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ORIGINAL RESEARCH

Association Between Atrial Fibrillation and Occupational Exposure in Firefighters Based on Self-Reported Survey Data

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BACKGROUND: Exposure to inhaled smoke, pollutants, volatile organic compounds, and polycyclic aromatic hydrocarbons in the firefighting environment has been associated with detrimental respiratory and cardiovascular effects, making firefighters a unique population with both personal and occupational risk factors for cardiovascular disease. Some of these exposures are also associated with development of atrial fibrillation. We aimed to study the association of atrial fibrillation and occupational exposure in firefighters.

METHODS AND RESULTS: A cross-sectional survey was conducted between October 2018 and December 2019. Data were gathered electronically and stored in a secure REDCap database through Louisiana State University Health Shreveport. Firefighters who were members of at least 1 of 5 preselected professional organizations were surveyed via electronic links distributed by the organizations. The survey queried the number of fires fought per year as a measure of occupational exposure, as well as self-reported cardiovascular disease. A total of 10 860 active firefighters completed the survey, of whom 93.5% were men and 95.5% were aged ≤60 years. Firefighters who fought a higher number of fires per year had a significantly higher prevalence of atrial fibrillation (0–5 fires per year 2%, 6–10 fires per year 2.3%, 11–20 fires per year 2.7%, 21–30 fires per year 3%, 31 or more fires per year 4.5%; $P<0.001$). Multivariable logistic regression showed that a higher number of fires fought per year was associated with an increased risk of atrial fibrillation (odds ratio 1.14 [95% CI, 1.04–1.25]; $P=0.006$).

CONCLUSIONS: Firefighters may have an increased risk of atrial fibrillation associated with the number of fires they fight per year. Further clinical and translational studies are needed to explore causation and mechanisms.

Key Words: atrial fibrillation ■ cardiovascular disease ■ firefighter ■ risk factors ■ smoke

Firefighters (FF) are a unique subsection of the population exposed to occupational risk factors for cardiovascular disease (CVD).[1–3] According to the National Fire Protection Association, in 2018 there were 29 705 fire departments with ≈1.1 million FF in the United States who were predominantly men (92%) and primarily composed of volunteer FF (67%) versus career FF (33%).[4] Over 50% of American FF fall in the 30- to 49-year-old age range. Despite being a younger population, CVD is associated with the greatest proportion of duty-related fatalities among FF.[5,6] The cause of CVD in FF is multifactorial, with obesity, excessive stress, inhalational exposures, and altered circadian rhythms being just a few of the proposed factors.[2,3,5,7–10]

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CLINICAL PERSPECTIVE

What Is New?

- In this survey-based study of 10 860 firefighters, an increased prevalence of atrial fibrillation was observed among firefighters with increased fire exposure as measured by fires fought per year (0–5 fires per year 2%, 6–10 fires per year 2.3%, 11–20 fires per year 2.7%, 21–30 fires per year 3%, 31 or more fires per year 4.5%; $P<0.001$).
- In a multivariable analysis, fires fought per year was a risk factor for atrial fibrillation (odds ratio 1.14 [95% CI, 1.04–1.25]; $P= 0.006$).

What Are the Clinical Implications?

- The association between atrial fibrillation and fire exposure is cause for concern.
- Further studies to elucidate the mechanisms are essential.

Nonstandard Abbreviations and Acronyms

FF	fire fighters
MCP-1	monocyte chemoattractant protein-1
PAI-1	plasminogen activator inhibitor
PM	particulate matter

Atrial fibrillation (AF), the most common clinical arrhythmia, affects over 2.2 million Americans and up to 37.5 million people worldwide, increasing their risk of stroke, congestive heart failure, and other cardiac complications.[11] Risk factors for AF, including hypertension, diabetes, coronary artery disease, and alcohol use, are common among FF.[5,12,13] In addition to these risk factors, FF are exposed to inhaled smoke, particulate matter (PM), polycyclic aromatic hydrocarbons, and volatile organic compounds in the firefighting environment. These exposures have been associated with proinflammatory cytokine release, oxidative stress, endothelial dysfunction, and impairment of autonomic function.[14–18] This may serve as a trigger for AF, either directly by causing a proarrhythmic substrate in the atria, or indirectly by contributing to atrial remodeling secondary to other structural heart disease. A prospective study performed by Link et al showed increased odds of AF following PM exposure within the prior 24 hours.[19]

Stroke and transient ischemic attack (TIA) are known major complications of AF. CHA_2DS_2VASc score is used in clinical practice to quantify stroke risk in the setting of an AF diagnosis, and subsequently to guide the discussion of using anticoagulation in these patients.[20] The score ranges from 0 to 9, with 2 or higher denoting moderate–high risk of stroke. This risk stratification tool incorporates the patient's other risk modifiers such as age, sex, congestive heart failure, diabetes, hypertension, stroke/TIA/thromboembolism, and vascular disease.

