



# Suicide mortality in United States urban career firefighters and emergency medical service providers

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## ABSTRACT

**Objective:** Evidence regarding whether first responders have elevated suicide rates is mixed. We investigated if career firefighters and emergency medical service providers (EMS) had increased suicide mortality compared with general populations.

**Methods:** We included two occupational cohorts of responders employed by United States urban fire departments: 32,925 FDNY firefighters and EMS employed between 9/11/2001–12/31/2023, and 11,917 non-FDNY responders employed between 9/11/2001–12/31/2009. Follow-up started at the later of hire date or 9/11/2001 and ended at earliest of death date or 12/31/2023. We obtained death data from the National Death Index. Demographic-specific US and NYC suicide rates were used to calculate standardized mortality ratios (SMRs) and 95% CIs. Multivariable extended Cox models with time-dependent variables assessed associations between select characteristics and suicide in FDNY responders.

**Results:** FDNY firefighters had lower suicide rates than US (SMR = 0.38, 95% CI = 0.27, 0.51) and NYC adults (SMR = 0.57, 95% CI = 0.41, 0.77). FDNY EMS suicide rates and non-FDNY responders' rates were not significantly different from general population rates. Suicide risk factors included posttraumatic stress disorder (hazard ratio [HR] = 5.44, 95% CI = 2.60, 11.40) and depression symptoms (HR = 5.41, 95% CI = 2.72, 10.77).

**Conclusions:** Among nearly 45,000 career first responders, suicide rates were not elevated compared with general populations.

## 1. Introduction

Suicide rates in the United States have increased in recent decades, from 10.9 deaths/100,000 persons in 2002 to 14.2 deaths/100,000 persons in 2022 (Garnett and Curtin, 2024). Known risk factors for suicide include male sex, single marital status, unemployment, and lower income and education levels (Hughes et al., 2025; Näher et al., 2019; Qin et al., 2022). Certain occupational groups have elevated suicide rates compared with the general population; for example, military veterans have higher suicide rates than non-veteran adults (Howard et al., 2025). High-risk non-military occupations include those in the agricultural, construction, and mining industries (Hughes et al., 2025; Sussell et al., 2023). Notably, suicide rates tend to be elevated in occupations involving manual or physically demanding work (Hawkins

and Patel, 2024; Milner et al., 2013).

Studies show that first responders have a greater suicide risk than general populations (Sussell et al., 2023; Hawkins and Patel, 2024; Milner et al., 2013; Tiesman et al., 2015), although this increase may be specific to protective service workers who have occupational access to firearms (Hawkins and Patel, 2024; Soupen et al., 2025; Violanti and Steege, 2021). Evidence of elevated suicide rates in other first responders is less conclusive (Sussell et al., 2023; Stanley et al., 2015; Stanley et al., 2016a; Stanley et al., 2016b). First responders are routinely exposed to workplace stressors and traumatic events, and consequently experience high rates of posttraumatic stress disorder (PTSD) and depression – mental health conditions associated with suicide (Qin et al., 2022; Woo and Postolache, 2008; Moslehi et al., 2025; Boffa et al., 2017; Carey et al., 2011; Martin et al., 2017). World Trade

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Center (WTC) responders were exposed to major trauma, but previous studies have shown inconsistent associations of WTC exposure with suicide mortality (Li et al., 2023; Jordan et al., 2018; Singh et al., 2023). In the current study, we evaluated suicide rates among nearly 45,000 career firefighters and emergency medical service providers (EMS) employed by four large urban fire departments. We aimed to explore whether suicide rates were elevated in these occupations compared with the United States and New York City (NYC) general populations. Additionally, we assessed potential risk factors for suicide within responders, including WTC exposure.

