Cardiovascular Disease in the World Trade Center Health Program General Responder Cohort

Presenter: Susan L. Teitelbaum, PhD

Department of Environmental Medicine and Climate Science

Icahn School of Medicine at Mount Sinai

World Trade Center General Responder Data Center

Icahn School of Medicine at Mount Sinai

WTC Health Program Research Meeting

November 13, 2024

Background: Authors and Affiliations

Am. J. Ind. Med. **64** (2) 97-107, 2021. PMID 33315266

Nancy L. Sloan, DrPH,[1] Moshe Z. Shapiro, MS,[1]
Ahmad Sabra, MS, MPH, [1] Christopher R. Dasaro, MA,[1]
Michael A. Crane, MD,[2] Denise J. Harrison, MD,[3]
Benjamin J. Luft, MD,[4] Jacqueline M. Moline, MD, MSc,[5]
Iris G. Udasin, MD,[6] Andrew C. Todd, PhD,[1] Susan L. Teitelbaum,PhD[1]

1. Icahn School of Medicine at Mount Sinai, Department of Environmental Medicine and Public Health
2. World Trade Center Health Program Clinical Center of Excellence, Icahn School of Medicine at Mount Sinai, Department of Environmental Medicine and Public Health
3. World Trade Center Health Program Clinical Center of Excellence, NYU Langone Medical Center, New York University School of Medicine, New York, NY
4. World Trade Center Health Program Clinical Center of Excellence, Department of Medicine, Stony Brook University Medical Center, Stony Brook, NY
5. World Trade Center Health Program Clinical Center of Excellence, Department of Occupational Medicine, Epidemiology and Prevention, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Hempstead, NY
6. World Trade Center Health Program Clinical Center of Excellence, Environmental and Occupational Health Sciences Institute, Rutgers University Biomedical Sciences, Piscataway, NJ

Background: Goals and Mission

- Heart disease continues to be the leading cause of death worldwide
- Major risk factors
  - greater age, cigarette smoking, diet and obesity, high blood pressure, high cholesterol, diabetes and work psychosocial stressors
- >90,000 responders exposed to toxic matter, physiological and psychological stress
  - associated with short-term and persistent respiratory disease, gastro-esophageal reflux disorder (GERD), post-traumatic stress disorder (PTSD), some cancers
- **Goal**: investigate association between WTC-related exposures with CVD risk over 17 years in the WTC HP GRC

Background: Outcomes

- Cases – post 9/11/2001 first-time (primary):
  - Coronary artery disease (CAD)
  - Myocardial infarction (MI)
  - Stroke
  - Congestive heart failure (CHF)
  - Exclusions: pre 9/11/2001 cardiovascular outcomes
- No CVD
  - included heart murmur and other heart disease

Background: Exposure Definition

- Self-reported WTC exposure surrogate measure
  - Very high exposure: 9/11/2001 arrival with direct dust cloud exposure
  - High exposure: 9/11/2001 without dust cloud exposure
  - Low/intermediate exposure: Arrival on or after 9/12/2001 (comparison group)

