Cross-sectional Association of Job Strain and Systolic Blood Pressure, Framingham Offspring Study, 1985-88

Controlling for age, body mass index, alcohol use and education

*p<.05
Why greater effect of job strain if low SES?

- In NYC BP study
  - smoking, BMI, job physical exertion, shiftwork controlled in analysis

- Hazards faced by lower SES workers
  - cardiotoxic chemicals, noise
  - other job stressors: effort-reward imbalance, threat-avoidant vigilant work, job insecurity
  - life stressors: unemployment, crime, deteriorating urban physical and social environment, low & decreasing economic rewards
  - psychological effects of these stressors: anger, depression
  - unhealthy behaviors: less exercise

- Resources, buffers available to higher SES workers
  - money, knowledge, power, prestige, social support, social network
  - exercise facilities, better housing, nutrition, and medical care

Job demands-control model: predictions for illness and behavior

Source: Karasek 1979.
3-Year Change in Smoking Prevalence and Job Decision Latitude

<table>
<thead>
<tr>
<th>Smoking</th>
<th>Time 1 (baseline)</th>
<th>Time 2 (3 years)</th>
<th>Change in Job Decision Latitude</th>
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<tbody>
<tr>
<td>Yes</td>
<td>Yes (n=27)</td>
<td>+1.5</td>
<td></td>
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<tr>
<td></td>
<td>No (n=13)</td>
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<tr>
<td>Yes</td>
<td>Yes (n=7)</td>
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<tr>
<td>No</td>
<td>No (n=142)</td>
<td>-0.3</td>
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F=4.37 (8,180), p=.005

(Controlling for age, race, education, marital status, and number of children at home)

## Job stressors and sedentary behavior

(Sweden population survey)

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>OR#</td>
<td>p</td>
</tr>
<tr>
<td>Psychological demands</td>
<td>--</td>
<td>ns</td>
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<tr>
<td>Monotonous work</td>
<td>1.31</td>
<td>.15</td>
</tr>
<tr>
<td>Learning opportunities</td>
<td>-1.51</td>
<td>.04</td>
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<tr>
<td>Work process control</td>
<td>-1.25</td>
<td>.09</td>
</tr>
<tr>
<td>Social interaction</td>
<td>-1.60</td>
<td>.001</td>
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</table>

# Top vs. bottom decile Odds Ratio, controlling for age and education

Effort-reward imbalance (ERI) at work and co-occurrence of lifestyle risk factors (RF)  
N=36,127 public employees in Finland

BMI ≥ 25, current smoking, heavy drinking, physical inactivity:

ORs fully adjusted with ERI scores at organizational level

<table>
<thead>
<tr>
<th></th>
<th>women</th>
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<tbody>
<tr>
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<td>1 vs. 0 RF</td>
<td>2 vs. 0 RF</td>
<td>3 vs. 0 RF</td>
<td></td>
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<tr>
<td>low ERI</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td>intermediate</td>
<td>0.98</td>
<td>1.07</td>
<td>1.02</td>
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<tr>
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<td>1.25</td>
<td>1.44</td>
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<table>
<thead>
<tr>
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<tr>
<td>intermediate</td>
<td>0.99</td>
<td>0.99</td>
<td>1.00</td>
<td></td>
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<tr>
<td>high ERI</td>
<td>1.06</td>
<td>1.22</td>
<td>1.36</td>
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</table>

How can we do about this problem?
Interventions: what is being changed?

**Primary prevention**
- Social change

**Organizational change**
- Job redesign

**Secondary prevention**
- Individual coping

**Tertiary prevention**
- Individual Tx, rehab

**Economic, political context**
- Downsizing
- Contingent work
- New systems of work organization

**Organizational context**
- Low job control
- High job demands
- Social isolation

**Job characteristics**
- Physiological effects (e.g., BP)
- Psychological effects (e.g., burnout)
- Health behaviors

**Stress response**
- Illness
How do we go about changing it?

Legislation, regulation, workers compensation

Employer initiated policies, programs, downsizing; Collective bargaining

Employer initiated job redesign, supervisor training, participatory ergonomics, Joint L-M S&H committees

Health promotion, EAPs

Stress management

Tx, Rehabilitation

Economic, political context

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Illness
Why not solely stress management?

Benefits seen, but….

- Limited follow-up (only 23% > 6 months)
  - Are benefits maintained?