The objective of this study was to investigate the association of occupational exposures with AF, stroke/TIA, and other comorbidities in FF. We hypothesized that there would be a positive correlation between prevalence of AF among FF and number of fires fought per year.

METHODS

The data supporting the findings of this study are available by emailed request to the corresponding author. Subjects were selected for participation in this study based on their affiliation with one of the following organizations that represent career and/or volunteer FF: International Association of Fire Fighters, National Volunteer Fire Council, National Fallen Firefighter Foundation, International Association of Fire Chiefs, and Secret List. With the help of these organizations, the survey link was distributed to members electronically in an email or on the webpage of the organization. The recipients were provided with information about the study aims and details of participation before completing the survey. Any FF affiliated with the organizations listed above who were aged ≥18 years, active members of the fire service, and completed the survey were included in the study. Institutional review board approval was obtained for the study (LSU Health Shreveport Institutional Review Board, number 00001031), and implied consent was given by the FF based on their acceptance of the information provided to them and their subsequent completion of the survey.

Study participants completed a survey with demographic information, occupational history, cardiac history, and other health history (Figure 1). Attempts were made to recruit non-FF family members or friends as a control group by asking the FF participants to forward the survey link to them. Despite multiple reminders and an extension of the study period, we were unable to collect enough data from non-FF to constitute a reasonable control group. Therefore, according to a preplanned protocol, the data collected from FF were stratified by level of exposure to fires for data analysis.

Statistical Analysis

χ^2 test and Fisher exact test were used where appropriate to assess the association between participant characteristics and the presence of AF diagnosis. Multivariable logistic regression was performed to assess the odds of having AF. Covariates included in the AF regression model included known risk factors for

