

**How do we move from Epidemiologic Evidence to
Prevention-oriented clinical cardiologic practice?**

The Need for Occupational Cardiology

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ESSENTIAL HYPERTENSION

- Approximately 1/2 of the adult population in industrialized countries has a persistently elevated BP >140/90mmHg by age 60
- Although risk factors such as age, obesity, alcohol intake etc., have been identified, these factors explain only a part of the risk
- The definition of essential hypertension remains:
PATIENTS WITH ARTERIAL HYPERTENSION AND NO DEFINABLE CAUSE

SUDDEN CARDIAC DEATH

- Most common mode of death among adults under the age of 65 in industrialized countries
- In the U.S. ½ of all cardiovascular mortality, 250,000 to 350,000 deaths/year
- Up to 50% had no previous history of known heart disease:

The first cardiac episode proves to be the last

Effect of Job Strain on Work Ambulatory BP in Men

- ***Cross-sectional analyses from Schnall et al. 1998

Effect of Job Strain on Work Ambulatory BP in Men

- ***Exposure at T1 & T2, from Schnall et al. 1998

Population Attributable Risk % for Elevated BP due to Job strain

Study Population	Study years	Job strain Exposure	RR	PAR%
New York City Men	1985-1988	21%	2.8	27.4

**Source: Schnall PL, Belkic KL, Landsbergis PA, Baker D (eds). Occupational
Medicine State of the Art Reviews 2000; 15(1).**

Elements of Causal Inference on the Relation between Exposure to Job Strain and Elevated AmBP

***Maybe revise as per review paper

--Studies that measure ambulatory blood pressure and examine averaged BP's during work, as well as other periods, show strong, consistent effects of job strain or its major dimension(s) on blood pressure.

--Some evidence: though not totally consistent, of a dose-response relationship with respect to ambulatory blood pressure and exposure to increasingly severe degrees of job strain.

--Cohort data demonstrates not only the expected temporal relationship between exposure and outcome but also the effect of cumulative exposure

--Biologically plausible

--Observational data indicate that a decrease in exposure to job strain is associated with a decrease AmBP

Other Potential Work-Related Pressors

Direct Epidemiologic Evidence

(+ in some cases Physiologic Evidence):

- Effort-Reward Imbalance
- Long Work Hours
- Shift Work
- Noise
- Lead
- Arsenic

High Risk Occupations for Hypertension

- Urban Transit Operators
- Truck Drivers
- Air Traffic Controllers
- Sea Pilots

Physiologic & indirect epidemiologic evidence:

- Threat Avoidant Vigilant Activity

Physiologic Evidence:

- Cold
- Heavy lifting
- Glare Exposure

Job Strain and Risk of MI

- Swedish men 45-65 y.o.
- N=1047 cases,
- N=1450 population controls
- First Hospitalized and/or fatal MI
- Exposure to high job strain quartile

Working men:

RR=2.2 (95% CI=1.2- 4.1)

Manual workers:

RR=10.0 (95% CI=2.6- 38.4)

Hallqvist J et al. Soc Sci Med 1998; 46: 1405-1415.

(Adjusted for hypertension, smoking, BMI)

Consistency of Data & Underestimation—Job Strain & CVD

***As per Abstract and Review Paper--Do

Effort-Reward Imbalance and MI

RH

N=2297 Eastern
Finnish men
(42-60 y.o.)

High Demands,
Low Resources, Low Reward

2.3 (95% CI=1.2 – 4.4)

8.1 year follow-up

(Adjusted for age, alcohol, smoking, physical activity)

Lynch J, et al. Am J Public Health 1997.

