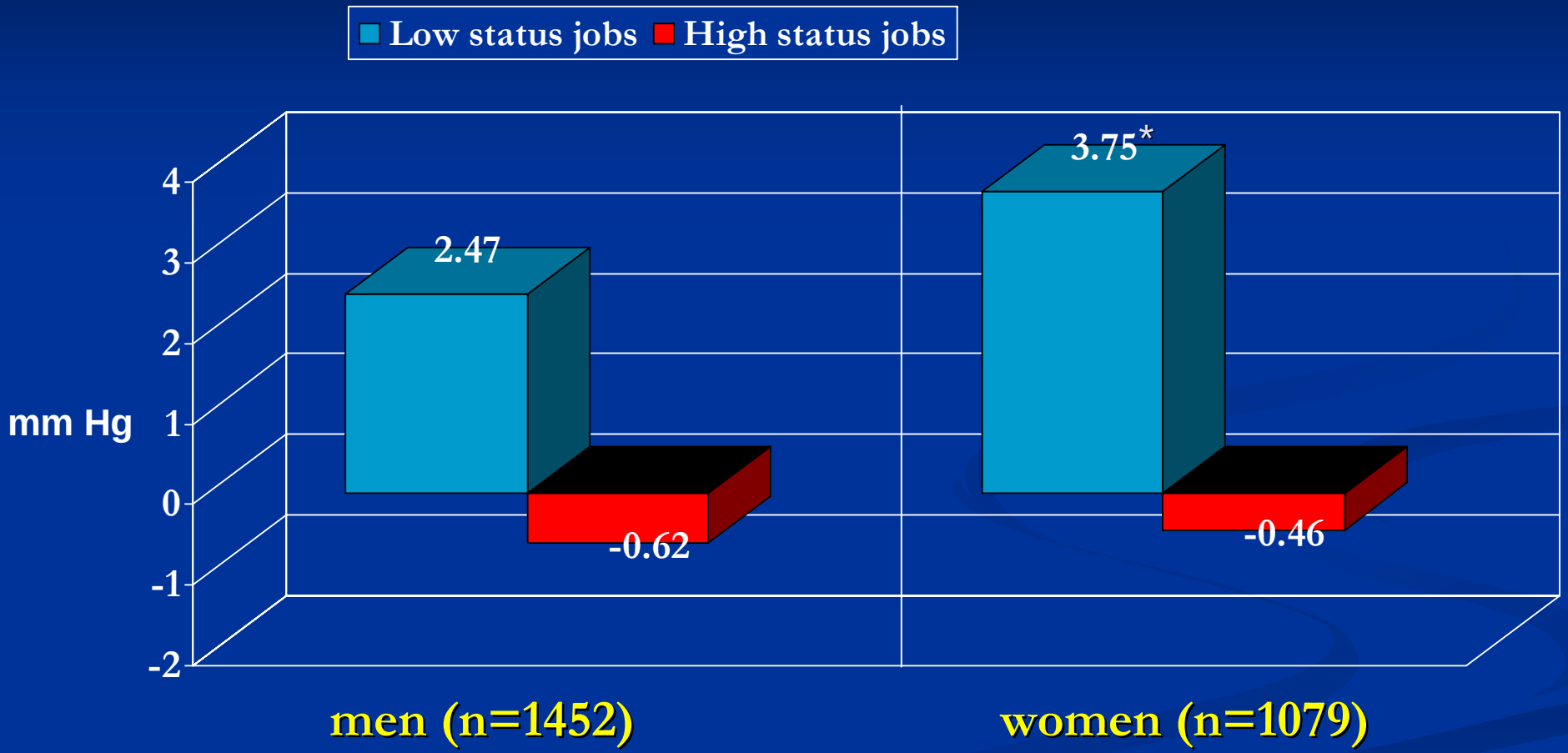
Cross-sectional Association of Job Strain and Systolic Blood Pressure, Framingham Offspring Study, 1985-88