## 2. Methods

### 2.1. Study population

The population included two cohorts of first responders employed by United States urban fire departments, for which we had complete rosters. One cohort included WTC-exposed and non-WTC-exposed employees of the Fire Department of the City of New York (FDNY), and the other consisted of non-WTC-exposed employees of the Chicago, Philadelphia, and San Francisco fire departments who were previously included in studies of firefighting and health outcomes (Zeig-Owens et al., 2021). FDNY members who worked at the WTC site anytime between 9/11/2001 and 7/25/2002 and those who were hired after 9/11/2001 but before 12/31/2023 were eligible for inclusion. Similarly, we restricted the cohort of responders from Chicago, Philadelphia, and San Francisco to those who were actively-employed on 9/11/2001 or hired between 9/11/2001 and 12/31/2009. All three non-FDNY populations were evaluated as a single pooled cohort in this study due to small numbers of suicides in some of the departments. We excluded FDNY and non-FDNY members with missing demographic information ( $N = 536$ ). The final study population included 32,925 FDNY members and 11,917 members of the other three fire departments ( $N = 44,842$ ). The Biomedical Research Alliance of New York (BRANY) Institutional Review Board approved this study and waived informed consent. A subset of the FDNY cohort ( $N = 21,326$ ) provided written informed consent for use of their mental health screening data.

### 2.2. Measures

Participants' race/ethnicity, sex, and dates of birth and employment were obtained from their respective fire departments. The FDNY employee database also contained its members' work assignments (firefighter or EMS). FDNY members self-reported their marital status and WTC exposure information, if applicable, via routine monitoring questionnaires. We took participants' marital status from all questionnaires completed between the start of follow-up and 12/31/2023, and WTC exposure from their baseline questionnaire.

The FDNY health monitoring questionnaire has included mental health screeners since 2006. Participants were screened for PTSD symptoms using the 17-item PTSD Checklist (PCL), and a score  $\geq 44$  was considered a positive screen (henceforth referred to as PTSD) (Blanchard et al., 1996). They were screened for depressive symptoms using the Center for Epidemiologic Studies Depression Scale (CES-D); a score  $\geq 16$  was considered positive (henceforth depression) (Radloff, 1977). Harmful alcohol use was assessed via the Alcohol Use Disorder Identification Test (AUDIT), with a score  $\geq 8$  corresponding to a positive screen (henceforth alcohol abuse) (Saunders et al., 1993). For the two-item Connor-Davidson Resilience Scale (CD-RISC 2), included in the FDNY questionnaire since 2008, higher scores corresponded to greater resilience (Vaishnavi et al., 2007). We created a binary variable for resilience using the continuous CD-RISC 2 score (range: 0–8); participants who scored within the lowest quartile ( $<6$ ) were classified as having low resilience. Mental health screening results from all questionnaires administered during the follow-up period were used to create time-dependent PTSD, depression, alcohol abuse and resilience status

variables. Questionnaire results were only available for the FDNY cohort.

Death data were retrieved via linkages with the Social Security Administration (SSA) and National Death Index (NDI). Both SSA and NDI provided death dates, and NDI additionally provided underlying causes of death, using International Classification of Diseases codes, 10th revision (ICD-10). ICD-10 codes X60–X84 and Y87.0 identified suicide deaths (Garnett and Curtin, 2024). If a decedent's cause of death was missing ( $n = 5$ , 0.2% of deaths), they were assumed not to have died by suicide. Deaths that occurred by 12/31/2023 were analyzed. We obtained demographic-specific rates of suicide-specific mortality and all-cause mortality for the United States and NYC populations from the National Institute for Occupational Safety and Health and the NYC Department of Health and Mental Hygiene, respectively, both available through 2022. Demographic-stratified suicide rates were not publicly available for several other regions of interest. Rates were provided in the following strata: five-year calendar period, sex, racial/ethnic group (non-Hispanic white vs. non-white and/or Hispanic), and five-year age group.

### 2.3. Statistical analyses

We summarized demographic characteristics of both cohorts and relevant characteristics of the FDNY cohort using means ( $\pm$ SD), medians (IQR) or counts (%). To compare suicide and overall mortality rates in responders to those in the general population between 9/12/2001 and 12/31/2023, we estimated standardized mortality ratios (SMRs) and 95% confidence intervals (CIs), counting deaths that occurred in each responder cohort and comparing them to the expected numbers given the reference population mortality rates. For the primary analyses, follow-up time for each participant began on the latest of their hire date or 9/11/2001 and ended at the earliest of death date or 12/31/2023. Expected numbers of suicides and overall deaths for each cohort were calculated by multiplying stratum-specific United States suicide and all-cause mortality rates, respectively, with the number of person-years in the corresponding strata. Observed and expected counts were then summed across strata, and suicide and all-cause mortality SMRs were computed as the ratio of total observed to total expected events. We estimated 95% CIs using Poisson assumptions (Byar's approximation) (Breslow and Day, 1987). These analyses were repeated using NYC suicide and all-cause mortality rates in the FDNY population, to account for regional variations in suicide rates (Arango et al., 2024). All FDNY cohort SMR analyses were stratified by employment class (firefighter or EMS). These data were not available for the non-FDNY cohort.