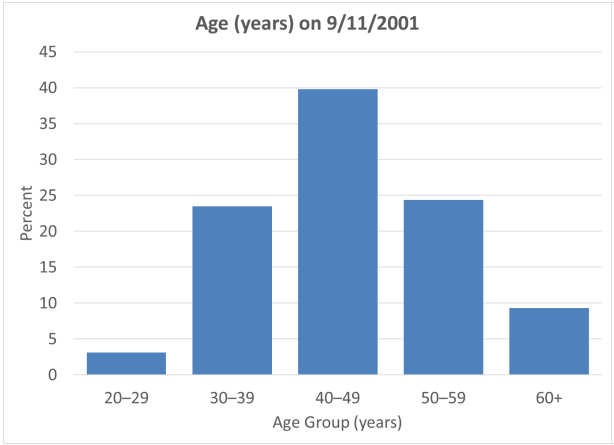
Background: Time Period of Analysis

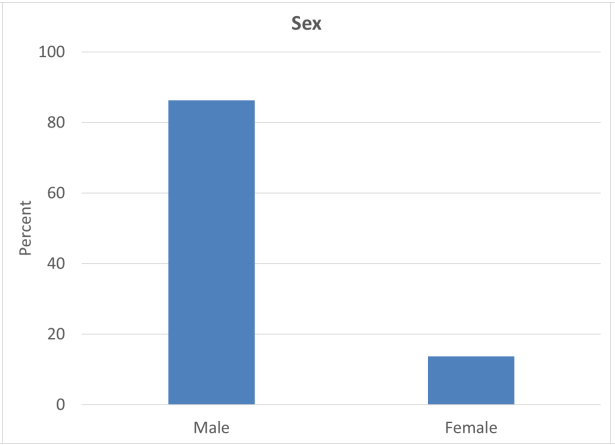
- WTC HP initiated periodic health monitoring on 07/16/2002
  - GRC is an open (continuing to enroll) cohort
- Information collected through 3/31/2019 included in analysis
- Inclusion criteria:
  - General responders providing written consent to use their data for research
  - Provided responses to questions on physician's diagnosis of / treatment for CVD

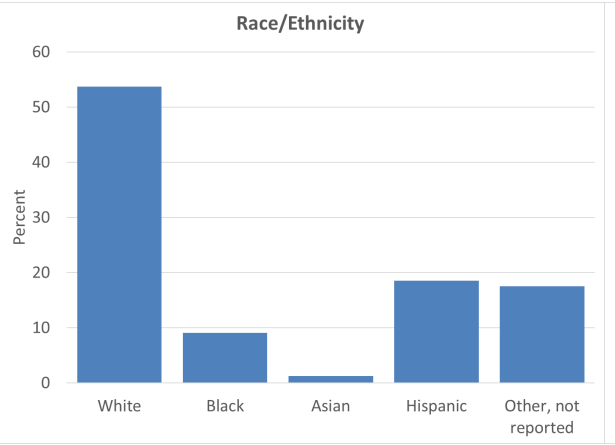
Methods: Statistical Analysis

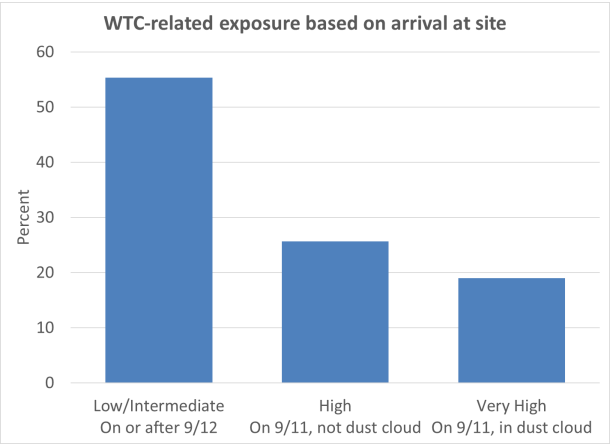
- Cox proportional hazards regression analyses
  - Outcome variable: Age to diagnosis primary CVD
    - Age at earliest diagnosis
  - Censoring (<17 years follow-up):
    - Cases: Age at the reported earliest post-9/11/2001 physician's primary CAD, MI, stroke or CHF diagnosis or treatment
    - Controls: Age at last monitoring visit
  - Adjusted and Sex-specific analyses
    - Race/ethnicity, Lifetime cigarette smoking, High cholesterol, Hypertension and Diabetes status, and Measured initial visit body mass index (BMI)
  - Additional analyses
    - Sensitivity analysis and recall bias review

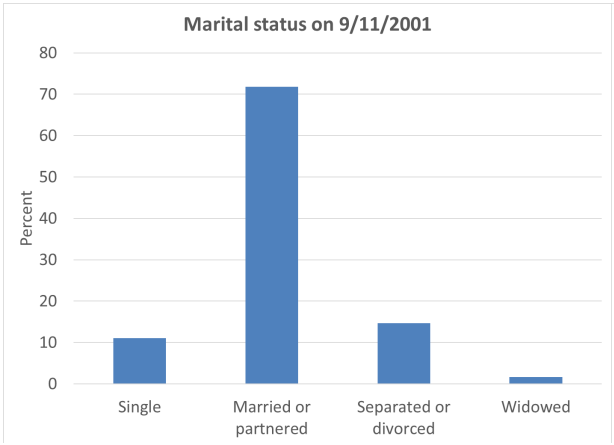
Key Findings: GRC Characteristics (n=37,725)