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

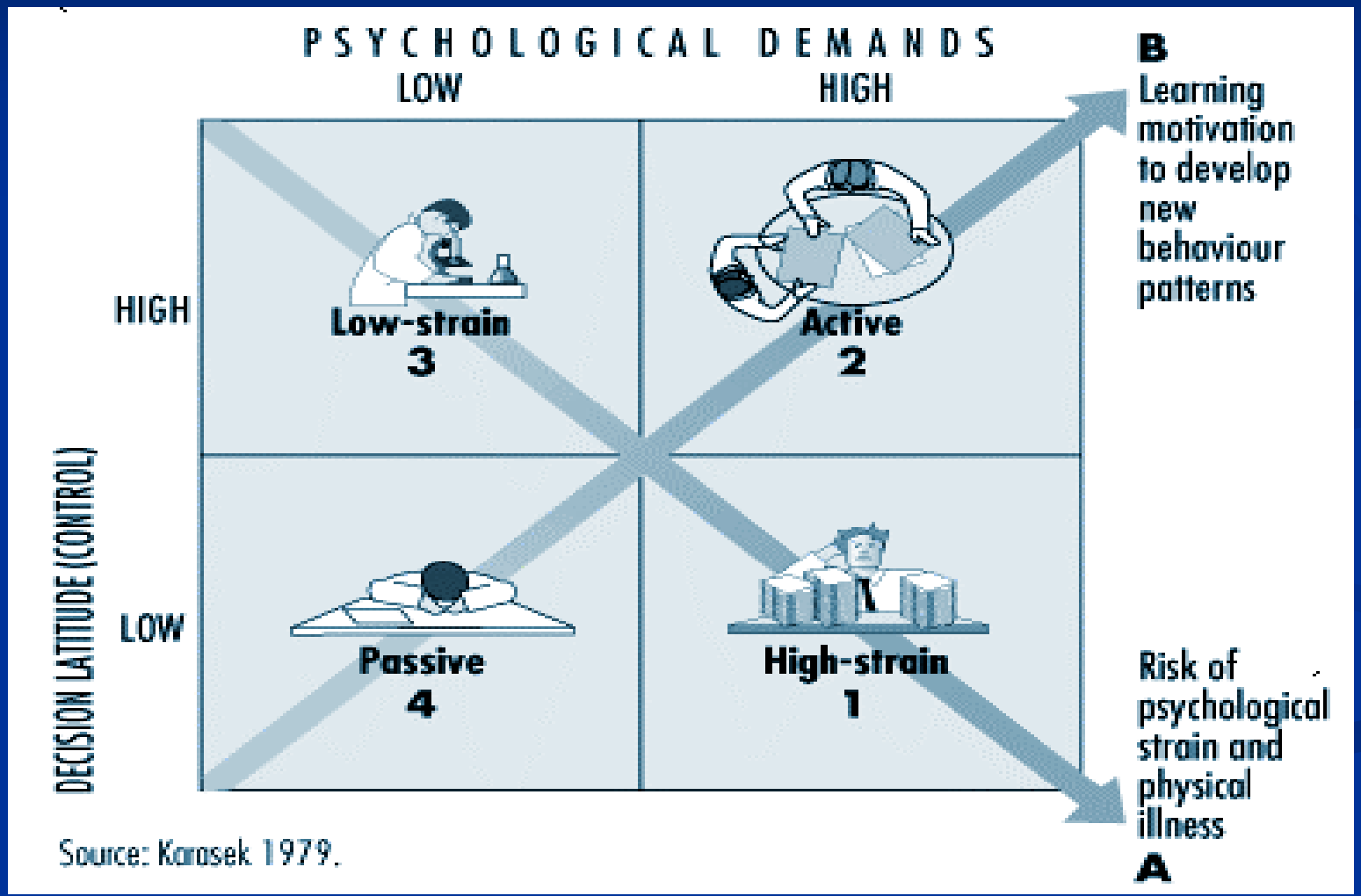
*p<.05

Why greater effect of job strain if low SES?