Shift Work and Risk of MI

	Shift Work vs. Day Work	OR
N=2006 cases N=2642 controls (population-based)	Men 45-55 y.o.	1.6 (95%CI=1.1 - 2.4)
	<u>Women</u> 45-55 y.o.	3.0 (95%CI=1.4 - 6.5)

(Adjusted for smoking, job strain, educational level)

Risk of Incident CHD among Urban Mass Transit Operators

- N=103 middle-aged male mass transit drivers in Gothenburg
- N=6596 men from other occupational groups
- 11.8 year follow-up
- Incident CHD=Disease Endpoint
- Urban Mass Transit Driving

OR= 3.0 (95% CI=1.8 – 5.2)

(Adjusted for age, serum cholesterol, blood pressure, smoking, body mass index, diabetes, positive parental history of CHD, physical activity and socio-demographic factors)

Rosengren A, et al. Int J Epidemiol 1991; 20:82-87.

Septadian Variation in Sudden Cardiac Death and Acute MI

- Among 3983 men without manifest IHD, an excess proportion of sudden deaths, but not MI or cancer deaths was found on Mondays (1).
- In a study of 5596 consecutive events among the population of Augsburg, Germany (Monica Study), a weekly variation in the occurrence of acute MI with a peak on Mondays found among working patients, but not among those who were not employed at the time of MI. A similar trend was not found for sudden cardiac death(2).

(1) Rabkin et al. JAMA 1980; 44: 1357-1358.

(2) Willich SN et al. Circulation 1994; 90:87-93.