In secondary SMR analyses restricted to the FDNY cohort, we repeated the above analyses but assessed actively-employed and retired follow-up time separately. For the actively-employed SMRs, follow-up time began at the latest of hire date or 9/11/2001 and ended at the earliest of retirement date, death date, or 12/31/2023. For retired SMRs, we calculated follow-up starting at the latest of retirement date or 9/11/2001 and ending at the earliest of death date or 12/31/2023. We applied United States and then NYC mortality rates to estimate expected deaths and SMRs in active firefighters, active EMS, retired firefighters, and retired EMS.

We also performed SMR analyses stratified by sex. For these analyses we used pooled data from both the FDNY and non-FDNY cohorts due to low suicide counts in the female subpopulations, and applied only United States reference rates.

Lastly, we conducted univariable and multivariable analyses to estimate associations between select participant characteristics and suicide mortality among FDNY responders. Covariates were selected based on known/theoretical risk factors for suicide (Hughes et al., 2025; Qin et al., 2022; Sussell et al., 2023). In univariable analyses, Cox proportional hazards models evaluated the associations of employment class and demographic characteristics with suicide mortality, and extended Cox models evaluated the associations of time-dependent marital and

retirement statuses with suicide mortality. Extended Cox models including both time-independent and time-dependent covariates were applied for the multivariable analyses. One multivariable model added WTC exposure (yes/no) as a potential predictor. We then assessed whether FDNY responders with PTSD, depression, alcohol abuse or low resilience over follow-up had an elevated hazard of suicide in analyses with and without controlling for confounders; these analyses were restricted to members who had completed monitoring questionnaires and consented to the use of their mental health data. Each of the mental health measures was evaluated separately due to overlapping constructs across measures. All multivariable extended Cox models were adjusted for sex, race/ethnicity, baseline age, employment class, and time-dependent marital and retirement statuses. We evaluated the proportional hazards assumption for Cox models by assessing Schoenfeld residuals (Schoenfeld, 1982). Analyses were performed using SAS v.9.4 (SAS Institute Inc., Cary, NC, USA).

### 3. Results

Demographic characteristics of both responder cohorts are shown (Table 1). FDNY responders were younger, on average, than non-FDNY responders. Both cohorts were overwhelmingly male and mostly non-Hispanic white. Approximately half of FDNY responders were WTC-exposed (48%), and over two-thirds were married at the time of their most recent monitoring exam (68%). Four percent of FDNY participants were deceased by 12/31/2023, compared with 11% of non-FDNY responders. There were 52 suicide deaths over 525,682.5 years of follow-up in the FDNY population (9.9/100,000 person-years); 41 in firefighters (9.8/100,000 person-years) and 11 in EMS (10.1/100,000 person-years). In the non-FDNY population, 52 suicides occurred over 243,090.7 years of follow-up (21.4/100,000 person-years).

In FDNY firefighters, suicide-specific mortality during the period 9/12/2001–12/31/2023 was significantly lower than expected given United States rates (SMR = 0.38, 95% CI = 0.27, 0.51) (Table 2). FDNY EMS, however, did not have a significantly different number of suicide deaths than would be expected based on national rates (SMR = 0.64, 95% CI = 0.32, 1.14). Suicide rates in non-FDNY responders were also not different from American adult rates (SMR = 1.00, 95% CI = 0.75, 1.32). Additionally, the combined population of female FDNY and non-FDNY responders had a suicide rate similar to American females (SMR = 1.12, 95% CI = 0.23, 3.28, Table S1), albeit based on few events. All groups had significantly lower all-cause mortality than the general population.