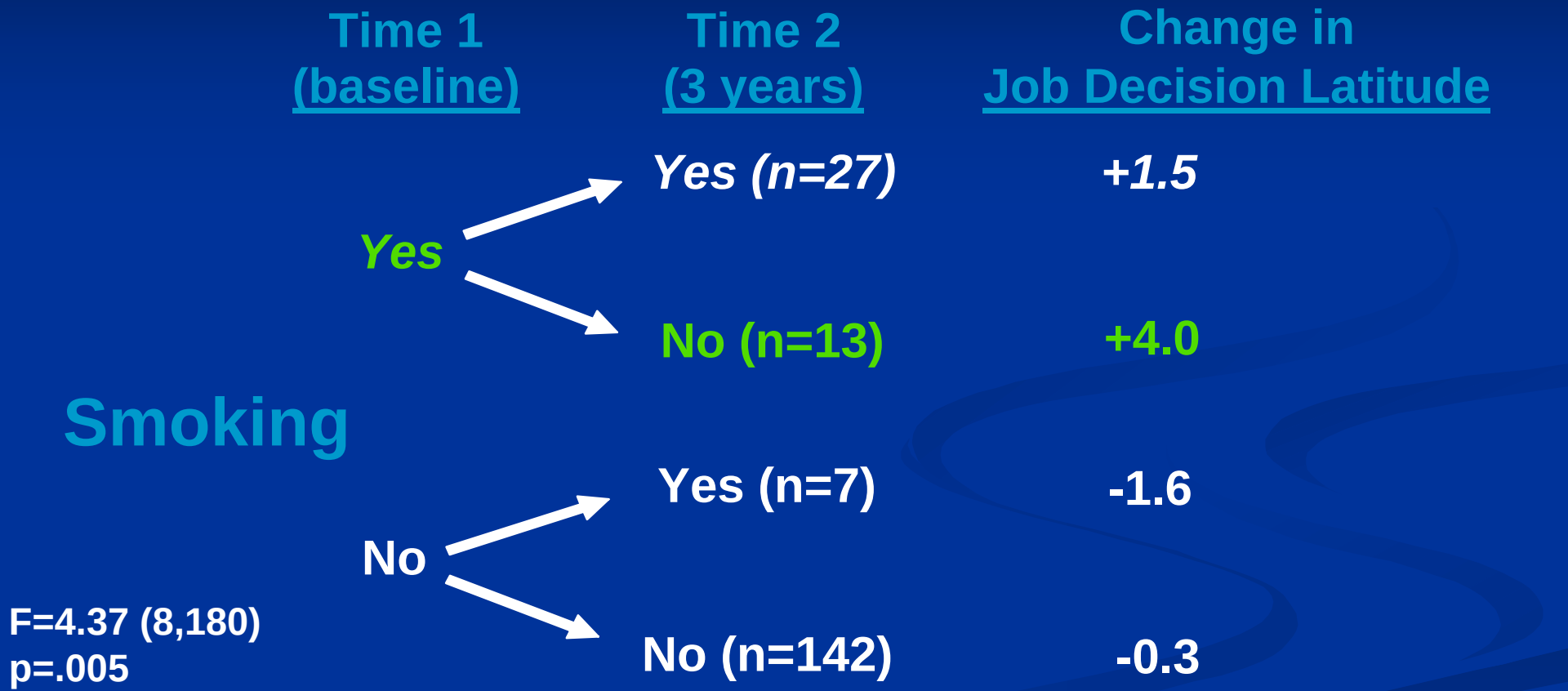
- **In NYC BP study**
  - smoking, BMI, job physical exertion, shiftwork controlled in analysis
- **Hazards faced by lower SES workers**
  - cardiotoxic chemicals, noise
  - other job stressors: effort-reward imbalance, threat-avoidant vigilant work, job insecurity
  - life stressors: unemployment, crime, 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

Landsbergis P, Schnall P, Pickering T, Warren K, Schwartz J. Lower socioeconomic status among men in relation to the association between job strain and blood pressure. Scandinavian Journal of Work, Environment and Health 2003;29(3):206-215.

Job demands-control model: predictions for illness and behavior



3-Year Change in Smoking Prevalence and Job Decision Latitude



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

Landsbergis PA, Schnall PL, Deitz DK, Warren K, Pickering TG, Schwartz JE. Job strain and health behaviors: results of a prospective study. *American Journal of Health Promotion* 1998;12(4), 237-245.

