

Cardiovascular Disease Risk Among WTC Firefighters

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FDNY Data Center Contracts and U01 OH011309/U01 OH011934



Background – Quick Review

- WTC disaster exposed individuals to fine particulate matter
- Fine particulate matter is a risk factor for cardiovascular disease (CVD)

Background

FDNY has published two cardiovascular disease studies:

1. Cohen HW, Zeig-Owens R, Joe C, Hall CB, Webber MP, Weiden MD, Cleven KL, Jaber N, Skerker M, Yip J, Schwartz T, Prezant DJ. Long-term Cardiovascular Disease Risk Among Firefighters After the World Trade Center Disaster. *JAMA Netw Open*. 2019 Sep 4;2(9):e199775.
2. Mueller AK, Cohen H, Singh A, Webber MP, Hall CB, Prezant DJ, Zeig-Owens R. Self-reported Cardiovascular Disease in Career Firefighters With and Without World Trade Center Exposure. *J Occup Environ Med*. 2024 Feb 1;66(2):135-140.

Background – Cohen *et al*



Original Investigation | Occupational Health

Long-term Cardiovascular Disease Risk Among Firefighters After the World Trade Center Disaster

Hillel W. Cohen, DrPH, MPH; Rachel Zeig-Owens, DrPH, MPH; Cynthia Joe, MPH; Charles B. Hall, PhD; Mayris P. Webber, DrPH, MPH; Michael D. Weiden, MS, MD; Krystal L. Cleven, MD; Nadia Jaber, RPA-C; Molly Skerker, BA; Jennifer Yip, MPH; Theresa Schwartz, MS; David J. Prezant, MD

Abstract

IMPORTANCE Published studies examining the association between World Trade Center (WTC) exposure on and after September 11, 2001, and longer-term cardiovascular disease (CVD) outcomes have reported mixed findings.

OBJECTIVE To assess whether WTC exposure was associated with elevated CVD risk in Fire Department of the City of New York (FDNY) firefighters.

DESIGN, SETTINGS, AND PARTICIPANTS In this cohort study, the association between WTC

Key Points

Question Is World Trade Center exposure on and after September 11, 2001, associated with long-term cardiovascular disease risk in Fire Department of the City of New York firefighters?

Findings In this cohort study of 9796 firefighters, age-adjusted incident rates

Background – Cohen *et al*

Aim: assessed whether acute (arrival time) and post-acute (duration) exposures to the WTC site were associated with elevated long-term CVD risk

Methods: Longitudinal cohort using internal analyses

Population: FDNY male firefighters (n= 9,796) who reported first arrival at the WTC site within the two weeks after 9/11, were actively employed on 9/11, no history of CVD on 9/11 and consented to research

Time period: 9/12/2001 to 12/31/2017

Background – Cohen *et al*

Arrival time defined as the time a participant first arrived at the WTC site

Three levels:

- Arrived on the morning of 9/11
- Arrived on the afternoon of 9/11
- Arrived between 9/12 and 9/24 (reference group)

Duration defined as the total number of months (1 -10) a participant reported working at the site ≥ 1 day

Two levels:

- ≥ 6 months (top 25% of cohort)
- < 6 months (reference group)

Background – Cohen *et al*

FDNY clinicians confirmed CVD cases via FDNY medical record review

Two case definitions:

Primary Outcome:

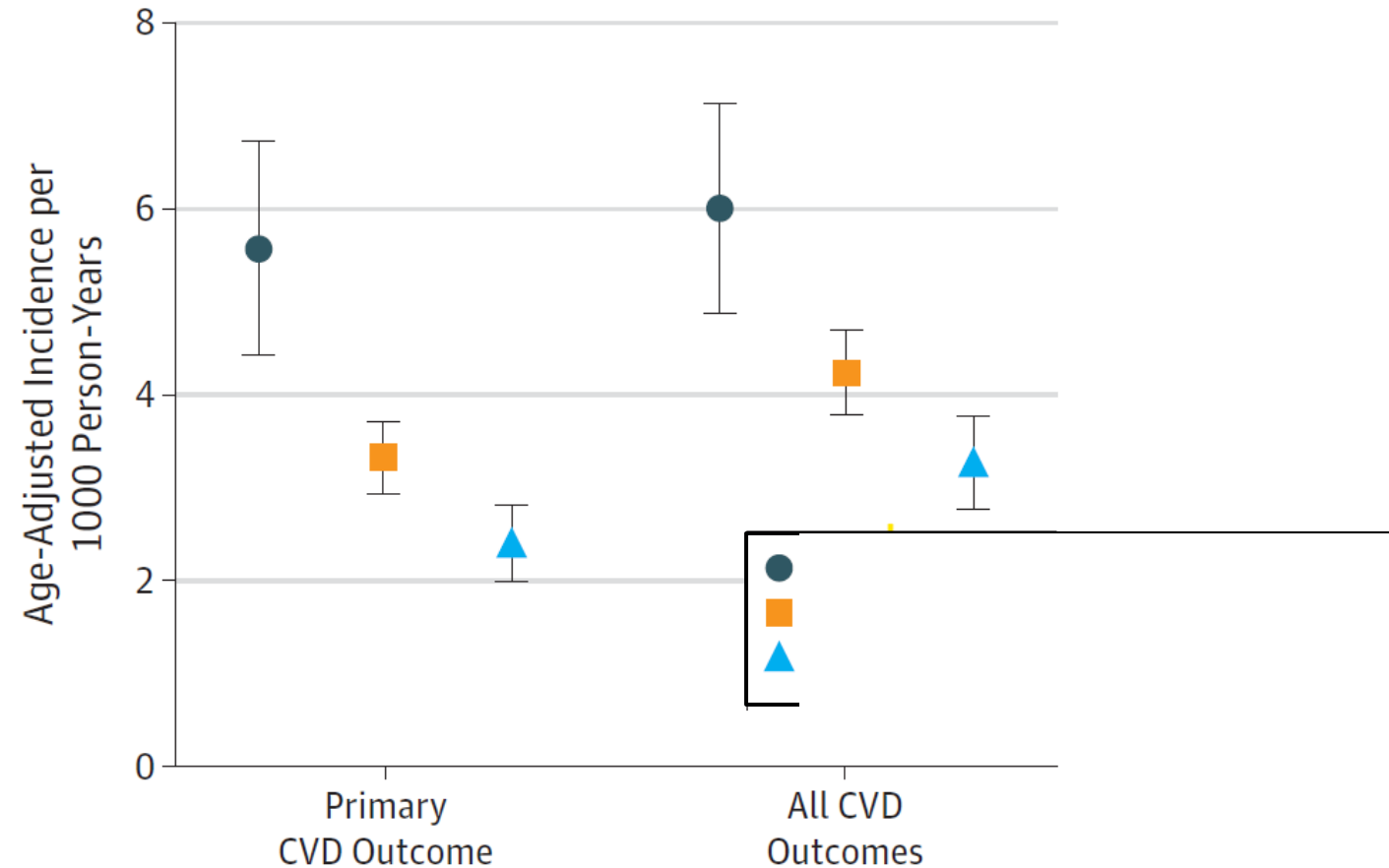
- Myocardial infarction (MI)
- Stroke/Cerebrovascular accident
- Coronary artery surgery
- Unstable angina or angioplasty
- Coronary heart failure
- CVD death

All CVD Outcomes:

- Myocardial infarction (MI)
 - Stroke/Cerebrovascular accident
 - Coronary artery surgery
 - Unstable angina or angioplasty
 - Coronary heart failure
 - CVD death
- Or
- Transient ischemic attack (TIA)
 - Stable angina
 - Cardiomyopathy
 - Other (aortic aneurysm, peripheral arterial vascular intervention, or carotid artery surgery)

