

Emergency Duties & Deaths from Heart Disease among US Firefighters

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Background

- More than one million firefighters in US
- About 100 firefighters die each year on-Duty (1 in 10,000 per year)
- 1977-2006, CVD has caused ~45% on-Duty Deaths
- CHD ~40%

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US Firefighter Fatalities

45% Heart Disease

25% Motor Vehicle Related

12% Asphyxiation

18% Burns, Other Trauma, other

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Heart Deaths by Occupation

	% of On-Duty Deaths caused by CVD
Firefighters	45%
Police	22%
Overall*	15%
Construction	11.5%
EMS	11%

*Average % of all Occupational Fatalities, all industries

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Cohort Studies vs. Presumption Laws

- Definitive evidence of an increased CHD risk in Firefighters lacking.
- Based on ≥ 10 cohort mortality studies
Firefighters' risk of CHD Death
SMR of ~0.9
- High proportion of CHD deaths and recognition of Cardiovascular Stressors has led to "Heart Presumption" laws in 37 / 50 states and 2 Canadian Provinces

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Firefighters

- "hours of ... boredom punctuated by brief periods of intense, unpredictable, life-threatening action."
- "You don't need physical fitness very often, but when you do, the absence of fitness can have dire consequences for the individualand the public we are sworn to protect."

(Law Enforcement Wellness Association)

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On-Duty Events, Work-Related or Just happen at Work???

Potential Occupational Cardiovascular Stressors

Heavy Physical Exertion - on an Irregular Basis

> 50 lbs Personal Protective Equipment

Near Maximal-Maximal HR (at least 10 METS)

Heat Stress & Fluid losses

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Potential Occupational Cardiovascular Stressors

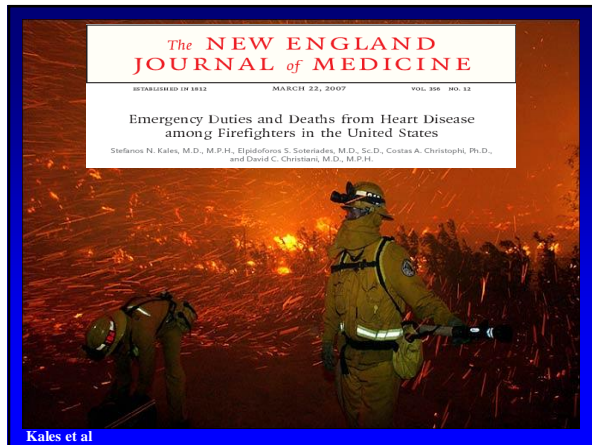
Smoke Exposure
CO, particulates, CN, other

Noise

Danger & Stress

Shift work

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U.S. Fire Administration: narrative summaries all US firefighting deaths 1994-2004 (n= 1144)

Excluded deaths associated September 11, 2001

Classified as cardiovascular or noncardiovascular

Excluded deaths more than 24 hours after the on-duty incident

Excluded cardiovascular deaths other than CHD

449 deaths due to CHD (39%).

Selected deaths classified according to the specific duty performed during onset of symptoms/ immediately preceding sudden death.

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Table 1. Deaths from Coronary Heart Disease among Firefighters, Classified According to Duty at the Time of Death.^a

Duty	Deaths (N= 449) no. (%)
Fire suppression	144 (32.1)
Alarm response	60 (13.4)
Alarm return	78 (17.4)
Physical training	56 (12.5)
Emergency medical services and other nonfire emergencies	42 (9.4)
Fire-station and other nonemergency duties	69 (15.4)

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Table 2. Fire Service Activity and the Estimated Proportion of Time Spent in Specific Firefighting Duties.^a

Variable	Municipal Fire Department	Large Metropolitan Fire Departments	National Data
Fire service activity			
Population served (no.)	101,355	760,935a888,916	280,000,000
Uniformed firefighters (no.)	274	1063a785	1,082,855a1,446
Population served per firefighter (no.)	370	655a218	259a3
Emergency incidents (no./firefighter/yr)	44	92a24	18a2
Fire incidents (no./firefighter/yr)	2.0	7.0a6.3	1.7a0.1
Duties (% of annual time)			
Fire suppression	2	5	1
Alarm response	6	9	4
Alarm return	10	15	7
Physical training	8	8	8
Emergency medical services and other nonfire emergencies	23	34	15
Fire-station and other nonemergency duties	51	29	65

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Table 4. Risk of Death from Coronary Heart Disease among Firefighters Engaged in Emergency Duties and Physical Training as Compared with Firefighters Engaged in Nonemergency Duties.*