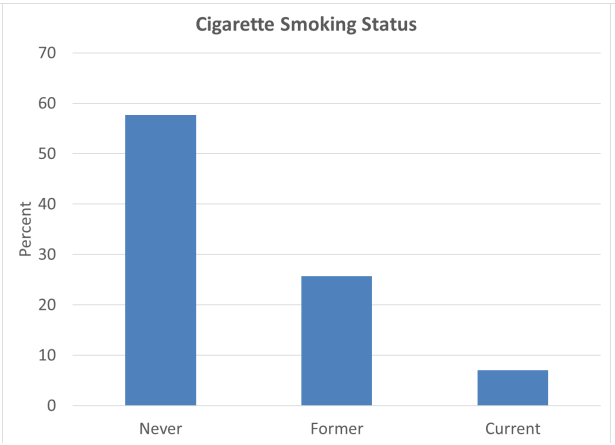


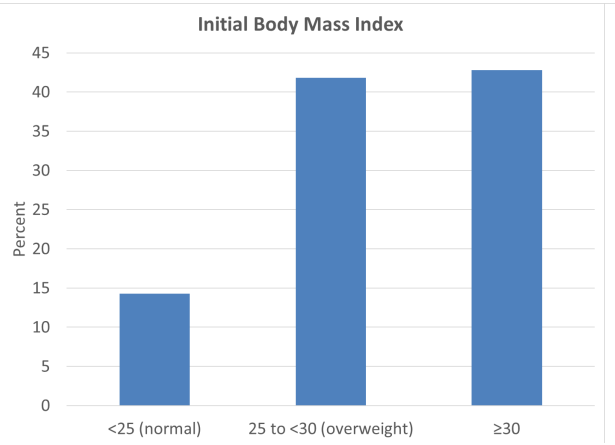


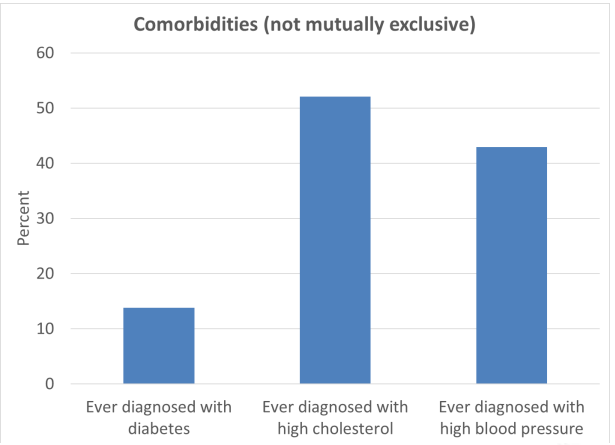












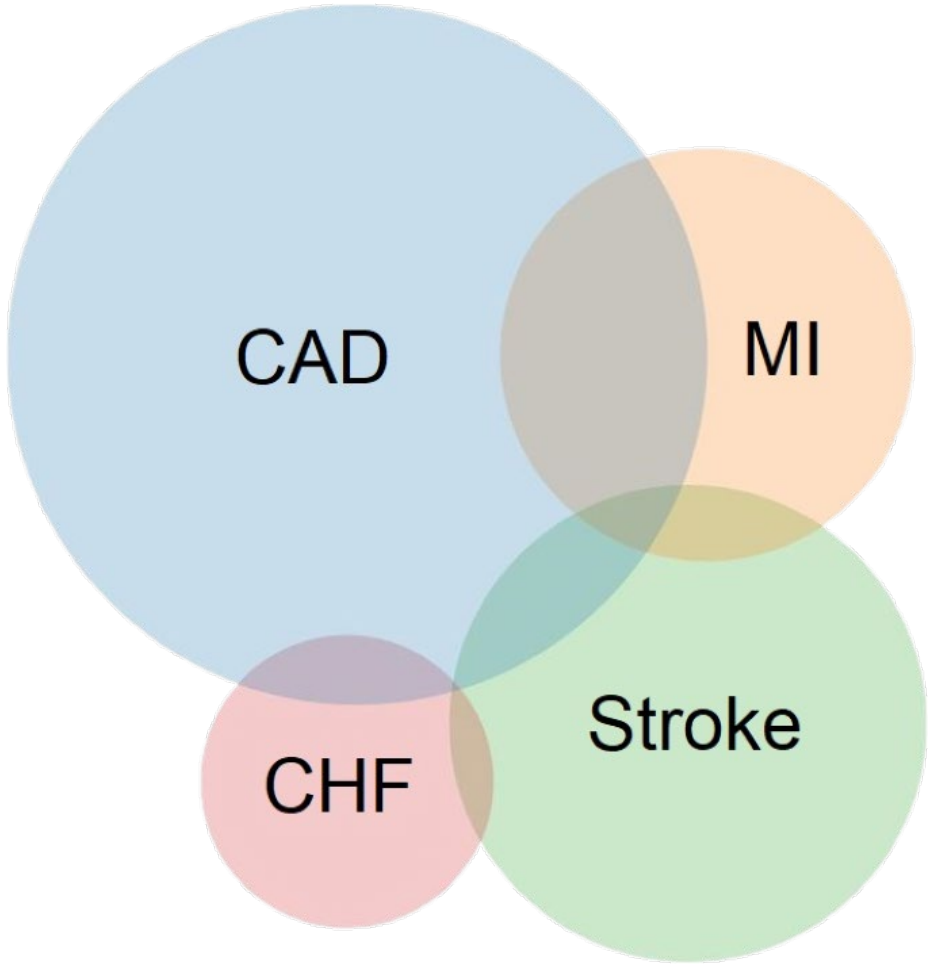
Key Findings: CVD prevalence

CVD (CAD, MI, Stroke, CHF) prevalence in WTC HP GRC[a]

	Diagnosed on/after 9/11								
	Men (*n* = 32,539)			Women (*n* = 5186)			Total (*n* = 37,725)		
	N	%	Age at diagnosis; mean (*SD*)	*N*	%	Age at diagnosis; mean (*SD*)	*N*	%	Age at diagnosis; mean (*SD*)
Coronary artery disease	1360	4.2	53.2 (8.6)	81	1.6	53.1 (9.9)	1441	3.8	53.2 (8.7)
Heart attack (MI)	476	1.1	52.3 (7.6)	26	0.5	54.4 (10.2)	502	1.3	52.4 (7.8)
Stroke	586	1.8	52.8 (9.6)	84	1.6	51.2 (10.6)	670	1.8	52.6 (9.7)
Congestive heart failure	226	0.7	51.3 (10.1)	27	0.5	49.5 (10.6)	253	0.7	51.2 (10.2)
Total reporting ≥1 CVD	2192	6.7	52.5 (8.8)	193	3.7	51.8 (10.4)	2385	6.3	52.4 (9.0)

Abbreviations: CAD, coronary artery disease; CHF, congestive heart failure; CVD, cardiovascular disease; GRC, General Responder Cohort; MI, myocardial infarction; WTCHP, World Trade Center Health Program.

Key Findings: Distribution of post 9/11 CVD



Responders with only one CVD condition		Total
Coronary artery disease (CAD)	1073	1441
Heart attack (MI)	192	502
Stroke	509	670
Congestive heart failure (CHF)	167	253
Any cardiovascular disease (CVD)		**2385**

Responders with two CVD conditions

	MI	Stroke	CHF
CAD	220	73	40
MI		47	12
Stroke			16

Responders with 3 or 4 CVD conditions	
CAD+MI+Stroke	18
CAD+MI+CHF	11
CAD+Stroke+CHF	5
MI+Stroke+CHF	1