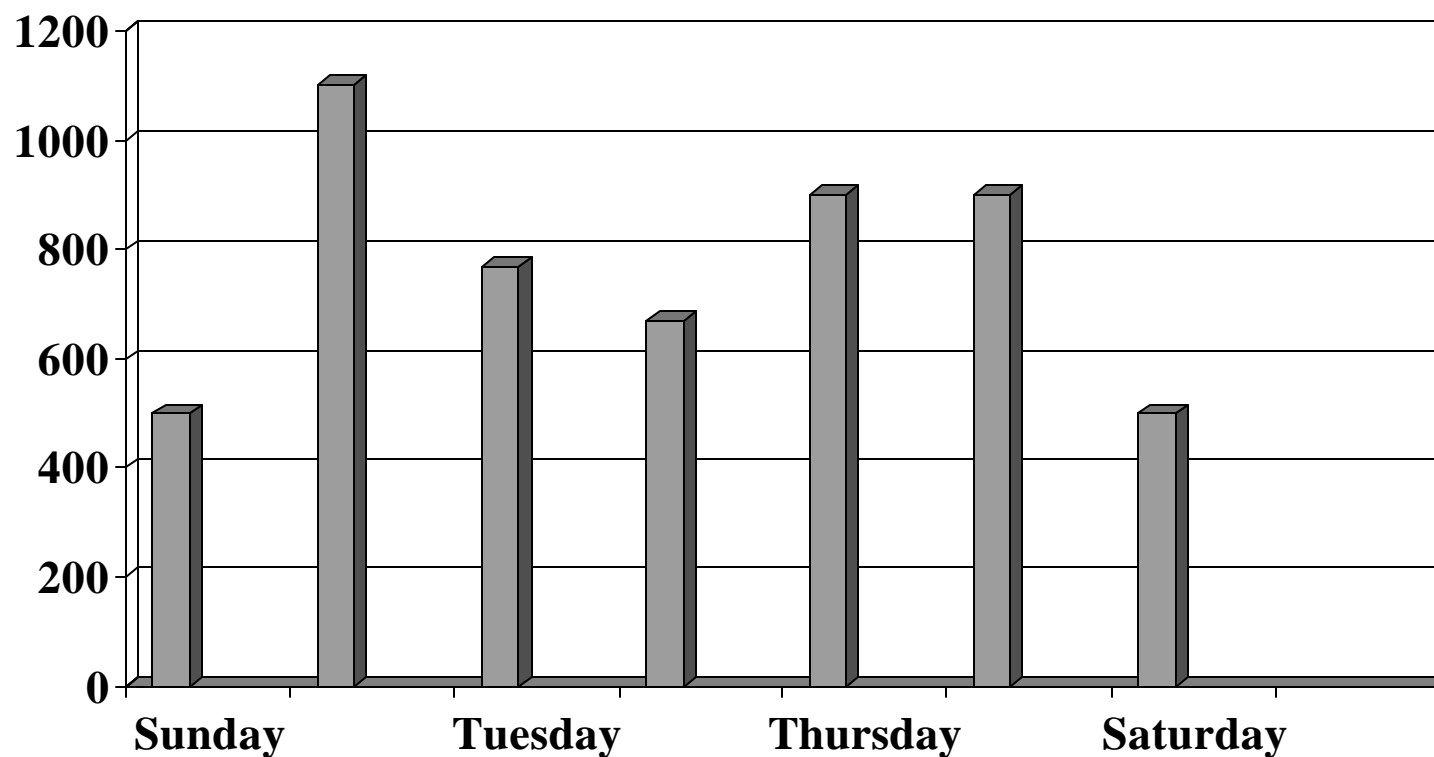
Sudden Cardiac Death at Work

- An investigation of coroner's reports in an industrial county reveals twice the annual age-adjusted rate of sudden death at work compared to that of fatal work injuries

Robinson CC, et al. Am J Epidemiol 1988; 128: 806-820

Septadian Distribution of Life-Threatening Arrhythmias (AICD Activation)

Peter RW et al. *Circulation* 1996; 94: 1346-1349



Cardiac Events: Sudden Cardiac Death or MI on Mondays

- "The stress of work after a weekend of respite may have been the precipitant of a lethal arrhythmia"(1)
- "An increase in physical and mental burden from leisurely weekend activities to stressful work on Monday in the majority of working patients" could have been causally related to the occurrence of acute MI (2)

(1) Lown B Circulation 1987; 76 (Suppl I):I-186-I-195.

(2) Willich SN et al. Circulation 1993; 87:1442-1459.

Major Stress-Mediated Mechanisms of Cardiac Electrical Destabilization

- Sympathetic Overdrive ↑ automaticity, ↑ triggered activity, reentry, catecholamine damage
- Other Autonomic Imbalances

PSP versus SP, R versus L sympathetic ganglia

- Increased Left Ventricular Mass
↑ automaticity, ↑ early & late triggering, reentry
- Acute Myocardial Ischemia

Acidosis → ↑ automaticity, slowed conduction → reentry,

Reflex sympathetic overdrive

Karoshi

- "Sudden death from ischemic heart disease or cerebrovascular disease due mainly to physiologically demanding work conditions, such as long working hours or shift work.
- *Karoshi* may be thought of as an occupational sentinel health event"

Shimomitsu T, Odagiri Y. Occupational Medicine State of the Art Review 2000; 15: 280-281.

Convergent Validation

- "Taken as a whole, the large body of empirical data confirms the relation of workplace factors to hypertension and ischemic heart disease. The theoretical constructs of how workplace factors affect the development of hypertension and IHD, together with a rich store of mediating biological mechanisms by which social factors such as work stress are perceived and processed by the central nervous system, and can lead to cardio-deleterious changes, provide convergent validation for the conclusion that environmental stressors from the workplace play an important role in the development of cardiovascular disease"

Current Trends in Working Life

- Increasing job demands
- Longer working hours
- Job instability

- In 1996, 23% of employed Europeans worked more than 45 hours/week and those working under time constraints increased markedly from 1977 to 1996 (1)
- In the US, the average number of hours workers per week rose by 3.5 hours from 1977 to 1997, being now 47.1 hours/week (2)

(1) Walters D. Int J Health Services 1998; 28:305-331, (2) ILO 1999, Geneva.