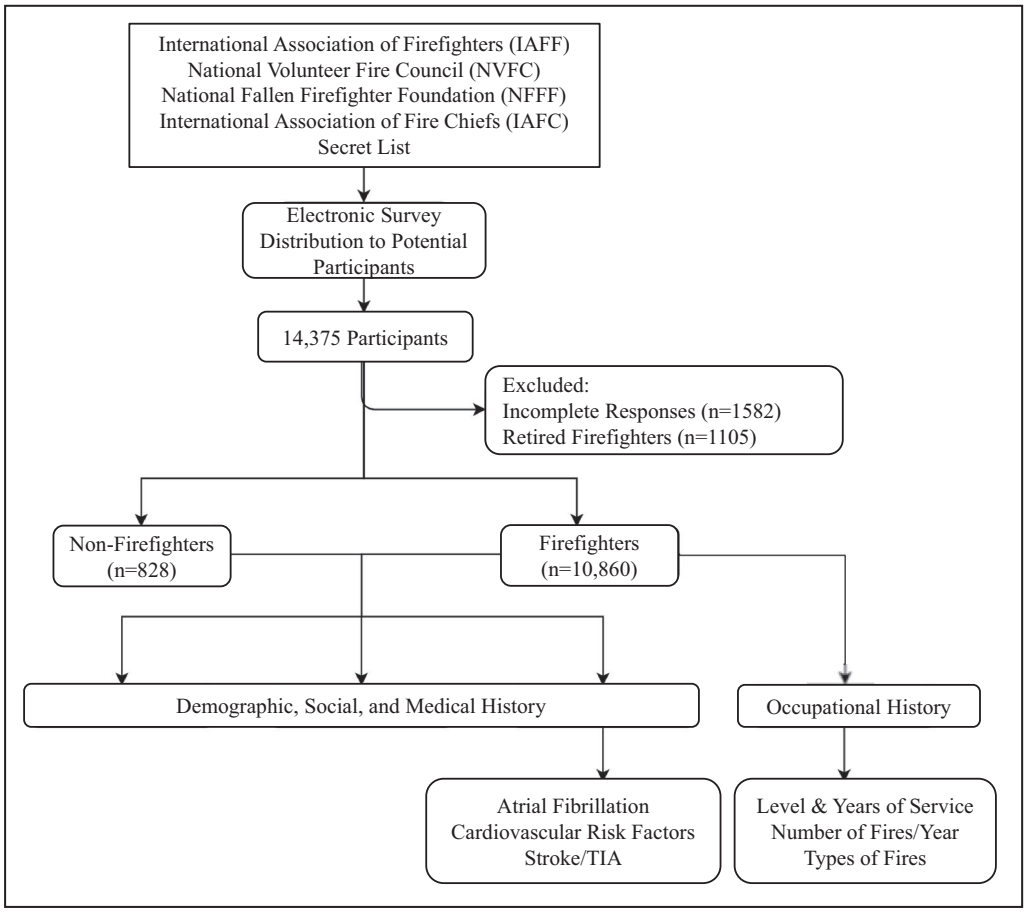

Figure 1. Survey distribution and data collection.
An electronic survey was distributed to firefighter members of 5 professional organizations. There were 14 735 survey responses collected via secure REDCap database. Demographic, social, medical, and occupational history was obtained. Incomplete responses (n=1582) and responses from retired firefighters (n=1105) were excluded. A total of 10 860 responses were included in the statistical analysis. TIA indicates transient ischemic attack.

AF, specifically: age ≥61 years, male sex, White race, alcohol use, current or prior smoking, secondhand smoke exposure, diabetes mellitus, obstructive sleep apnea, and hypertension. Covariates in the stroke/TIA regression model included: age ≥61 years, male sex, Black race, AF, diabetes mellitus, hypertension, and absence of anticoagulation use. CHA_2DS_2VASc score was defined by aggregating age, sex, hypertension, diabetes, heart failure, stroke/TIA, and vascular disease history as reported by study respondents. *P* values <0.05 were considered statistically significant.

RESULTS

Characteristics of Responding Firefighters

A total of 14 375 respondents attempted the questionnaire; 10 860 responses were from active (not retired) FF aged >18 years (Figure 1). The remaining responses were from retired FF, non-FF subjects, or were incomplete responses, and were thus excluded. Among FF, the participants were predominantly men (93.5%), aged ≤60 years (95.5%), and primarily of White, American Indian, or Alaskan Native race (92.2%), as shown in Table S1. Among these, 15.4% of FF had prior military experience. The majority of FF (77.3%) served at the local level, whereas others served at the county (18.2%), state (3.3%), or federal (1.2%) levels of the fire service. The respondents were predominantly career FF (89%). Career firefighters are employed by a city, municipality, or fire district and are paid for their work. They typically work more hours than a volunteer firefighter would, but schedules vary by location. The comorbidities observed and other participant characteristics are listed in Table S1. Self-reported CVD among FF included AF (2.7%), myocardial infarction (1.7%), coronary artery disease (4.2%), peripheral artery disease (0.5%), and stroke/TIA (0.8%).

AF in Firefighters

Among FF, 2.9% of men and 0.9% women reported diagnoses of AF (*P*=0.005). Prevalence of AF increased with age. FF aged ≥61 years had a significant increase in AF compared with FF who were aged ≤60 years (8.2% versus 2.5%; *P*<0.001). The governmental level at which the FF were employed (federal, state, county, or local), the type of employment (career, volunteer, or paid per call), and presence of prior military service had no effect on the prevalence of AF (Table S2).

AF was more prevalent in FF with multiple different medical comorbidities including chronic obstructive pulmonary disease, myocardial infarction, peripheral or carotid artery disease, congestive heart failure, valvular heart disease, diabetes, obstructive sleep apnea, and hypertension (Table 1). Exposure to secondhand smoke was significantly associated with AF compared with FF without secondhand smoke exposure (3.5% versus 2.3%; *P*<0.001; Table S2).

Risk of AF and Number of Fires Fought

As shown in Figure 2, the prevalence of AF increased significantly with the increase in the number of fires fought per year (2.01% in FF fighting 0–5 fires per year, 2.28% in FF fighting 6–10 fires per year, 2.75% in FF fighting 11–20 fires per year, 3.01% in FF fighting 21–30 fires per year, and 4.55% in FF fighting ≥31 fires per year; *P*<0.001). We performed a multivariable analysis to identify risk factors for AF among survey respondents (Table 2). We investigated the occupational risks associated with increased exposure to the firefighting environment by analyzing fires per year by logistic regression. Age, male sex, obstructive sleep apnea, and hypertension were all associated with increased risk of AF (Table 2). Alcohol use in this population, however, was inversely associated with AF risk. An increased number of fires fought per year was associated with an increased risk of AF (odds ratio, 1.14 [95% CI, 1.04–1.25]; *P*=0.006). The Hosmer-Lemeshow test was performed for goodness of fit (*P*=0.365).