- Benefits seen also in control groups
  - Example: 20 BP studies: Avg. drop in systolic BP =
    - 7.8 mm Hg (stress mgmt groups)
    - 4.9 mm Hg (control groups)

- About 1/3 of participants failed to learn techniques
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Illness
Copenhagen Healthy Bus project

- Action research project, 1999-2004
  - >200 interventions to improve health, well-being and work environment of 3,500 Copenhagen bus drivers
  - Labor-management-researcher cooperation

- Evaluation
  - Quantitative and qualitative assessments
  - Improvements in stress measures, job characteristics, and lifestyle
  - Typical problems such as stress and physical hazards remain

Tuchsen et al. Unpublished manuscript.
Copenhagen Healthy Bus project
examples of interventions

- **Job characteristics/work organization**
  - Test more flexible schedules
  - Meet drivers wishes on rotation, typical and holiday schedules
  - Better communication between management and drivers

- **Life style**
  - Smoking cessation, healthy diet courses
  - Fresh fruit available in garage

- **Competence/education**
  - Education of managers in personnel mgmt and communication
  - Courses on handling threats & violence; “know your bus”

- **Physical work environment**
  - More resources for bus preventive maintenance
  - Joint labor-management meetings
Copenhagen Healthy Bus project: changes from baseline (1999-2000) to follow-up (2003-4)

Tuchsen et al. Unpublished manuscript.
Dutch manufacturing employees

Intervention (3 years)

- Individual-level
  - Exercise
  - Health fair, health education
  - Training in social skills and leadership

- Organizational-level
  - Support for lifestyle improvement
    - exercise facility
    - smoking policy + healthier food for cafeteria
  - “Task group” of workers given greater authority over production
    - Greater task variety, job rotation
    - Training
    - Reorganization of production line (to improve ergonomics)

Results (intervention, n=134 vs. control, n=130)

- Greater perceived “job control”, reduced “job demands”
- Improved ergonomics
- Reduced cardiovascular risk
- Reduced absenteeism
  - from 15.8% to 7.7% (intervention)
  - From 14.3% to 9.5% (controls)

Swedish government office workers

Intervention (8 months)

- Education program
- Relaxation training
- Worker committees developed “action plans” (job conditions to be improved, proposed actions, responsible individuals, time table, priority), held weekly meetings

Groups

- 4 intervention groups (n=94); 1 control group (n=35)

Swedish government office workers
Work stimulation and autonomy

<table>
<thead>
<tr>
<th></th>
<th>March</th>
<th>October</th>
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<tbody>
<tr>
<td>Intervention</td>
<td>3.41</td>
<td>3.53</td>
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<tr>
<td>Controls</td>
<td>3.59</td>
<td>3.56</td>
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</table>

Swedish government office workers
Supervisor support

<table>
<thead>
<tr>
<th>Month</th>
<th>Intervention</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>2.07</td>
<td>2.57</td>
</tr>
<tr>
<td>June</td>
<td>1.93</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>2.19</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Swedish government office workers
ApoB/ApoAl Ratio

Job Strain change and 3-yr Work Ambulatory BP change (n=195 men, Time 1-2)

Strain-T1: no no yes yes no no yes yes yes
Strain-T2: no yes no yes no yes no yes yes

Systolic AmBP

Diastolic AmBP

controlling for age, race, body mass index, smoking, alcohol use, work site

*p<.05, **p<.01, (vs Ref group)

How do we go about changing it?

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Health promotion, EAPs Stress management Tx, Rehabilitation

Economic, political context

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Illness
Systems of work organization

- Lean production (Japanese production management)
  - Total quality management
  - Quality circles
- Team concept
- Modular manufacturing
- Reengineering, restructuring
- Socio-technical systems
  - Self-directed worker teams (control pace, content)
  - Longer cycle time
  - More flexible work organization
- High-performance work organizations

Physiological impact of more flexible work organization

Swedish auto assembly-line workers

(36 men, 29 women)

Compared traditional assembly-line to:

More flexible work organization (socio-technical)

Figure 5. Epinephrine excretion during work at the assembly line and the flexible form of work organization.
Relief man, passing, relief man, passing!
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Stress response

Physiological effects (e.g., BP)
Psychological effects (e.g., burnout)
Health behaviors

Illness
Downsizing and 7.5 yr CVD mortality
(22,430 Finnish municipal workers, age 19-62, in 4 cities)

Personnel decrease in each occup. group in each city:

<8% (ref)  8-18%  >18%

Adjusted for age, sex, SES, type of employment; *p<.05; p(trend) <0.043

Collective bargaining

- Staffing; flextime; rest breaks
- SF hotel cleaners – workload quotas
- Labor-management programs
- NY state hospitals – workplace violence prevention programs
- Family friendly programs
  - childcare, eldercare, family leave, flextime
- Need to evaluate such programs for worker health impacts
- 30-day heart attack death rate in California hospitals with an RN union was 6.8% lower than non-union hospitals
  - adjusted for many hospital variables (including annual discharges, MD ratios, hospital size, cardiac Tx services, teaching hospital, urban-rural)

How do we go about changing it?

