    | 0.32           | 0.16 to 0.60   |
| 71     | Infection of kidney                                   | 9       | 0.68        | 0.31 to 1.29    | 1.04           | 0.21 to 3.04   |
| 72     | Calculi of urinary system                            | 5       | 1.26        | 0.41 to 2.94    | 1.18           | 0.03 to 6.57   |
| 73     | Hyperplasia of prostate                              | 12      | 1.18        | 0.61 to 2.06    | 1.56           | 0.42 to 3.99   |
| 74     | Other diseases of male genital organs                 | 0       | NC          | NC              | NC             | NC             |
| 75     | Diseases of the breast                                | 0       | NC          | NC              | NC             | NC             |
| 76     | Diseases of the female genital organs                 | 0       | NC          | NC              | NC             | NC             |
| 77     | Other genitourinary system organs                     | 55      | 0.96        | 0.73 to 1.26    | 1.13           | 0.62 to 1.89   |
| 78-79  | Diseases of skin & subcutaneous tissue                | 16      | 1.15        | 0.66 to 1.87    | 1.39           | 0.38 to 3.57   |
| 80-82  | Diseases musculoskeletal & connective tissue          | 21      | 0.59        | 0.36 to 0.90    | 0.53           | 0.34 to 1.38   |
| 80     | Arthritis & spondylitis                              | 5       | 0.38        | 0.12 to 0.88    | 0.36           | 0.01 to 1.98   |
| 81     | Osteomyelitis & periostitis                           | 5       | 1.00        | 0.32 to 2.33    | 0.95           | 0.02 to 5.31   |
| 82     | Other diseases musculoskeletal                        | 11      | 0.63        | 0.32 to 1.13    | 0.56           | 0.07 to 2.03   |
| 83     | Symptoms & ill-defined conditions                    | 177     | 1.18        | 1.01 to 1.36    | 0.07           | 0.01 to 0.24   |
| 84-88  | Accidents                                             | 600     | 0.81        | 0.74 to 0.87    | 0.73           | 0.59 to 0.88   |
| 84     | Transportation accidents                              | 174     | 0.52        | 0.45 to 0.61    | 0.55           | 0.38 to 0.77   |
| 85     | Accidental poisoning                                 | 66      | 0.90        | 0.70 to 1.15    | 0.53           | 0.34 to 1.38   |
| 86     | Accidental falls                                      | 136     | 1.18        | 0.99 to 1.40    | 1.26           | 0.86 to 1.79   |
| 87     | Other accidents                                       | 213     | 1.03        | 0.90 to 1.18    | 0.70           | 0.46 to 1.02   |
| 88     | Medical complications & misadventure                 | 11      | 0.68        | 0.34 to 1.21    | 0.31           | 0.01 to 1.71   |
| 89-91  | Violence                                              | 299     | 0.80        | 0.71 to 0.89    | 0.94           | 0.72 to 1.20   |
| 89     | Suicide                                               | 240     | 0.91        | 0.80 to 1.03    | 1.16           | 0.87 to 1.50   |
| 90     | Homicide                                              | 59      | 0.54        | 0.41 to 0.69    | 0.38           | 0.15 to 0.78   |
| 91     | Terrorism                                             | 0       | NC          | NC              | NC             | NC             |
| 92     | Other & unspecified causes                            | 447     | 1.06        | 0.97 to 1.16    | 0.61           | 0.45 to 0.80   |

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)

1 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) | 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*                      | 3,844 | 1.14  | 1.10 to 1.18 | 159  | 0.79  | 0.68 to 0.93 |
| MN esophagus (<15)                | 728   | 1.38  | 1.15 to 1.64 | <5   | 0.50  | 0.41 to 1.28 |
| MN stomach (<15)                  | 118   | 1.09  | 0.91 to 1.31 | 6    | 0.68  | 0.25 to 1.48 |
| MN intestine (<15, >14)           | 359   | 1.30  | 1.17 to 1.44 | 11   | 0.67  | 0.34 to 1.21 |
| MN rectum (<15, >14)              | >5    | 1.24  | 0.54 to 2.45 | <5   | 1.20  | 0.15 to 4.33 |
| MN lung (<15, >14)                | 1,163 | 1.11  | 1.05 to 1.18 | 34   | 0.57  | 0.39 to 0.80 |
| MN breast (<15)                   | <5    | 0.41  | 0.11 to 1.05 | 0    | NC    | NC     |