Risk of Stroke/TIA and CHA_2DS_2VASc Score

Only 83 out of 10 860 respondents reported a history of stroke/TIA. Stroke/TIA prevalence did not exhibit a linear relationship with fires fought per year, as shown in Figure 2. In the adjusted multivariable model shown in Table 2, AF, diabetes, hypertension, and anticoagulation use were associated with a statistically significant increased risk of stroke/TIA. Age ≤60 years was associated with decreased risk of stroke/TIA. Fires fought per year did not have a statistically significant impact on risk of stroke/TIA. The Hosmer-Lemeshow test was performed for goodness of fit (*P*=0.861). CHA_2DS_2VASc score for FF with AF exhibited the following breakdown: 36.6% (104/284) with a score of 0, 40.5% (115/284) with a score of 1, 13.0% (37/284) with a score of 2, 4.6% (13/284) with a score of 3, 3.9% (11/284) with a score of 4, and 1.4% (4/284) with a score of 5 or higher.

DISCUSSION

Firefighters represent a unique population with occupational exposure to smoke and other inhaled matter in the firefighting environment, which are known to have a negative impact on pulmonary and cardiovascular

Table 1. Prevalence of AF in Firefighters Based on Comorbidities (n=10860)

	Prevalence of AF with comorbidity (%)	Prevalence of AF without comorbidity (%)	*P* value*
Risk factors			
Cancer	55/891 (6.2)	242/9897 (2.4)	<0.001
Carotid artery disease	7/35 (20)	289/10 813 (2.7)	<0.001
Chronic obstructive pulmonary disease	7/94 (7.4)	290/10 746 (2.7)	0.015
Congestive heart failure	16/50 (32)	280/10 801 (2.6)	<0.001
Coronary artery disease	62/456 (13.6)	233/10 363 (2.2)	<0.001
Diabetes	20/470 (4.3)	275/10 367 (2.7)	0.042
Hypertension	150/2551 (5.9)	146/8245 (1.8)	<0.001
Myocardial infarction	18/189 (9.5)	277/10 655 (2.6)	<0.001
Obstructive sleep apnea	93/1660 (5.6)	196/9024 (2.2)	<0.001
Open heart surgery	19/102 (18.6)	279/10 756 (2.6)	<0.001
Peripheral artery disease	12/58 (20.7)	283/10 776 (2.6)	<0.001
Stroke/transient ischemic attack	13/83 (15.7)	285/10 765 (2.6)	<0.001
Valvular disease	20/288 (6.9)	276/10 515 (2.6)	<0.001

AF indicates atrial fibrillation.
*χ^2 test. *P*<0.05 is considered significant.