Implications of these Trends for Cardiology

- These trends suggest that work-related hypertension and IHD will become an increasingly important problem in the years to come
- The clinician is often called upon to judge the cardiovascular work fitness of patients. Given the rising prevalence of working conditions that are potentially harmful to the cardiovascular system, this type of judgment will be ever more frequently sought, and ever more difficult to render
- Further complicating the issue is that the very jobs in which public safety could be compromised with the occurrence of an acute cardiac event, are often those in which exposure to potentially cardio-deleterious factors is the greatest

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Fitness of the Work Environment

- Cardiologists and other clinicians caring for patients with hypertension or ischemic heart disease are routinely called upon to make a judgment about the cardiovascular work fitness of their patients
- Unfortunately, however, the more fundamental question has rarely been posed in the clinical context: *Is the work environment fit, or conducive to cardiovascular health?*

The Clinician's Challenge:

- *To offer the cardiac patient a style of life and of work that protects both his or her health and right to be productive.*
- *In order to achieve the aforementioned goal, understanding of the job and the work environment, in addition to a functional evaluation of the patient, is absolutely essential.*

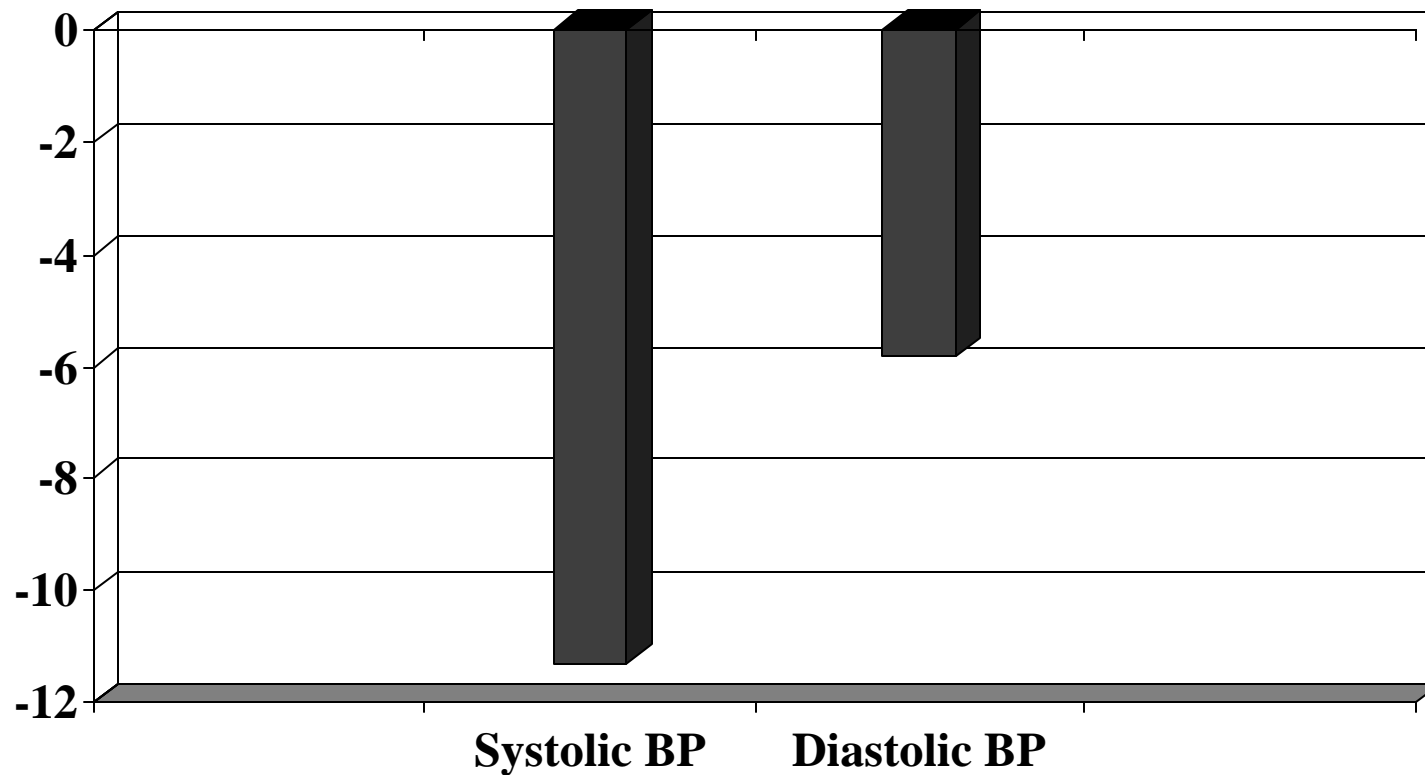
Exposure to Job Strain in Prognosis of Young Men post-MI