Key Findings: CVD Risk and WTC-related exposure

	Men (n=32,539)				Women (n=5,186)			
	Race/ethnicity adjusted		Race/ethnicity and comorbidity adjusted		Race/ethnicity adjusted		Race/ethnicity and comorbidity adjusted	
Arrival date	**HR**	**95% CI**	**HR**	**95% CI**	**HR**	**95% CI**	**HR**	**95% CI**
9/12 or later	1.00	reference	1.00	reference	1.00	reference	1.00	reference
9/11, not in dust cloud	1.43	(1.29 - 1.58)	1.33	(1.20 - 1.47)	1.59	(1.11 - 2.27)	1.49	(1.04 – 2.13)
9/11, in dust cloud	1.40	(1.26 - 1.56)	1.29	(1.16 - 1.44)	2.16	(1.49 - 3.11)	2.17	(1.50 - 3.14)

Comorbidities: smoking status; body mass index; diabetes; high blood pressure; high cholesterol

Key Findings: CVD Risk and WTC-related exposure

additionally adjusted for protective services occupation

	Men (n=32,539)		Women (n=5,186)	
	Race/ethnicity and comorbidity adjusted		Race/ethnicity and comorbidity adjusted	
Arrival date	**HR**	**95% CI**	**HR**	**95% CI**
9/12 or later	1.00	reference	1.00	reference
9/11, not in dust cloud	1.24	(1.12 - 1.38)	1.25	(0.87 - 1.80)
9/11, in dust cloud	1.14	(1.02 - 1.28)	1.71	(1.17 - 2.48)
Occupation				
Protective services	2.07	(1.89 - 2.27)	2.81	(2.02 - 3.90)

Comorbidities: smoking status; body mass index; diabetes; high blood pressure; high cholesterol

Discussion

- Higher risks of CVD with 9/11/2001 exposures compared ≥ 9/12/2001
- Consistent with FDNY & Registry results
- Women's risk greater than men's
- 9/11/2001 Employment in protective services was associated with CVD, and attenuated the WTC exposure risks
  - no significant interaction between 9/11/2001 arrival & protective services occupation
- Associations of known CVD risk factors included as covariates were in the expected direction
- GRC CVD may be occurring at younger ages than expected
  - WTC HP GRC's average age at heart attack 52 years old
  - US population average age at heart attack is 64 (men) & 70 (women)

Potential Limitations

- The validity of self-reported CVD is imperfect
  - Effects may have been spuriously increased due to possible inaccuracy of CVD classification (usually over-estimated)
  - Exact date of CVD events were not always recalled; depending on available information, date was imputed or event was excluded
- Classifying heart murmur and other heart disease as non-cases and comparing high to low exposure may have attenuated the associations

Future Research Recommendations

- Obtaining electronic health record data on responder cardiovascular health to validate self-reported CVD diagnoses.
- Collection of diet and exercise information, both known CVD risk factors, to control for potential confounding in risk estimates.
  - Family history of CVD could also be collected
- Consider a pooled analysis of CVD incidence across the General Responders, FDNY and Registry cohorts.
- Consider investigating post 9/11 air pollution exposures as potential effect modifiers of the CVD risk associated with WTC-related.
  - Knobel, Pablo et al. “The Association of Air Pollution Exposure With Glucose and Lipid Levels: The Role of an Extreme Air Pollution Event Alongside 2 Decades of Moderate Exposure.” *American Journal of Epidemiology.* 2024. 193(1): 87-95. doi:10.1093/aje/kwad173

Acknowledgements

- We thank the WTC HP and Data Center staff, the labor, community, and volunteer organization stakeholders; and the WTC GRC who so readily and generously gave of themselves in response to the WTC terrorist attacks and to whom the WTC programs are dedicated.
- This study was supported by grant sponsor Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health; through cooperative agreements and contracts 200–2002- 00384, U10-OH008216/23/25/32/39/75, 200–2011-39356/61/77/84/85/88, and 200–2017-93325.


Thank You
gracias
danke
grazie
merci
takk
tak
grazzi
xièxiè
arigatô
obrigado
faleminderit
hvala
tänan
köszönöm
감사합니다
paldies
dankie
dank u
mahalo
tack
ngiyabonga
shukran
kiitos
teşekkür ederim
mulţumesc
choukrane
kop khun
diolch
terima kasih
dhanyavâd
ngiyabonga
ačiū
gràcies
dėkuju