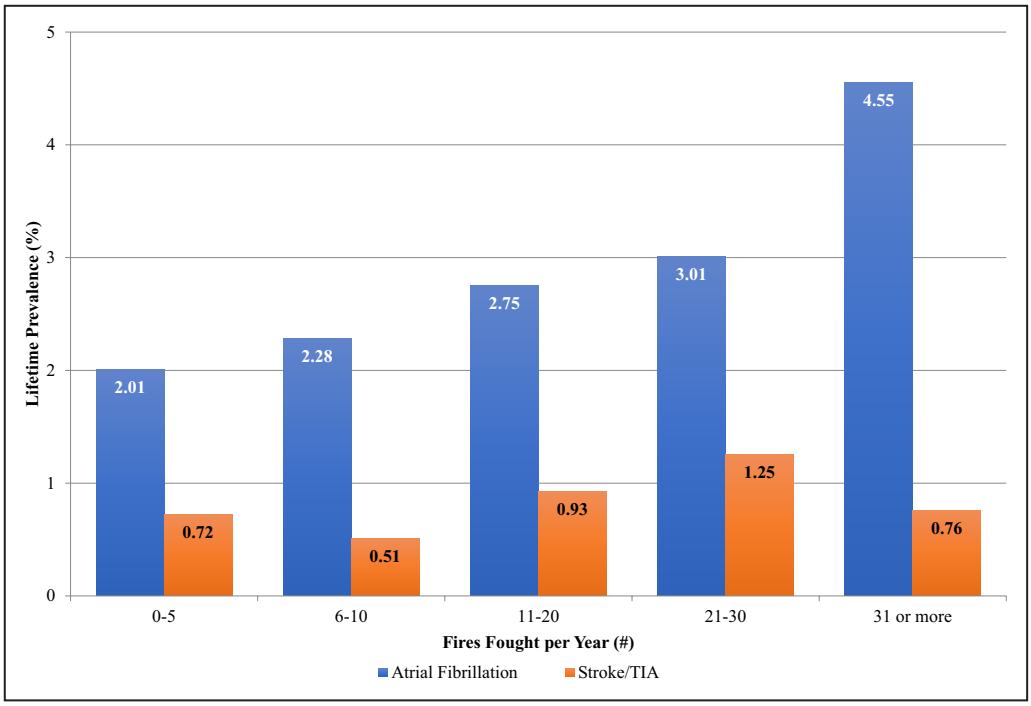

Figure 2. Prevalence of atrial fibrillation (AF) and stroke/transient ischemic attack (TIA) in firefighters based on fires fought per year.
This graph depicts self-reported prevalence data for AF and stroke/TIA collected from firefighters in the electronic survey. Atrial fibrillation prevalence increases with fires fought per year, whereas stroke/TIA prevalence does not.

health.[1,3,5,7,10,21–25] There are many potential mechanisms by which fire suppression could be associated with increased prevalence of atrial fibrillation. During firefighting, firefighters are exposed to polycyclic aromatic hydrocarbons, PM, benzene, and hydrogen cyanide along with many other compounds.[26–29] Although respiratory protection is intended to limit exposure to these compounds, firefighters do not always wear respiratory protection before entering a structure, even when smoke levels in the air are high. Furthermore, firefighters may remove their self-contained breathing apparatus during the overhaul/cleanup phase of firefighting because of the weight and increased heat.[27–29] Dermal absorption is also of concern, because polycyclic aromatic hydrocarbons breakthrough the personal protective clothing, deposit on the skin, and may be absorbed into the body.[26] Research has begun to investigate the magnitude of exposure based on type of fire and fuel load, protective equipment design, and mitigation strategies, but more research is necessary to fully understand the exposure risk of firefighters responding to different types of fires (ie, cars, residential homes with different building construction, industrial) and performing different roles or wearing different personal protective equipment.

Our study shows that there is a statistically significant correlation between increased exposure (based on the number of fires fought per year) and increased prevalence of AF as well as several other cardiac and medical diagnoses. The mechanism for this correlation is almost certainly multifactorial, with stress response, long work hours, inhaled exposure to products of combustion, smoke inhalation, and strong activation of the sympathetic nervous system all playing a role.

Prior studies have demonstrated an increased risk of CVD among FF. CVD has been documented at autopsy in a large fraction of duty-related deaths in FF, which has been attributed to personal risk factors as well as job-related factors including exposure to products of combustion, strenuous work, and the sympathetic nervous system activation associated with responding to emergencies.[1,3,5,25] Occupational stress has also been correlated with the development of CVD and sleep disorders in FF in particular.[3] A study of FF with greater exposure to the World Trade Center fires in New York after the September 11, 2001 terrorist attacks demonstrated that they had a 44% increased risk for the primary outcome of the study, which was composed of myocardial infarction, stroke, unstable angina, revascularization, or cardiovascular death.[30] Our findings build on this established knowledge of the clustering of CVD and its risk factors in FF.

This study shows, for the first time, a dose-dependent relationship between AF and occupational

Table 2. Odds of Atrial Fibrillation and Stroke/Transient Ischemic Attack in Firefighters