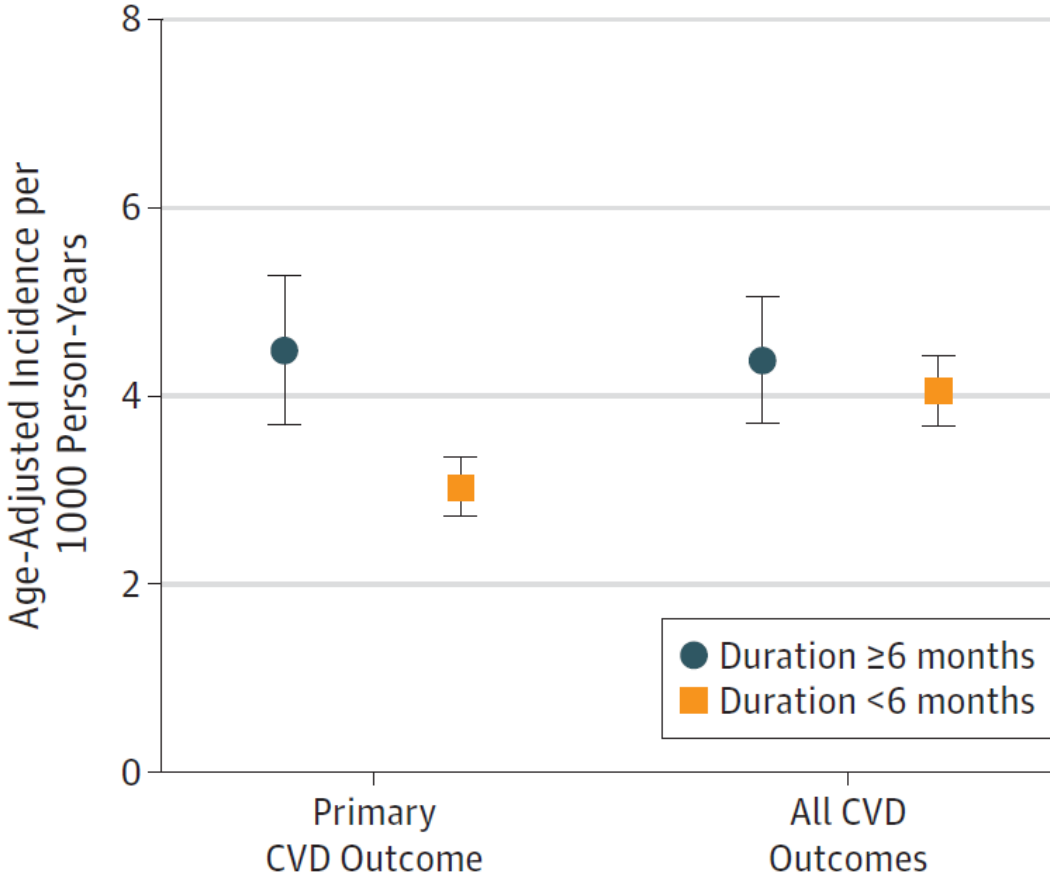
Key Findings – Cohen *et al*

A Incidence rates by arrival group



Key Findings – Cohen *et al*

B Incidence rates by duration group



Key Findings – Cohen *et al*

Adjusted Hazard Ratio was significant for those who arrived earliest compared with those arriving 9/12 or later:

- Arrived Morning of 9/11: **HR=1.44 (1.09-1.90)**
- Arrived Afternoon of 9/11: HR=1.24 (1.00-1.54)

Adjusted Hazard Ratio was significant for those who worked the most months at the site:

- 6+ months vs <6 months: **HR=1.33 (1.05-1.60)**

Background – Mueller *et al*

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ORIGINAL ARTICLE

Self-reported Cardiovascular Disease in Career Firefighters With and Without World Trade Center Exposure

Alexandra K. Mueller, MPH, Hillel Cohen, DrPH, Ankura Singh, MPH, Mayris P. Webber, DrPH, Charles B. Hall, PhD, David J. Prezant, MD, and Rachel Zeig-Owens, DrPH

Objective: To assess the effect of World Trade Center (WTC) exposure on cardiovascular disease (CVD) in career firefighters. **Methods:** Firefighters from four US cities completed health questionnaires that provide information about demographics, CVD diagnoses, and CVD risk factors. Firefighters were also compared with respondents of the 2019 National Health Interview Survey. **Results:** Greater WTC exposure was positively associated with combined coronary artery disease, myocardial infarction, and angina (termed “CAD”) when comparing WTC-exposed with non-WTC-exposed firefighters. Compared with the National Health Interview Survey population, firefighters had lower odds of CAD and stroke. **Conclusions:** An occupationally appropriate comparison is important to mitigate potential bias from the healthy worker effect. While the risk of CVD in WTC-exposed and non-WTC-exposed firefighters was significantly lower than a general US population, we observed an exposure gradient where greater WTC exposure was associated with greater odds of CVD.

Keywords: cardiovascular disease, World Trade Center, firefighting, occupational exposure

LEARNING OUTCOMES

- Describe the association between World Trade Center exposure and cardiovascular disease when accounting for the firefighting occupation
- Recognize how the healthy worker effect can bias association between World Trade Center exposure and cardiovascular disease

Background – Mueller *et al*

Aim: assessed the effect of WTC exposure on CVD in career firefighters

Methods: Cross-sectional prevalence analysis with external, non-WTC-exposed comparison population

Population: Male WTC-exposed (FDNY) and non-WTC–exposed (non-FDNY) firefighters from the Career Firefighter Health Study cohort who were actively employed on 9/11 by their fire depts

Time period: completed a health questionnaire between 2/2019 and 5/2021 – questionnaires evaluated current and past diagnoses