| MN other male genital (<15, >14)  | 101   | 1.20  | 0.98 to 1.46 | 7    | 1.55  | 0.62 to 3.19 |
| MN bladder (<15, >14)             | 98    | 0.95  | 0.77 to 1.15 | 6    | 2.16  | 0.79 to 4.70 |
| MN skin (<15, >14, >17)           | >73   | 1.06  | 0.83 to 1.32 | <5   | 0.72  | 0.02 to 4.02 |
| Mesothelioma (<15)                | 18    | 1.91  | 1.13 to 3.03 | 0    | NC    | NC     |
| MN brain (<15, >14)               | 86    | 1.03  | 0.83 to 1.28 | 0    | NC    | NC     |
| NHL (<15, >14, >14)               | 146   | 1.23  | 1.04 to 1.44 | 5    | 0.88  | 0.29 to 2.06 |
| Leukemia (<15, >14, >14, >14)     | 141   | 1.09  | 0.92 to 1.29 | 9    | 1.55  | 0.71 to 2.95 |
| Multiple myeloma (<15, >14, >14)  | >49   | 0.95  | 0.71 to 1.25 | <5   | 0.66  | 0.14 to 1.92 |
| Ischemic heart disease (<15, >14) | 3,832 | 0.99  | 0.96 to 1.02 | 113  | 0.79  | 0.65 to 0.95 |
| Cerebrovascular disease (<15, >14) | 704   | 0.93  | 0.86 to 1.00 | 21   | 0.43  | 0.27 to 0.66 |
| COPD (<15, >14)                   | 481   | 0.79  | 0.72 to 0.86 | 10   | 0.60  | 0.29 to 1.10 |
| Cirrhosis & other chronic liver disease (<15, >14) | 310   | 1.22  | 1.09 to 1.36 | 11   | 0.46  | 0.23 to 0.83 |

*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) | 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 (C00-C97)           | 1,237 | 0.96 | 0.90 to 1.01 | 2,606 | 1.22 | 1.17 to 1.27 | <0.01 |
| MN esophagus (C15)              | 54 | 1.26 | 0.94 to 1.64 | 79 | 1.35 | 1.07 to 1.68 | 0.70 |
| MN stomach (C16)                | 40 | 0.74 | 0.53 to 1.01 | 84 | 1.34 | 1.07 to 1.65 | <0.01 |
| MN intestine (C17-C18)          | 104 | 1.01 | 0.82 to 1.22 | 266 | 1.40 | 1.24 to 1.58 | <0.01 |
| MN rectum (C19-C21)             | 40 | 1.21 | 0.87 to 1.65 | 57 | 1.41 | 1.07 to 1.83 | 0.46 |
| MN lung (C33-C34)               | 402 | 0.94 | 0.85 to 1.03 | 795 | 1.18 | 1.10 to 1.26 | <0.01 |
| MN breast (C50)                 | <5 | 1.34 | 0.54 to 2.75 | <5 | 1.05 | 0.22 to 3.07 | 0.73 |
| MN prostate (C61)               | 41 | 1.04 | 0.74 to 1.41 | 293 | 1.09 | 0.97 to 1.22 | 0.77 |
| MN other male genital (C60, C62-C63) | <5 | 0.53 | 0.14 to 1.35 | 0 | NC | NC | 0.24 |
| MN kidney (C64-C66)             | 51 | 1.35 | 1.00 to 1.77 | 57 | 1.12 | 0.85 to 1.45 | 0.34 |
| MN bladder (C67-C68)            | 20 | 0.81 | 0.49 to 1.25 | 84 | 1.03 | 0.82 to 1.27 | 0.33 |
| MN skin (C43-C44, C46.0, C46.9) | 27 | 0.81 | 0.54 to 1.18 | 51 | 1.24 | 0.93 to 1.63 | 0.07 |
| Mesothelioma (C45)              | <5 | 0.68 | 0.02 to 3.76 | >13 | 2.07 | 1.21 to 3.32 | 0.25 |
| MN brain (C14, C70-C72)         | 41 | 0.81 | 0.58 to 1.10 | 45 | 1.25 | 0.91 to 1.68 | 0.04 |
| NHL (C46.3, C82-C85, C88.0, C88.3, C91.4, C96) | 40 | 0.87 | 0.62 to 1.18 | 111 | 1.41 | 1.16 to 1.70 | <0.01 |
| Leukemia (C81.0-C91.3, C91.5-C91.9, C92-C95) | 47 | 0.98 | 0.72 to 1.31 | 103 | 1.18 | 0.97 to 1.44 | 0.29 |
| Multiple myeloma (C90, C91, K56.9) | 16 | 0.86 | 0.49 to 1.40 | 38 | 0.96 | 0.68 to 1.32 | 0.71 |
| Ischemic heart disease (I20-I22, I24-I25, I51.3, I51.6) | 1,365 | 0.89 | 0.84 to 0.93 | 2,580 | 1.04 | 1.00 to 1.08 | <0.01 |
| Cerebrovascular disease (G45.0-G45.2, G45.4-G45.9, I60-69) | 144 | 0.64 | 0.54 to 0.75 | 581 | 1.00 | 0.92 to 1.08 | <0.01 |
| COPD (J40-J44, K70, K71-K74, K76.0) | 64 | 0.56 | 0.43 to 0.71 | 427 | 0.83 | 0.76 to 0.92 | <0.01 |
| Cirrhosis & other chronic liver disease (J70, J71) | 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 | p-value |
|----------------------------------|-----|------|-----|-----|---------------|---------|
|                                  | Obs | SMR  | 95% CI | Obs | SMR  | 95% CI | Obs | SMR  | 95% CI | Obs | SMR  | 95% CI |
| 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*                     | 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*                    | 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*                      | 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 intesting*                    | 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*                       | 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*                         | 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*                       | 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*                     | 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*           | <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*                       | 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*                      | 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*                         | 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 |