	Unadjusted, OR (95% CI)*	*P* value†	Adjusted OR (95% CI)*	*P* value†
Atrial fibrillation				
Age, y, ≤60 vs ≥61)	0.28 (0.20–0.40)	<0.001	0.50 (0.34–0.73)	<0.001
Sex, men vs women	3.45 (1.53–7.77)	0.003	2.98 (1.22–7.25)	0.017
Race, Black§ vs White‡	0.78 (0.34–1.79)	0.555	0.68 (0.30–1.57)	0.858
Race, Asian‖ vs White‡	0.48 (0.24–0.98)	0.044	0.55 (0.27–1.12)	0.323
Military service	0.90 (0.64–1.26)	0.541	0.88 (0.63–1.23)	0.457
Level of service, county vs state	1.18 (0.56–2.50)	0.664	1.09 (0.51–2.35)	0.860
Level of service, federal vs state	2.04 (0.70–5.88)	0.189	1.35 (0.42–4.31)	0.619
Level of service, local vs state	1.23 (0.61–2.50)	0.555	1.09 (0.53–2.26)	0.852
Alcohol use, yes vs no	0.60 (0.47–0.77)	<0.001	0.68 (0.52–0.89)	0.004
Smoking, never smoker vs current	0.76 (0.36–1.64)	0.495	1.03 (0.47–2.25)	0.646
Smoking, quit vs current	0.82 (0.37–1.82)	0.628	0.86 (0.38–1.95)	0.502
Secondhand smoke exposure	1.56 (1.24–1.96)	<0.001	1.23 (0.96–1.57)	0.095
Diabetes	1.63 (1.03–2.59)	0.039	0.72 (0.45–1.18)	0.196
Obstructive sleep apnea	2.67 (2.08–3.44)	<0.001	1.89 (1.44–2.48)	<0.001
Hypertension	3.47 (2.75–4.37)	<0.001	2.75 (2.13–3.53)	<0.001
Fires per year¶			1.14 (1.04–1.25)	0.006
Stroke/transient ischemic attack				
Age, y, ≤60 vs ≥61	0.19 (0.11–0.34)	<0.001	0.42 (0.22–0.78)	0.006
Sex, men vs women)	1.39 (0.51–3.81)	0.519	1.04 (0.37–2.92)	0.939
Race, Black§ vs White‡	0.47 (0.06–3.33)	0.449	0.46 (0.06–3.34)	0.577
Race, Asian‖ vs White‡	0.65 (0.21–2.08)	0.472	0.68 (0.21–2.23)	0.996
Atrial fibrillation	4.95 (3.15–7.76)	<0.001	3.40 (1.62–7.14)	0.001
Diabetes	5.36 (3.08–9.31)	<0.001	3.14 (1.72–5.75)	<0.001
Hypertension	3.69 (2.40–5.70)	<0.001	2.33 (1.44–3.76)	0.001
Anticoagulation use	9.98 (4.49–22.18)	<0.001	2.78 (1.03–7.52)	0.043
Fires per year¶			1.01 (0.85–1.2)	0.898

OR indicates odds ratio.
*OR with 95% CI.
†*P*<0.05 is considered significant.
‡Race includes White/American Indian/Alaskan Native.
§Race includes Black/African American.
‖Race includes Asian/Native Hawaiian/Pacific Islander/Other.
¶No unadjusted analysis for this variable because it was incorporated as a continuous variable via logistic regression. See Figure 2 for atrial fibrillation and stroke/transient ischemic attack prevalence by fires per year.

exposure in FF. The prevalence of AF increased incrementally by approximately a half or full percentage point with every additional 5 to 10 fires fought per year. Given the fact that the age of an FF may be directly related to his or her experience and the number of fires fought per year, our multivariable analysis of AF was risk adjusted for age in addition to other common risk factors for AF.

AF risk in FF can be attributed to several proposed mechanisms. Firefighting and exposure to PM have been linked to reduced heart rate variability.[7,15] Agarwal et al reported in 2017 that low overall heart rate variability and increased sympathetic-to-parasympathetic dominance were independently associated with higher AF risk.[31] Low heart rate variability, coupled with the prominent sympathetic tone found in FF, could increase the prevalence of AF in FF.[21] Systemic inflammation, a finding connected to AF risk, has also been seen in connection with firefighting. FF have been found to have increased monocytes and inflammatory cytokines such as IL-6 (interleukin-6), IL-8 (interleukin-8), and MCP-1 (monocyte chemoattractant protein-1) in their blood after firefighting activities.[9,32] Multiple studies have also shown that PM exposure is associated with increased odds of new-onset AF and AF-related admissions to the hospital.[19,33,34] A 2019 study revealed

increased ventricular arrhythmias and ST segment changes on electrocardiograms taken within a period of time immediately after firefighting compared with a control period.[35] Exposure to PM can cause mitochondrial dysfunction by increasing mitochondrial permeability transition pore opening and altering calcium regulation, resulting in a favorable atrial substrate for arrhythmias.[36] These direct effects of firefighting and exposure to inhaled matter in the firefighting environment may interact with the personal susceptibilities of individual FF because of background CVD risk factors, which are also increased by some of the same mechanisms, and play a major role in increasing AF risk.