Job stressors and sedentary behavior
(Sweden population survey)

	Men		Women	
	OR[#]	p	OR[#]	p
Psychological demands	--	ns	1.38	.01
Monotonous work	1.31	.15	1.38	.11
Learning opportunities	-1.51	.04	-1.95	.002
Work process control	-1.25	.09	-1.24	.11
Social interaction	-1.60	.001	--	ns

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

Johansson G, Johnson JV, Hall EM. *Social Science and Medicine* 1991;32(7):837-846

Effort-reward imbalance (ERI) at work and co-occurrence of lifestyle risk factors (RF)

N=36,127 public employees in Finland

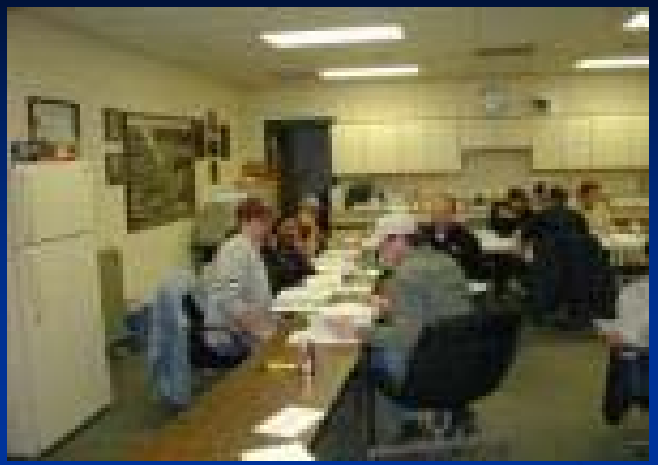
BMI ≥ 25, current smoking, heavy drinking, physical inactivity:

ORs fully adjusted with ERI scores at organizational level

women	1 vs. 0 RF	2 vs. 0 RF	3 vs. 0 RF
low ERI	1.00	1.00	1.00
intermediate	0.98	1.07	1.02
high ERI	1.07	1.25	1.44
men			
low ERI	1.00	1.00	1.00
intermediate	0.99	0.99	1.00
high ERI	1.06	1.22	1.36

Source: A. Kouvonen et al. (2006), BMC Public Health, 6: 24.

How can we do about this problem?



Interventions: what is being changed?

Primary prevention

Social change → **Economic, political context**

↓

Organizational change → **Organizational context**
Downsizing
Contingent work
New systems of work organization

↓

Job redesign → **Job characteristics**
Low job control
High job demands
Social isolation

↓

Secondary prevention

Individual coping → **Stress response**
Physiological effects (e.g., BP)
Psychological effects (e.g., burnout)
Health behaviors

↓

Tertiary prevention

Individual Tx, rehab → **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 →

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

Murphy LR. Stress management in work settings: A critical review of the health effects. American Journal of Health Promotion 1996;11:112-135.

How do we go about changing it?

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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