When comparing mortality rates in FDNY responders vs. NYC adults (Table 2), we again found that FDNY firefighters had significantly reduced suicide-specific (SMR = 0.57, 95% CI = 0.41, 0.77) and all-cause mortality. The FDNY EMS suicide rate was similar to that of the NYC population (SMR = 0.94, 95% CI = 0.47, 1.69), while its all-cause mortality rate was significantly lower.

Both actively-employed and retired FDNY firefighters had lower than expected suicide mortality given national rates, though the protective effect appeared greater among the actively-employed (SMR = 0.24, 95% CI = 0.14, 0.40 [active]; SMR = 0.55, 95% CI = 0.36, 0.81 [retired]) (Table S2). Neither active nor retired FDNY EMS had significantly different suicide rates from the United States population (SMR = 0.78, 95% CI = 0.34, 1.54 [active]; SMR = 0.42, 95% CI = 0.09, 1.24 [retired]). All groups again had lower all-cause mortality.

Active FDNY firefighters also had significantly reduced suicide mortality compared with NYC adults (SMR = 0.40, 95% CI = 0.22, 0.65), while there was no significant difference for retired firefighters (SMR = 0.76, 95% CI = 0.50, 1.11), active EMS (SMR = 1.19, 95% CI = 0.51, 2.34) or retired EMS (SMR = 0.61, 95% CI = 0.12, 1.78) (Table S3). For all-cause mortality, all groups had reduced rates vs. NYC adults except for retired EMS.

Additional analyses within the FDNY population found that participants who were divorced/separated had a greater risk of suicide than

**Table 1**

Characteristics of United States urban career firefighters and emergency medical service providers. 9/11/2001–12/31/2023

|                                                      | FDNY responders            | Non-FDNY responders |
|------------------------------------------------------|----------------------------|---------------------|
|                                                      | N (%)                      | N (%)               |
| Total N                                              | 32,925                     | 11,917              |
| Age in years at baseline, mean $\pm$ SD <sup>a</sup> | 33.7 $\pm$ 9.8             | 40.7 $\pm$ 10.1     |
| Age group at baseline <sup>a</sup>                   |                            |                     |
| 18–24 years                                          | 5989 (18.2)                | 527 (4.4)           |
| 25–34 years                                          | 15,102 (45.9)              | 3303 (27.7)         |
| 35–44 years                                          | 7027 (21.3)                | 3989 (33.5)         |
| 45–54 years                                          | 3590 (10.9)                | 2971 (24.9)         |
| 55–64 years                                          | 1046 (3.2)                 | 1117 (9.4)          |
| 65+ years                                            | 171 (0.5)                  | 10 (0.1)            |
| Sex                                                  |                            |                     |
| Male                                                 | 30,525 (92.7)              | 11,085 (93.0)       |
| Female                                               | 2400 (7.3)                 | 832 (7.0)           |
| Race/ethnicity                                       |                            |                     |
| White                                                | 23,874 (72.5)              | 8067 (67.7)         |
| Black                                                | 3474 (10.6)                | 2212 (18.6)         |
| Hispanic                                             | 4620 (14.0)                | 1141 (9.6)          |
| Other                                                | 957 (2.9)                  | 497 (4.2)           |
| Deceased by 12/31/2023                               | 1321 (4.0)                 | 1299 (10.9)         |
| Suicide by 12/31/2023                                | 52 (0.2)                   | 52 (0.4)            |
| Person-years of follow-up, median (IQR) <sup>b</sup> | 19.9 (9.0–22.3)            | 22.3 (19.5–22.3)    |
| Total person-years of follow-up                      | 525,682.5                  | 243,090.7           |
| Retired by end of follow-up                          | 18,084 (54.9)              | NA                  |
| Marital status <sup>c</sup>                          |                            |                     |
| Single/never married                                 | 6197 (19.3) <sup>d</sup>   | NA                  |
| Married                                              | 21,920 (68.3) <sup>d</sup> |                     |
| Divorced/separated                                   | 3570 (11.1) <sup>d</sup>   |                     |
| Widowed                                              | 412 (1.3) <sup>d</sup>     |                     |
| Work assignment                                      |                            |                     |
| Firefighter                                          | 24,275 (73.7)              | NA                  |
| EMS                                                  | 8650 (26.3)                |                     |
| WTC exposure                                         |                            |                     |
| No                                                   | 17,280 (52.5)              | NA                  |
| Yes                                                  | 15,645 (47.5)              |                     |
| PTSD <sup>c,e</sup>                                  | 1318 (6.3) <sup>f</sup>    | NA                  |
| Depression <sup>c,g</sup>                            | 2750 (13.1) <sup>f</sup>   | NA                  |
| Alcohol abuse <sup>c,h</sup>                         | 1265 (6.0) <sup>f</sup>    | NA                  |
| Low resilience <sup>c,i</sup>                        | 2577 (12.4) <sup>j</sup>   | NA                  |