Firefighting has also been associated with an increased risk of thrombogenesis. Firefighting activities increase platelet numbers, platelet activity, coagulation factor VIII, and tissue factor, leading to a net reduction in activated partial thromboplastin time.[37] Moreover, PAI-1 (plasminogen activator inhibitor-1), a protein that has been implicated in thrombogenesis, is elevated after FF activities and exposure to PM.[37–40] Exposure to extreme heat and physical exertion during firefighting is associated with increased platelet monocyte binding and altered endothelial function as illustrated by attenuated flow mediated dilatation.[6] Therefore, we speculated that FF may have a higher prevalence of stroke/TIA, with or without AF. Our analysis of association between fires fought per year and stroke/TIA risk did not reveal a statistically significant correlation, but the hypothesis requires further investigation.

By design, this study is not able to elucidate any causal relationships, but the association between firefighting and AF is striking and merits deeper research. Our findings with regard to AF are consequential particularly because FF are at increased occupational risk of physical injury, making anticoagulation, a cornerstone of medical AF management, more dangerous. Further investigation into the cause of increased AF prevalence in FF is certainly indicated, but these results alone may be a reasonable basis to offer firefighters screening electrocardiograms or other monitoring to identify AF and pursue treatment earlier. Such an intervention may greatly prevent the high-morbidity sequelae associated with AF, including tachycardia- or arrhythmia-induced cardiomyopathy and TIA or stroke.

Limitations

This study is inherently limited based on the fact that the data on the medical conditions of the subjects are self-reported, which could introduce reporting bias. Because we do not have access to the subjects' health records, we are unable to verify the reported diagnoses. Study subjects were recruited by representative organizations, which may have biased the data set toward certain responders. This study design does not account for study subjects who have undiagnosed or asymptomatic AF, but this limitation related to formal diagnosis would be equally present across the entire study group. It is also possible that some study respondents may have retired from active FF duty because of AF or sequelae, which would not have been incorporated into this analysis because retired FF were excluded.

The lack of a robust non-FF control group may prevent comparison to a wider population; however, this impediment in data collection was anticipated and addressed with a prespecified analysis to using internal comparison of FF based on the number of fires fought. This led to better matching of the unknown or uncollected confounders we could not have adjusted for in the analysis. The small size of the respondents with stroke/TIA history was a limiting factor for that subgroup analysis. A distinction between ischemic and hemorrhagic strokes was not made in the survey, because this detail in a self-reported survey can be unreliable. In addition, we also did not adjust the stroke risk for CHA_2DS_2VASc score, because the scoring system includes stroke/TIA, and the cross-sectional survey model does not provide the ability to ascertain current versus previous stroke.

We believe that the high number of responses from study participants balances the weaknesses of the study design. Furthermore, well-established risk factors for AF and stroke/TIA were significantly associated in the multivariable analysis, providing internal validation for the quality of data obtained with this study.

CONCLUSIONS

Through survey-based collection of data from over 10000 respondents, this study has shown that increased prevalence of AF in FF is associated with increased exposure to the firefighting environment. Further research into causal relationships, underlying mechanisms, and risk mitigation strategies is crucial and will lead to a better understanding of cardiovascular risk factors in FF and the ability to protect and care for FF in the line of duty.

ARTICLE INFORMATION

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Author contributions: C.V. and R.T. were equal contributors to both development and completion of the study and interpretation of the study findings. C.V. jointly conceived the study with D.S. and P. Dominic. P. Dominic served as the principal investigator. A.B. acquired institutional review board approval. C.V. developed the survey in conjunction with D.S., P. Dherange, A.H., and P. Dominic. R.S. and R.T. performed statistical data analysis. All authors contributed to interpretation of the results. C.V., R.T., R.S., and P. Dominic wrote the article with input from all authors. Critical revision of the article for important intellectual content was provided by R.G., B.O., and D.L.S.

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Disclosures

None.

Supplemental Material

Tables S1–S2

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SUPPLEMENTAL MATERIAL

Table S1. Demographics, occupational characteristics, and risk factors of firefighters.