Duty	Municipal Fire Department		Large Metropolitan Fire Departments		National Data	
	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value	Odds Ratio (95% CI)	P Value
Fire suppression	5.3 (4.0-7.2)	<0.001	12.1 (9.0-16.4)	<0.001	13.6 (10.1-18.3)	<0.001
Alarm response	7.4 (5.1-11.1)	<0.001	2.8 (1.9-4.0)	<0.001	14.1 (9.8-20.3)	<0.001
Alarm return	5.8 (4.1-8.1)	<0.001	2.2 (1.6-3.1)	<0.001	10.5 (7.5-14.7)	<0.001
Emergency medical services and other nonfire emergencies	1.3 (0.9-2.0)	0.16	0.5 (0.3-0.8)	<0.001	2.6 (1.8-3.9)	<0.001
Physical training	5.2 (3.6-7.5)	<0.001	2.9 (2.0-4.2)	<0.001	6.6 (4.6-9.5)	<0.001
Nonemergency duties (fire station and other)	1.0		1.0		1.0	

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Type of Duty	Kales et al 2003 (relative risk of CHD death)	Holder et al 2006 (relative risk of heart event leading to retirement)	Kales et al 2007 (relative risk of CHD death)
Fire suppression – OR** (95% CI)	64.1 (7.4-556)	51 (12-223)	53 (40-72)
Physical training – OR** (95% CI)	7.6 (1.8-31.3)	0.68 (0.2-2.7)	5.2 (3.6-7.5)
Alarm response – OR** (95% CI)	5.6 (1.1-28.8)	6.4 (2.5-17)	7.4 (5.1-11)
Alarm return – OR (95% CI)	3.4 (0.8-14.7)	0.37 (0.07-1.8)	5.8 (4.1-8.1)
EMS and other non-fire emergencies – OR** (95% CI)	1.7 (0.5-5.9)	0.75 (0.3-1.8)	1.3 (0.9-2.0)
Firehouse and other non-emergency activities – OR** (95% CI)	1.0	1.0	1.0

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Duty-related Risks: Interpretation

- **Fire Suppression:** Heavy Physical Exertion, > 50 lbs PPE, Near Maximal, Heat Stress & Fluid losses, Smoke Exposure, Danger & Stress
- **Training:** Risk concentrated in live-fire/simulation drills (exposures as above) & Physical testing in persons without adequate medical clearance.
- **Alarm Response:** "Fight or Flight" physiology with full cardiovascular arousal, Noise

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On-Duty CHD Death: Work-related? Conclusions

Both circadian and job activity data support that on-duty CHD death is often job-precipitated.

Events within a day of firefighting or onset during strenuous duty* resulting in cardiovascular arousal support work-relatedness.

* Does not include

Non-emergency duty, Most EMS work, Off-duty

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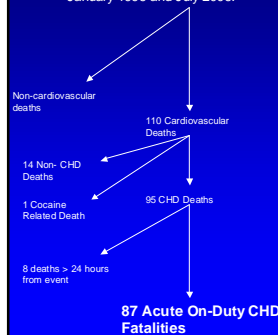
Predictors of On-Duty Coronary Events in U.S. Male Firefighters

JR Geibe, J Holder, L Peeples, AM Kinney, JW Burress, SN Kales

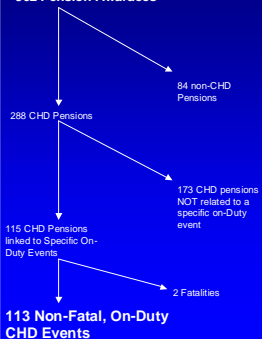
[Am J Cardiol in Press 2008]

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A. Fire Fighter Fatality Investigation and Prevention Program of NIOSH On-Duty Fatalities reported between January 1996 and July 2006.



B. Massachusetts Heart Disease Disability Pensions received between 1997 and 2004. 362 Pension Awardees



Variable	Non Fatal (n=113)	Fatal (n=87)	P-Value
Mean Age +/- SD* (years)	54.4 +/- 6.6	50.4 +/- 7.6	<0.001
Age Range (years)	33-66	29-69	N/A
Career Firefighters	113 (100%)	54 (63%)	<0.001
Mean Body Mass Index +/- SD (Kg/m ²)	30.3 +/- 5.7 (n=86)	31.3 +/- 6.2 (n=31)	0.447
Strenuous Duty at Time of Event	56/90 (62%)	66 (57)	0.648