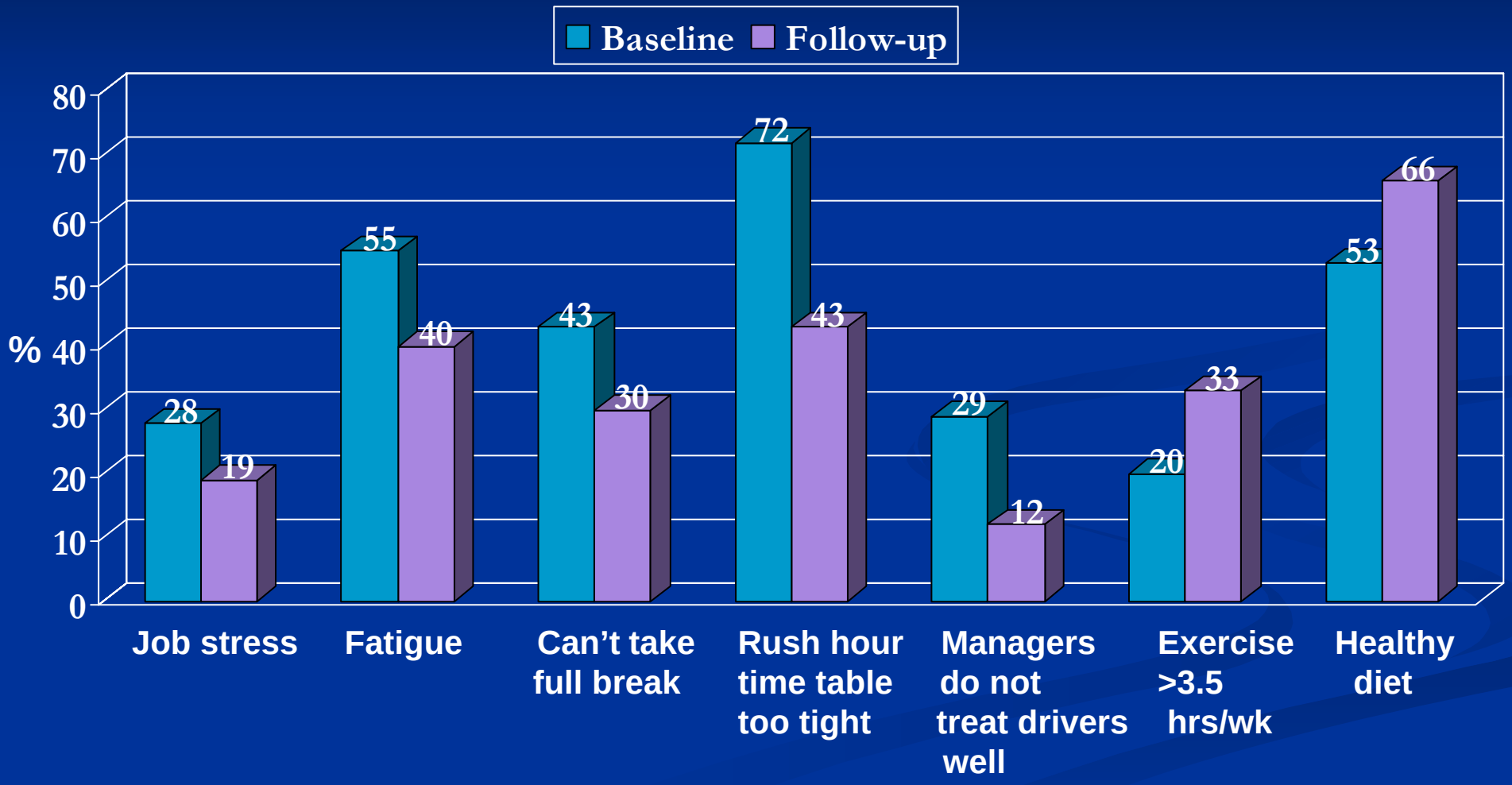
examples of interventions

- 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

Tuchsen et al. Unpublished manuscript.

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)

Maes S, Verhoeven C, Kittel F, Scholten H. Effects of a Dutch work-site wellness-health program: The Brabantia Project. *American Journal of Public Health* 1998;88(7):1037-1041.

Dutch manufacturing employees

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)

Maes S, Verhoeven C, Kittel F, Scholten H. Effects of a Dutch work-site wellness-health program: The Brabantia Project. *American Journal of Public Health* 1998;88(7):1037-1041.

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)

Source: Orth-Gomer K, Eriksson I, Moser V, Theorell T, Fredlund P. Lipid lowering through work stress reduction. *international Journal of Behavioral Medicine* 1994;1(3):204-214.

Swedish government office workers

Work stimulation and autonomy

	March	October
Intervention	3.41	3.53
Controls	3.59	3.56

Source: Orth-Gomer K, Eriksson I, Moser V, Theorell T, Fredlund P. Lipid lowering through work stress reduction. *international Journal of Behavioral Medicine* 1994;1(3):204-214.

Swedish government office workers

Supervisor support

	March	June	October
Intervention	2.07	1.93	2.19
Controls	2.57		2.4

Source: Orth-Gomer K, Eriksson I, Moser V, Theorell T, Fredlund P. Lipid lowering through work stress reduction. *international Journal of Behavioral Medicine* 1994;1(3):204-214.