- A 5-year follow-up of 79 men who had survived a first MI before age 45, return to work at a high strain job was a significant, independent predictor of IHD-related mortality. The predictive strength of return to high strain work was of comparable magnitude to degree of angiographically assessed coronary atheromatosis, and more powerful than left ventricular ejection fraction. This finding remained robust after adjustment for standard cardiac risk factors. (1)
- *”Should heart attack patients return to stressful jobs?”* (2)

(1) Theorell T, Perski A, et al. Int J Cardiology 1991; 30: 61-67,

(2) Theorell T, Karasek R. Stress Medicine 1995; 11: 219-220.

Adjusted Change in WorkAmBP among NYC Men with Hypertension
(N=10) initially exposed to Job Strain, and not exposed 3 years later
(Schnall et al. Psychosom Med 1998; 60: 697-706.)



Diagnostic Classification of Hypertension using Casual versus AmBP in a Sample of 267 Working Men*

Casual Diastolic BP taken at the Work Site Clinic	Work Site Diastolic BP Ambulatory		Total (N)
	>85mmHg (N)	< = 85mmHg (N)	
>85mmHg	59	27	86
< = 85mmHg	36	145	181
Total	95	172	267

*From The Work Site Blood Pressure Study
(Schnall et al. JAMA 1990)

Occult Workplace Hypertension: The False Negatives

- ***Liu data

Clinical Implications of Misclassification

- **Type I errors: false positives**
(*White Coat Hypertension*)
- Unnecessary treatment

- **Type II errors: false negatives**
(*Occult Workplace Hypertension*)
- Failure to treat individuals at high risk with elevated worksite AmBP

The Occupational Sentinel Health Event Concept

conveys three important and related notions:

- First, it is useful as a heuristic device to allow health care providers and public health authorities to sort through health events of individuals and populations to determine a priori which health events and patterns of health events are most likely to be caused by occupation factors, given current knowledge.
- Second, the sentinel health event concept transforms the health problems of individuals into the potential health problems of populations. To recognize the diagnosis of an occupational disease in an individual as a sentinel health event facilitates the identification of others at the workplace who are also ill or who may become ill if exposure continues.
- Third, the occurrence of a sentinel health event may signify the failure of a system to control known occupational hazards and thereby to prevent cases of unnecessary occupational disease"

(Markowitz SB. The role of surveillance in occupational health, 1998, p. 20).

In the most recent list of OSHE, cardiovascular diagnoses are nowhere included!

Occupational Cardiology--A link between Primary Cardiology and Occupational & Preventive Medicine

Tasks Ahead

- Further refining our knowledge of the role of workplace stressors in the etiology of hypertension and various manifestations of CVD, and dissemination of that information to clinicians
- Furthering clinical acumen in taking and interpreting an occupational history, as it relates to the cardiovascular system.
- Formulating, testing and validating algorithms and guidelines for the diagnosis and management of work-related hypertension and relevant cardiovascular diseases and pre-pathologic conditions,
- Promoting cooperation with other key participants such as occupational health psychologists and other occupational health specialists and epidemiologists, as well as labor and management,
- Further empowering the physician to formulate and implement changes to help create a “heart healthy” workplace,
- Developing educational programs to integrate these skills and knowledge into specialty and continuing education training in cardiology; and
- Providing needed legislative and policy support for these goals.

Overall, the further development of Occupational Cardiology would be a vehicle for achieving the goal of moving from epidemiological evidence to prevention-oriented clinical practice.