Background – Mueller *et al*

Binary WTC Exposure

Two levels:

- WTC-exposed FDNY firefighters
- Non-WTC-exposed firefighters from Chicago, Philadelphia and San Francisco (reference group)

Categorical WTC Exposure and trend analysis

Four levels:

- Arrived on the morning of 9/11
- Arrived on the afternoon of 9/11
- Arrived between 9/12 and 9/24
- Non-WTC-exposed firefighters (reference group)

Background – Mueller *et al*

Non-Firefighter Comparison

- Additionally compared both WTC-exposed and non-WTC-exposed firefighters with US males who responded to the National Health Interview Survey 2019

Background – Mueller *et al*

- Three Primary Outcomes: **self-reported** cardiovascular diagnoses
 - *Coronary artery disease (CAD)* – includes myocardial infarction, angina, and coronary artery disease
 - *Stroke* – includes stroke/cerebrovascular accident and transient ischemic attack
 - *Stroke/CAD* – includes reporting either or both of the above conditions

Key Findings – Mueller *et al*

TABLE 2. Estimated Odds Ratios for Self-reported CVD Diagnoses by Exposure Status

	Stroke/CAD ^a		Stroke ^b		OR (95% CI)	
	OR (95% CI)		OR (95% CI)		OR (95% CI)	
	Model 1 ^d	Model 2 ^e	Model 1	Model 2	Model 1	Model 2
WTC-exposed	1.23 (1.06–1.43)	1.03 (0.88–1.20)	1.03 (0.79–1.35)	0.93 (0.71–1.22)	1.25 (1.06–1.47)	1.03 (0.87–1.21)
Nonexposed	Ref	Ref	Ref	Ref	Ref	Ref

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High exposure	1.45 (1.18–1.79)	1.19 (0.96–1.48)	1.18 (0.80–1.75)	1.04 (0.70–1.55)	1.48 (1.18–1.86)	1.20 (0.95–1.51)
Moderate exposure	1.31 (1.11–1.54)	1.10 (0.93–1.30)	1.07 (0.79–1.44)	0.97 (0.72–1.30)	1.32 (1.10–1.57)	1.09 (0.91–1.31)
Low exposure	1.00 (0.83–1.21)	0.83 (0.69–1.01)	0.90 (0.64–1.27)	0.81 (0.57–1.15)	1.03 (0.84–1.26)	0.85 (0.69–1.05)
Nonexposed	Ref	Ref	Ref	Ref	Ref	Ref
<i>P</i> for trend	<0.0001	0.01	0.33	0.74	<0.0001	0.03

^aIncludes any report of stroke or CAD.

^dAge, race, and BMI were also included in the model (complete case analysis, *n* = 12,516).

^bIncludes diagnoses of stroke/CVA or TIA.

^eAge, race, BMI, high cholesterol, diabetes, hypertension, and smoking were also included in the model (complete case analysis, *n* = 12,435).

Key Findings – Mueller *et al*

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Key Findings – Mueller et al

TABLE 4. Estimated Odds Ratios for Self-reported CVD Diagnoses in Firefighters From All Four Cities Compared With the NHIS Population by Exposure Status

	Stroke/CAD ^a		Stroke ^b		Coronary artery disease (CAD)	
	OR (95% CI)		OR (95% CI)		OR (95% CI)	
	Model 1 ^d	Model 2 ^e	Model 1 ^d	Model 2 ^e	Model 1 ^d	Model 2 ^e
WTC-exposed	0.81 (0.73–0.90)	0.62 (0.55–0.70)	0.62 (0.51–0.74)	0.54 (0.44–0.66)	0.86 (0.77–0.97)	0.64 (0.57–0.73)
Non-exposed	0.71 (0.62–0.82)	0.59 (0.51–0.68)	0.66 (0.51–0.84)	0.60 (0.47–0.76)	0.74 (0.64–0.87)	0.60 (0.51–0.71)
NHIS Population	Ref	Ref	Ref	Ref	Ref	Ref

Firefighters have lower odds of self-reported CVD diagnoses than US males

Future Research Recommendations

Self-report data has the potential for differential misclassification

- A sensitivity analysis in Mueller et al found among FDNY members the exposure gradient was attenuated when using medical record-confirmed cases.

Medical record data using WTC health records has the potential to miss cases because CVD is not a WTC-covered condition

Future research should use medical record data that does not require a participant to actively inform us of their diagnosis.

- Cause of death data from NDI gets at some of this but not all events are fatal.