Abbreviations: AUDIT, Alcohol Use Disorders Identification Test; CD-RISC, Connor-Davidson Resilience Scale; CES-D, Center for Epidemiologic Studies Depression Scale; EMS, emergency medical service; FDNY, Fire Department of the City of New York; IQR, interquartile range; PTSD, posttraumatic stress disorder; SD, standard deviation; WTC, World Trade Center.

<sup>a</sup> At latest of 9/11/2001 or hire date.

<sup>b</sup> Per individual.

<sup>c</sup> As of most recent health monitoring exam.

<sup>d</sup> N = 32,099.

<sup>e</sup> Scored  $\geq 44$  on the PTSD checklist.

<sup>f</sup> N = 21,025.

<sup>g</sup> Scored  $\geq 16$  on the CES-D.

<sup>h</sup> Scored  $\geq 8$  on the AUDIT.

<sup>i</sup> Scored  $< 6$  on the CD-RISC 2.

<sup>j</sup> N = 20,703.

those who were married (HR = 2.46, 95% CI = 1.13, 5.32) (Table 3), controlling for age, sex, race/ethnicity, employment class and retirement status. We did not find other characteristics to be associated with suicide. WTC-exposed members did not have a greater risk of suicide than non-WTC-exposed members (HR = 0.86, 95% CI = 0.44, 1.68) after

**Table 2**

Standardized mortality ratios (SMRs) of suicide-specific mortality and all-cause mortality in United States urban career firefighters and emergency medical service providers vs. general populations, 9/12/2001–12/31/2023.

|                                             | Suicide <sup>a</sup> |          |                   | All-cause |          |                   |
|---------------------------------------------|----------------------|----------|-------------------|-----------|----------|-------------------|
|                                             | Observed             | Expected | SMR (95% CI)      | Observed  | Expected | SMR (95% CI)      |
| SMRs using United States rates <sup>b</sup> |                      |          |                   |           |          |                   |
| FDNY firefighters                           | 41                   | 108      | 0.38 (0.27, 0.51) | 1057      | 2980     | 0.35 (0.33, 0.38) |
| FDNY EMS                                    | 11                   | 17       | 0.64 (0.32, 1.14) | 264       | 410      | 0.64 (0.57, 0.73) |
| Non-FDNY responders                         | 52                   | 52       | 1.00 (0.75, 1.32) | 1299      | 2141     | 0.61 (0.57, 0.64) |
| SMRs using NYC rates <sup>c</sup>           |                      |          |                   |           |          |                   |
| FDNY firefighters                           | 41                   | 72       | 0.57 (0.41, 0.77) | 1057      | 2478     | 0.43 (0.40, 0.45) |
| FDNY EMS                                    | 11                   | 12       | 0.94 (0.47, 1.69) | 264       | 323      | 0.82 (0.72, 0.92) |

Abbreviations: EMS, emergency medical service; FDNY, Fire Department of the City of New York; NYC, New York City.

<sup>a</sup> Cause of death as defined in Robinson CF, Schnorr TM, Cassinelli RT, et al. Tenth revision US mortality rates for use with the NIOSH Life Table Analysis System. J Occup Environ Med 2006; 48: 662–67.

<sup>b</sup> Reference rate data from the National Institute for Occupational Safety and Health life table analysis system (Bertke SJ, Kelly-Reif K. Introducing LTASR, a new R package based on the NIOSH life table analysis system. Occupational and environmental medicine. 2022;79(11):792–792. Doi:<https://doi.org/10.1136/oemed-2022-108462>). As United States rates were available through 2022, rates for the 2020 to 2022 period were applied to person-time from 2020 to 2023.