		[*]Prevalence (%)
Demographic Characteristics		
Sex	Male	10146/10850 (93.5)
	Female	704/10850 (6.5)
Age	≥ 61 Years	486/10860 (4.5)
	≤ 60 Years	10374/10860 (95.5)
Race	[†]White	10014/10859 (92.2)
	[‡]Black	269/10859 (2.5)
	[§]Asian	576/10859 (5.3)
Ethnicity	Hispanic	694/10858 (6.4)
Occupational Characteristics		
History of Military Service		1668/10859 (15.4)
Level of Service	Federal	133/10860 (1.2)
	State	357/10860 (3.3)
	County	1972/10860 (18.2)
	Local	8398/10860 (77.3)
Fires Fought/Year	0-5	1934/10860 (17.8)
	6-10	3365/10860 (31)
	11-20	2914/10860 (26.8)
	21-30	1196/10860 (11)
	31 or more	1451/10860 (13.4)
Type of Firefighter	Career	9666/10860 (89)
	Volunteer	787/10860 (7.2)
	Paid-on-call/per-call	301/10860 (2.8)
	Other	106/10860 (1)
Occupational Medical Evaluation		8170/10860 (75.2)
Risk Factors		
Atrial Fibrillation		298/10792 (2.7)
Cancer		891/10788 (8.3)

Carotid Artery Disease	35/10848 (0.3)
Chronic Obstructive Pulmonary Disease	94/10840 (0.9)
Congestive Heart Failure	50/10851 (0.5)
Coronary Artery Disease	456/10819 (4.2)
Diabetes Mellitus	470/10837 (4.3)
Hypertension	2551/10796 (23.6)
Myocardial Infarction	189/10844 (1.7)
Obstructive Sleep Apnea	1660/10684 (15.5)
Open Heart Surgery	102/10858 (0.9)
Peripheral Artery Disease	58/10834 (0.5)
Stroke/Transient Ischemic Attack	83/10848 (0.8)
Valvular Disease	288/10803 (2.7)

[*]Denominator (sample number) varies due to exclusion of respondents answering "not sure" or electing to not answer

[†]Race includes White/Caucasian/American Indian/Alaskan Native

[‡]Race includes Black/African American

[§]Race includes Asian/Native Hawaiian/Pacific Islander/Other

Table S2. Prevalence of atrial fibrillation in firefighters based on characteristics (n = 10860).

		*Prevalence of AF (%)	†*p*-value
Demographic Characteristics			
Sex	Male	292/10146 (2.9)	0.005
	Female	6/704 (0.9)	
Age	≥ 61 Years	40/486 (8.2)	<0.001
	≤ 60 Years	258/10374 (2.5)	
Race	‡White	284/10014 (2.8)	0.103
	§Black	6/269 (2.2)	
	ǁAsian	8/576 (1.4)	
Ethnicity	Hispanic	12/694 (1.7)	0.0931
	Non-Hispanic	286/10164 (2.8)	
Occupational Characteristics			
History of Military Service	Present	47/1668 (2.8)	0.8073
	Absent	251/9191 (2.7)	
Level of Service	Federal	6/133 (4.5)	0.574
	State	8/357 (2.2)	
	County	52/1972 (2.6)	
	Local	232/8398 (2.8)	
Fires Fought/Year	0-5	39/1934 (2)	<0.001
	6-10	77/3365 (2.3)	
	11-20	80/2914 (2.7)	
	21-30	36/1196 (3)	
	31 or more	66/1451 (4.5)	
Type of Firefighter	Career	253/9666 (2.6)	0.106
	Volunteer	32/787 (4.1)	
	Paid-on-call/per-call	10/301 (3.3)	
	Other	3/106 (2.8)	
Occupational Medical Evaluation	Present	221/8170 (2.7)	0.683
	Absent	77/2690 (2.9)	
Social Characteristics			

History of Alcohol Use	Present	209/8622 (2.4)	<0.001
	Absent	89/2238 (4)	
History of Smoking	Present, current	7/200 (3.5)	0.759
	Absent, quit	58/2042 (2.8)	
	Absent, never	233/8618 (2.7)	
Secondhand Smoke Exposure	Present	144/4105 (3.5)	<0.001
	Absent	154/6755 (2.3)	
History of Hospital Admission	Present	248/5368 (4.6)	<0.001
	Absent	50/5492 (0.9)	

[*]Denominator (sample number) varies due to exclusion of respondents answering "not sure" or electing to not answer

[†]Chi-squared test, $p<0.05$ is considered significant

[‡]Race includes White/Caucasian/American Indian/Alaskan Native

[§]Race includes Black/African American

[‖]Race includes Asian/Native Hawaiian/Pacific Islander/Other