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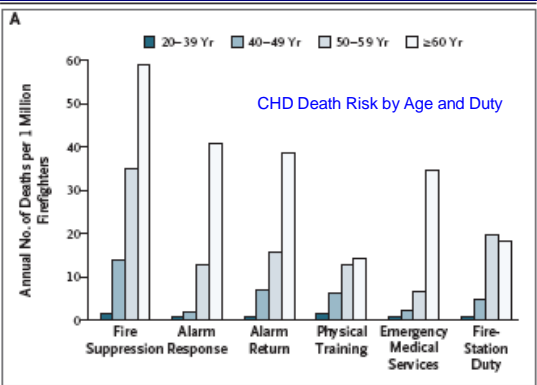
Variable	Non Fatal Events n=113	Fatal Events n=87	Odds Ratio for Fatal Event (95% CI)*
Age ≥ 45 years old	107 (95%)	68 (78%)	0.20 (0.08-0.53)
Current Smoking	27 (24%)	35 (40%)	2.14 (1.17-3.94)
Hypertension	55 (49%)	68 (78%)	3.77 (2.01-7.07)
Diabetes Mellitus	24 (21%)	12 (14%)	0.59 (0.28-1.27)
Total Cholesterol ≥/≤ 200 mg/dl	66 (58%)	54 (62%)	1.16 (0.66-2.06)
Prior Diagnosis of Coronary Heart Disease	20 (18%)	27 (31%)	2.09 (1.08-4.06)
Body Mass Index ≥/≤30	35/86 (41%)	19/31 (61%)	2.31 (1.00-5.35)

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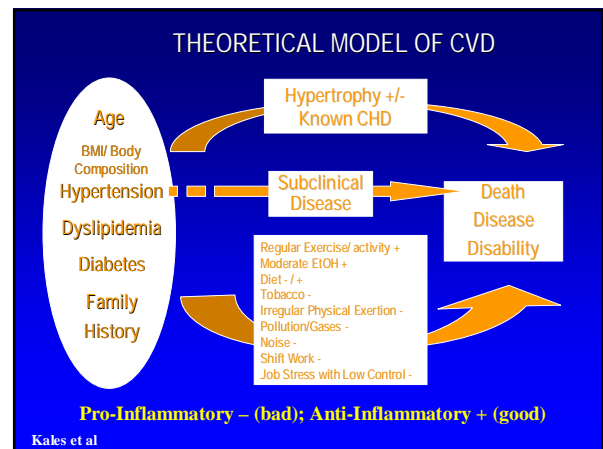
Variable	Multivariate Odds Ratio [‡] for Fatal Event (95% CI*)	P- Value
Current Smoking	3.68 (1.61, 8.45)	0.002
Hypertension	4.15 (1.83, 9.44)	<0.001
Total Cholesterol ≥/≤ 200 mg/dl	1.16 (0.53, 2.54)	0.72
Prior Diagnosis of Coronary Heart Disease	4.09 (1.58, 10.58)	0.004

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Multivariable-adjusted odds ratios for the association of risk factors and on-duty CHD [†] death.		
	OR [#] (95% CI) [§] *	
	Model 1	Model 2
	Age <60 [§]	Age <60 and no prior CHD diagnosis ^{‡‡}
Age ≥ 45 years old	6.5 (2.6 – 15.9)	6.2 (2.4 – 16.0)
Current Smoking	7.0 (2.8 - 17.4)	8.7 (3.3 - 22.5)
Hypertension	4.7 (2.0 - 11.1)	6.2 (2.4 – 15.7)
Diabetes Mellitus	2.0 (0.5 – 8.6)	2.4 (0.5 – 13.1)
Prior Diagnosis of CHD or other evidence of arterial-occlusive disease	15.6 (3.5 – 68.6)	-



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USA Today Wed, August 29, 2007

"Firefighters plagued by heart attacks get fitness challenge"

"I would rather fire you for your health than to go tell your wife or your mother that you're laying out here with a heart attack, dead"

Chief Jolley



Each quarter, Pelham-Batesville (SC) firefighters take a test that includes running, push-ups, sit-ups and a flexibility test.

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PREVENTION

1) Fitness Promotion:

Physical Standards not maintained; high prevalence of obesity (>33%); ~75% Nationally- NO fitness programs

--Mandatory exercise programs

--Nutrition programs

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PREVENTION

3) Risk Factor Reduction:

Low rates of HTN and lipid treatment

Data supports Smoking BAN

4) Exercise Testing:

Should be mandated >45 and sooner if excess risk factors, study needed to determine best protocols

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Proposed Management Scheme for Emergency Responders

BP	Action	Follow-up
Normal	Unrestricted Population-Based	Annual
Prehypertension	Unrestricted Individual Education	6-12 mos per other RF's
Stage 1 Hypertension	Time-limited Clearance Rx & Evaluation	3-6 months Expect improved BP
Stage 2 Hypertension	Restricted Rx & Evaluation	Time-limited Clearance after Adequate BP Control

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PREVENTION

5) RTW Protocols:

Need Occupational Medicine Clearance after Illness or Injury

6) Pre-Existing CHD:

Once CHD is diagnosed, most affected Firefighters should be removed from Emergency Operations

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Major Study Team Members 1996-2007

- Elpidoforos Soteriades, MD, MSc, ScD
- Jonathan Holder, DO, MPH
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- Ibe Mbanu MD, MPH
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- Antonios Tsismenakis
- David Christiani, MD, MPH, MS Professor & Director Occupational Health Program, HSPH

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