<sup>c</sup> Reference rate data from New York City Department of Health and Mental Hygiene, Office of Vital Statistics. As NYC rates were available through 2022, rates for the 2020 to 2022 period were applied to person-time from 2020 to 2023.

**Table 3**

Select participant characteristics and risk of suicide mortality in New York City first responders, 9/12/2001–12/31/2023.

| Variable                    | Univariable analyses <sup>a</sup> |             | Multivariable analysis <sup>b</sup> |             |
|-----------------------------|-----------------------------------|-------------|-------------------------------------|-------------|
|                             | HR                                | 95% CI      | HR                                  | 95% CI      |
| Marital status <sup>c</sup> |                                   |             |                                     |             |
| Single/never married        | 1.80                              | 0.95, 3.43  | 2.03                                | 0.99, 4.15  |
| Widowed                     | 3.14                              | 0.42, 23.27 | 2.62                                | 0.32, 21.40 |
| Divorced/separated          | 2.36                              | 1.11, 5.02  | 2.46                                | 1.13, 5.32  |
| Married                     | 1.00                              |             | 1.00                                |             |
| EMS vs. firefighter         | 0.99                              | 0.51, 1.92  | 0.94                                | 0.40, 2.18  |
| Retired <sup>c</sup>        | 1.67                              | 0.97, 2.88  | 1.61                                | 0.80, 3.23  |
| Female vs. male             | 0.63                              | 0.15, 2.58  | 0.54                                | 0.12, 2.42  |
| Race/ethnicity              |                                   |             |                                     |             |
| Non-Hispanic black          | 0.93                              | 0.33, 2.63  | 0.91                                | 0.30, 2.77  |
| Hispanic                    | 1.05                              | 0.44, 2.50  | 1.12                                | 0.43, 2.87  |
| Other                       | 1.13                              | 0.16, 8.25  | 1.21                                | 0.14, 10.42 |
| Non-Hispanic white          | 1.00                              |             | 1.00                                |             |
| Baseline age in years       | 1.01                              | 0.99, 1.04  | 1.00                                | 0.97, 1.04  |

Abbreviations: CI, confidence interval; EMS, emergency medical service; FDNY, Fire Department of the City of New York; HR, hazard ratio.

<sup>a</sup> Each assessed in separate univariable analyses using cox proportional hazards regression models or extended cox proportional hazards regression models.

<sup>b</sup> Multivariable analysis using an extended cox proportional hazards regression model with both time-independent and time-dependent variables.

<sup>c</sup> Time-dependent variables.

controlling for age, sex, race/ethnicity, marital status, retirement status, and employment class (data not shown).

Most mental health measures assessed had strong associations with suicide (Table 4), even when controlling for confounders. PTSD and depression were each associated with a five-fold increase in suicide risk (HR = 5.44, 95% CI = 2.60, 11.40 and HR = 5.41, 95% CI = 2.72, 10.77, respectively). FDNY participants who reported low resilience had a four-fold increase in suicide risk vs. those with higher resilience (HR = 4.41, 95% CI = 2.33, 8.34). Alcohol abuse was not significantly associated with suicide after controlling for confounders.

#### 4. Discussion

This was a comprehensive investigation of suicide mortality in 44,842 career firefighters and EMS employed by four urban fire departments. We found that suicide rates were not elevated among FDNY

**Table 4**

Mental health conditions<sup>a</sup> and risk of suicide mortality in New York City first responders, 9/12/2001–12/31/2023.

| Model                               | Univariable analyses |             | Multivariable analyses <sup>b</sup> |             |
|-------------------------------------|----------------------|-------------|-------------------------------------|-------------|
|                                     | HR                   | 95% CI      | HR                                  | 95% CI      |
| PTSD model <sup>c</sup>             |                      |             |                                     |             |
| Positive PTSD <sup>d</sup>          | 6.38                 | 3.17, 12.88 | 5.44                                | 2.60, 11.40 |
| Negative PTSD                       | 1.00                 |             | 1.00                                |             |
| Depression model <sup>c</sup>       |                      |             |                                     |             |
| Positive depression <sup>e</sup>    | 5.97                 | 3.13, 11.39 | 5.41                                | 2.72, 10.77 |
| Negative depression                 | 1.00                 |             | 1.00                                |             |
| Alcohol abuse model <sup>c</sup>    |                      |             |                                     |             |
| Positive alcohol abuse <sup>f</sup> | 2.71                 | 1.14, 6.40  | 2.27                                | 0.93, 5.55  |
| Negative alcohol abuse              | 1.00                 |             | 1.00                                |             |
| Resilience model <sup>g</sup>       |                      |             |                                     |             |
| Low resilience <sup>h</sup>         | 5.04                 | 2.56, 9.92  | 4.41                                | 2.33, 8.34  |
| High resilience                     | 1.00                 |             | 1.00                                |             |