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Illness
Legislative & regulatory efforts

- **U.S. ergonomic regulations (rescinded in 2001)**
  - Rest breaks, task variability, job rotation/enlargement, work pace, job design

- **U.S. state legislation**
  - Minimum staffing levels (nurses)
  - Bans on mandatory overtime (health care workers)

- **Swedish Work Environment Act (1977)**

- **European Union directive (12 June 1989)**
  - Alleviate monotonous work at predetermined pace to reduce health effects


- **European labor-management agreement (8 October 2004)**
  - Includes work-related stress and its causes among risks to be prevented
  - Employers’ responsibility; workers’ participation in implementation
Newer programs to reduce cardiovascular risks due to job stressors

- Integrate health promotion/occupational health
  - WellWorks Project - 24 Massachusetts worksites
    - When workers aware of employer changes to reduce workplace hazards → more likely to participate in smoking cessation, nutrition, workplace hazard activities

- Occupational medicine clinics
- Occupational cardiology
- Worksite surveillance programs
Occupational and Environmental Medicine Clinics

- Prevention or early detection of work and environmentally-related disease
- Interdisciplinary team approach
- Variety of services
  - Patient education
  - Industrial hygiene
  - Ergonomics
  - Social work, support groups
  - Research
Occupational and Environmental Medicine Clinics

Integrate occupational health and health promotion in daily practice

- Personal health education
  - smoking cessation
  - primary care MD follow-ups
- Occupational health education
  - work environment role in disease causation, prevention and Tx
- As a result
  - atmosphere of trust
  - patients more responsive and engaged

New goal: Diagnose and treat work stress-related disease
Occupational Cardiology

link cardiologists, CV health promotion experts and occupational health specialists to:

- Conduct work site screening/surveillance
  - For risk factors, such as hypertension
  - Exposure to job stressors (and changes over time)
  - High risk occupations
- Include occupational Hx in standard cardiologic work-up
- Develop RTW guidelines for cardiac patients
  - including workplace modifications
- Expand use of ambulatory monitoring techniques

Ambulatory (Upper Arm) Blood Pressure (ABPM) Monitoring (“gold standard”)

- Monitor automatically measures BP at preset intervals (can monitor for 24+ hrs)
- Validity improved due to:
  - Repeated measures
  - Patients go about normal activities
- ABPM predicts cardiovascular morbidity better than clinic BP
- Expensive
  - Alternative: wrist monitor

Hidden (“occult”) hypertension

- Normal clinic (office) BP
- + elevated ambulatory BP
Hidden ("occult") Hypertension is associated with higher LV Mass & more carotid plaque.

### Prevalence of hidden ("occult") hypertension if normal clinic BP

<table>
<thead>
<tr>
<th></th>
<th>Prevalence</th>
<th>Cutpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td><strong>MEN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mt. Sinai Work &amp; Health study</td>
<td>10.3%</td>
<td>3/29</td>
</tr>
<tr>
<td>Mt. Sinai Work &amp; Health study</td>
<td>5.9%</td>
<td>2/34</td>
</tr>
<tr>
<td>NYC Work Site BP study</td>
<td>20.6%</td>
<td>36/175</td>
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<tr>
<td><strong>WOMEN</strong></td>
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<tr>
<td>Mt. Sinai Work &amp; Health study</td>
<td>12.3%</td>
<td>13/106</td>
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<tr>
<td>Mt. Sinai Work &amp; Health study</td>
<td>6.0%</td>
<td>7/117</td>
</tr>
<tr>
<td>Kent Ohio residents</td>
<td>27.2%</td>
<td>28/103</td>
</tr>
</tbody>
</table>


Hidden ("occult") hypertension

- Requires:
  - Counseling
  - Treatment
  - Workplace stressor assessment
  - Workplace intervention

- However, patients do not often receive these because their office BP appears normal.

- Current screening for hypertension inadequate
Summary of prevention strategies

- Integrate health promotion/occupational health
  - Workplace policies on exercise, smoking, nutrition
  - Suggest stress management
  - Suggest work-family (childcare, flexible schedules, family leave)
  - Suggest job redesign, career ladders, worker participation

- Educate labor and management
  - Present this research
  - Document health ins. costs of HTN, HD, sick leave, psych

- Worksite screening/surveillance programs
  - Ambulatory monitoring for high BP
  - Identify job stressors, high risk jobs
  - Work with labor-management safety & health committees

- Evaluate on-going work site changes
  - Staffing & O/T rules, contract provisions, downsizing
For Further Information

- NIOSH
  http://www.cdc.gov/niosh/topics/stress/

- Center for Social Epidemiology
  http://www.workhealth.org

- Job Content Questionnaire (JCQ)
  http://www.uml.edu/Dept/we/jcq/htm

- International conference on Work Environment and Cardiovascular Disease, March 9-11, 2005, Newport Beach, CA
  http://www.coeh.uci.edu/ICOH/