| Mesotheliomas*                   | 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*                        | 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*                             | 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*                        | 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*                | 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*          | 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*         | 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*                            | 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  | 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 | Loglinear model | Exposure windows for time since exposure (years) | LRT p-value |
|---------------------------|-----------------|--------------------------------------------------|-------------|
|                           | HR @ 8800 vs 2100 runs | Lag to <20 | 20 to <30 | 30+ | 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 C00-C97       | 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 C15          | 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 C16            | 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 C18              | 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 C19-C21         | 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 C33-C34           | 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 C31           | 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 C64-C66         | 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 C45-C44, C46.0, C46.9 | 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 C47, C70-C72     | 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 C48.3, C82-C85, C86.0, C88.3, C91.4, C96 | 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 C91.0-C91.3, C91.5-C91.9, C92-C95 | 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 ^7^, 228.2, 224.2, 313.1, 315.6 | 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 G45.0-G45.2, G45.4-G45.9, I60-I69 | 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 J40-J44              | 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 K73-K74, K76.0 | 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 | p-value | p-value |
|---------------------------|----------------|-------------------------------------|-------------------------------------|---------|---------|
|                           | HR | 95% CI | HR | 95% CI | HR | 95% CI | LRT | HR | 95% CI | HR | 95% CI |
| All cancers | 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 |
| MN esophagus | 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 |
| MN stomach | 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 |
| MN colon | 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 |
| MN rectum | 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 |
| MN lung | 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 |
| MN prostate | 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 |
| MN kidney | 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 |
| MN skin | 0.76 | 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 |
| MN brain | 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 |
| NHL | 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 |
| Leukemia | 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 |
| Ischemic heart disease | 1.01 | 0.91 to 1.13 | 1.90 | 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 |
| Cerebrovascular disease | 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 |
| COPD | 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 |
| Cirrhosis & other chronic liver disease | 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 |

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\textsuperscript{th}, 50\textsuperscript{th}, 75\textsuperscript{th} and 90\textsuperscript{th} 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 (\(<10, 10\text{--}20, 20\text{--}30, 30+\) years) by including variables in the model. COPD: chronic obstructive pulmonary disease.