Abbreviations: CI, confidence interval; FDNY, Fire Department of the City of New York; HR, hazard ratio; PTSD, posttraumatic stress disorder.

<sup>a</sup> Time-dependent variables.

<sup>b</sup> Each assessed in separate extended cox proportional hazards regression models adjusted for sex, race/ethnicity, age, employment class, and time-dependent retirement and marital statuses.

<sup>c</sup> N = 21,025 (37 suicide deaths) participants with at least one monitoring exam between 12/27/2005 and 12/31/2023, when mental health screening data were available.

<sup>d</sup> Scored  $\geq 44$  on the PTSD checklist.

<sup>e</sup> Scored  $\geq 16$  on the Center for Epidemiologic Studies Depression Scale.

<sup>f</sup> Scored  $\geq 8$  on the alcohol use disorders identification test.

<sup>g</sup> N = 20,703 (34 suicide deaths) participants with at least one monitoring exam between 5/27/2008 and 12/31/2023, when resilience screening data were available.

<sup>h</sup> Scored  $< 6$  on the 2-item Connor-Davidson resilience scale.

or other departments' responders compared with the general population between 2001 and 2023. Among FDNY responders, risk factors for suicide included divorced/separated marital status, low self-rated resilience, PTSD, and depression; WTC rescue/recovery work and retirement were not associated with suicide mortality.

The FDNY firefighter subpopulation experienced fewer suicide deaths than expected based on United States and NYC suicide rates. This



discrepancy was especially pronounced among actively-employed firefighters, and therefore may be a manifestation of the healthy worker survivor effect and/or the greater social support provided by active employment in the fire service (Li and Sung, 1999; Carpenter et al., 2015). Studies of occupational status and suicide have shown unemployment and early retirement to be risk factors (Hughes et al., 2025; Näher et al., 2019; Qin et al., 2022). While we found active firefighters to have a relatively low suicide rate, neither actively-employed nor retired EMS had significantly different suicide rates compared with the general population. Firefighters and EMS at urban fire departments undergo pre-employment health screenings, and the health requirements for firefighters are more stringent than those for EMS (National Fire Protection Association (NFPA), 2025). Individuals hired as career firefighters likely have better physical and mental health than the general population, consistent with the healthy worker hire effect (Li and Sung, 1999). Reduced suicide rates in the FDNY firefighters could also be due to other differences between the firefighter and general populations that we were unable to account for, such as socioeconomic status. Finally, part of the FDNY cohort's reduction in suicide risk versus the United States population may be explained by regional variations in suicide rates; between 2013 and 2022, the NYC suicide rate was about half that of the country overall (Arango et al., 2024). Even when using NYC suicide rates as reference, however, we observed the FDNY firefighters' rate to be relatively low.

Our findings run counter to those of some studies of suicidality in firefighters, which reported elevated prevalences of suicidal thoughts and behaviors (Stanley et al., 2015; Moslehi et al., 2025). Unlike those studies, our analyses focused on deaths and were restricted to career firefighters from large urban fire departments. Volunteer firefighters and/or those at smaller community fire departments often lack access to the same healthcare resources provided to career firefighters (Stanley et al., 2017). Accordingly, volunteer firefighters have been found to have greater levels of PTSD, depression, and self-reported suicidal behaviors than career firefighters (Stanley et al., 2015; Stanley et al., 2017).

The non-FDNY responder cohort had a similar suicide rate to the general population between 2001 and 2023. Unfortunately, we did not have individual-level data on employment class for the non-FDNY cohort and were therefore unable to separately assess non-FDNY firefighters and EMS. Marital status and mental health data were also unavailable for non-FDNY responders. Our findings for that cohort and the FDNY EMS population are similar to those from a recent report that showed no significant difference between suicide rates in firefighter or EMS occupations and the overall United States civilian working population (Sussell et al., 2023). Similarly, our 2023 investigation of mortality in a subset of the FDNY and non-FDNY responder cohorts found suicide mortality in the non-FDNY group between 2001 and 2016 to be similar to expected levels based on national rates (Singh et al., 2023).

Our results regarding WTC exposure and suicide are consistent with two previous WTC responder studies that did not find elevated suicide rates among the WTC-exposed (Li et al., 2023; Singh et al., 2023). Conversely, an earlier study found that suicide mortality was elevated in a population of WTC-exposed workers compared with NYC adults (Jordan et al., 2018). The majority of responders included in that study were not career firefighters or EMS.

While WTC exposure was not a risk factor for suicide in FDNY responders, other established risk factors were strongly associated with suicide mortality in this population. Responders with PTSD, depression, and/or self-reported low resilience were many times more likely to die from suicide than those without these conditions. These findings, consistent with other studies linking mood disorders to suicidality in first responders (Moslehi et al., 2025; Boffa et al., 2017; Martin et al., 2017), highlight the importance of mental health screening. Early detection of mental health symptoms in responders via routine screening can prompt appropriate interventions. Marital status and employment status, variables that could be considered indicators of social support

levels, also had a relationship with suicide risk in the first responders and in other populations (Hughes et al., 2025). The primary strength of this study was that we conducted it within existing cohorts of career emergency responders. Having access to complete roster data from the fire departments allowed us to accurately estimate mortality rates in these occupational groups. Additionally, we were able to show robust findings across different large urban fire departments. Furthermore, we used both United States and NYC mortality rates when analyzing suicide and all-cause mortality in FDNY responders. We also benefitted from a large sample size, long follow-up period, and the ability to assess WTC rescue/recovery work as well as traditional urban firefighting and EMS work as possible risk factors for suicide mortality. Finally, this study characterizes suicide outcomes in EMS specifically, which few studies have investigated (Stanley et al., 2016a).

A limitation of this study is the potential for unmeasured confounding, both from the healthy worker effect and various socioeconomic correlates of suicide, like income, education, social integration, and marital status (Hughes et al., 2025; Näher et al., 2019; Qin et al., 2022). For example, 68% of FDNY members reported being married at the time of their most recent health monitoring examination (vs. ~50% of US males according to the American Community Survey) (U.S. Census Bureau, 2018). Another limitation is that regional differences in suicide rates could not be accounted for because demographic-stratified suicide rates were not publicly available for some regions. We also lacked data on suicidal ideation and attempts. A screener for suicidal thoughts and behaviors was added to the FDNY monitoring survey in 2020 and should be assessed in future studies of suicide in FDNY responders. Finally, due to relatively low numbers of events in the EMS group and among females, additional years of follow-up in this and other responder cohorts are needed to confirm that suicide risks in EMS and in female responders do not significantly differ from those in the general population. Effect estimates from FDNY-only multivariable models that were adjusted for many variables may also be unstable due to limited numbers of events in some of the groups.

## 5. Conclusion

In this study, the largest cohort study of suicide in career firefighters and EMS to date, we did not observe that firefighting or EMS occupations were risk factors for suicide mortality. Suicide rates in career firefighters may be lower than in the general population due to the differences in population characteristics outlined above. First responders experiencing mental health symptoms have an elevated risk of suicide, highlighting the importance of mental health screening and providing appropriate treatment to workers with these conditions.

## CRedit authorship contribution statement

**Ankura Singh:** Writing – original draft, Formal analysis, Data curation. **Rachel Zeig-Owens:** Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Tyrone Moline:** Writing – review & editing, Project administration, Data curation. **Madeline F. Cannon:** Writing – review & editing, Data curation. **David G. Goldfarb:** Writing – review & editing, Data curation. **Jaeun Choi:** Writing – review & editing, Methodology. **Charles B. Hall:** Writing – review & editing, Methodology. **David J. Prezant:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

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## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpmed.2026.108608>.

## Data availability

Data will be made available on request.

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