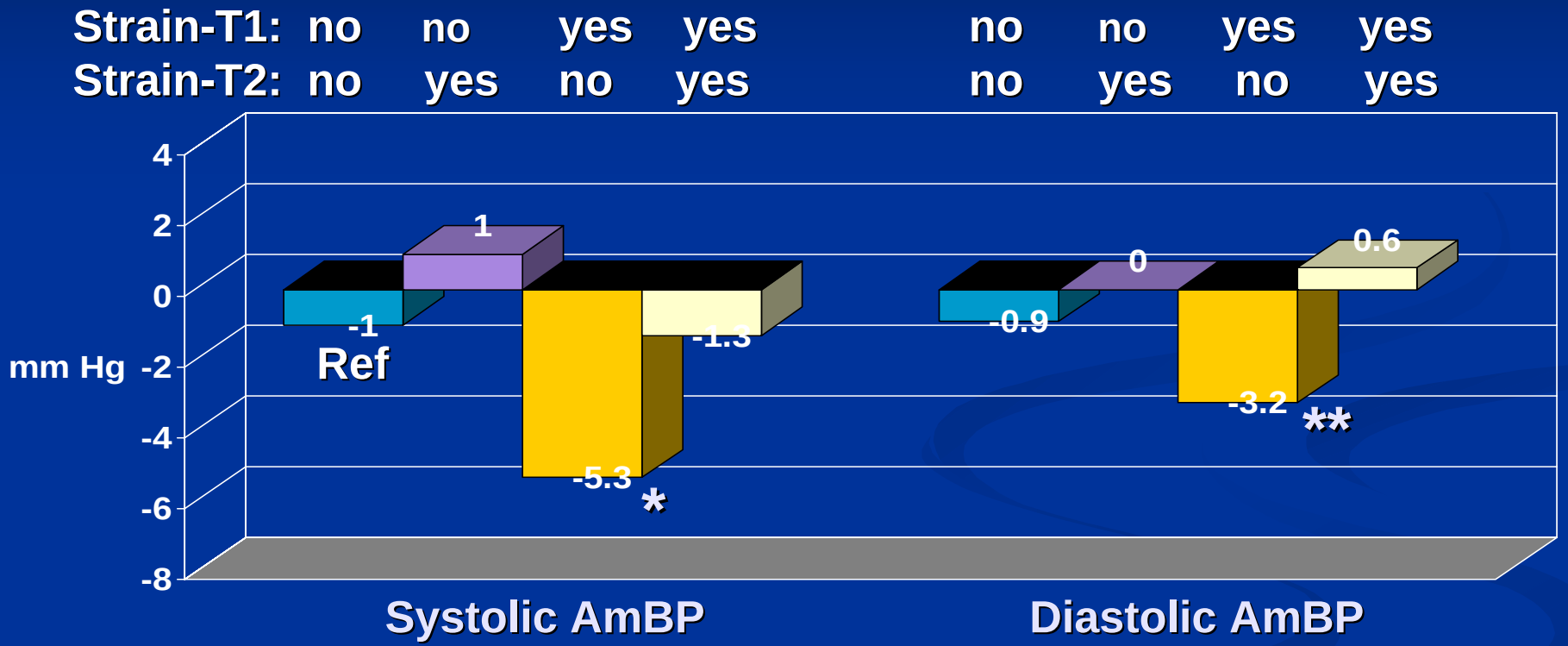
Swedish government office workers

ApoB/ApoAI Ratio

	March	June	October
Intervention	0.84	0.81	0.79
Controls	0.78		0.78

Source: Orth-Gomer K, Eriksson I, Moser V, Theorell T, Fredlund P. Lipid lowering through work stress reduction. *international Journal of Behavioral Medicine* 1994;1(3):204-214.

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



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

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

Schnall PL, Schwartz JE, Landsbergis PA, Warren K, Pickering TG. Psychosomatic Medicine 1998;60:697-706.

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 →

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

Landsbergis PA, Cahill J, Schnall P. *Journal of Occupational Health Psychology* 1999;4(2):108-130.

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)

Melin B, Lundberg U, Soderlund J, Granqvist M. Psychophysiological stress reactions of male and female assembly workers: a comparison between two different forms of work organization. *Journal of Organizational Behavior* 1999;20:47-61.

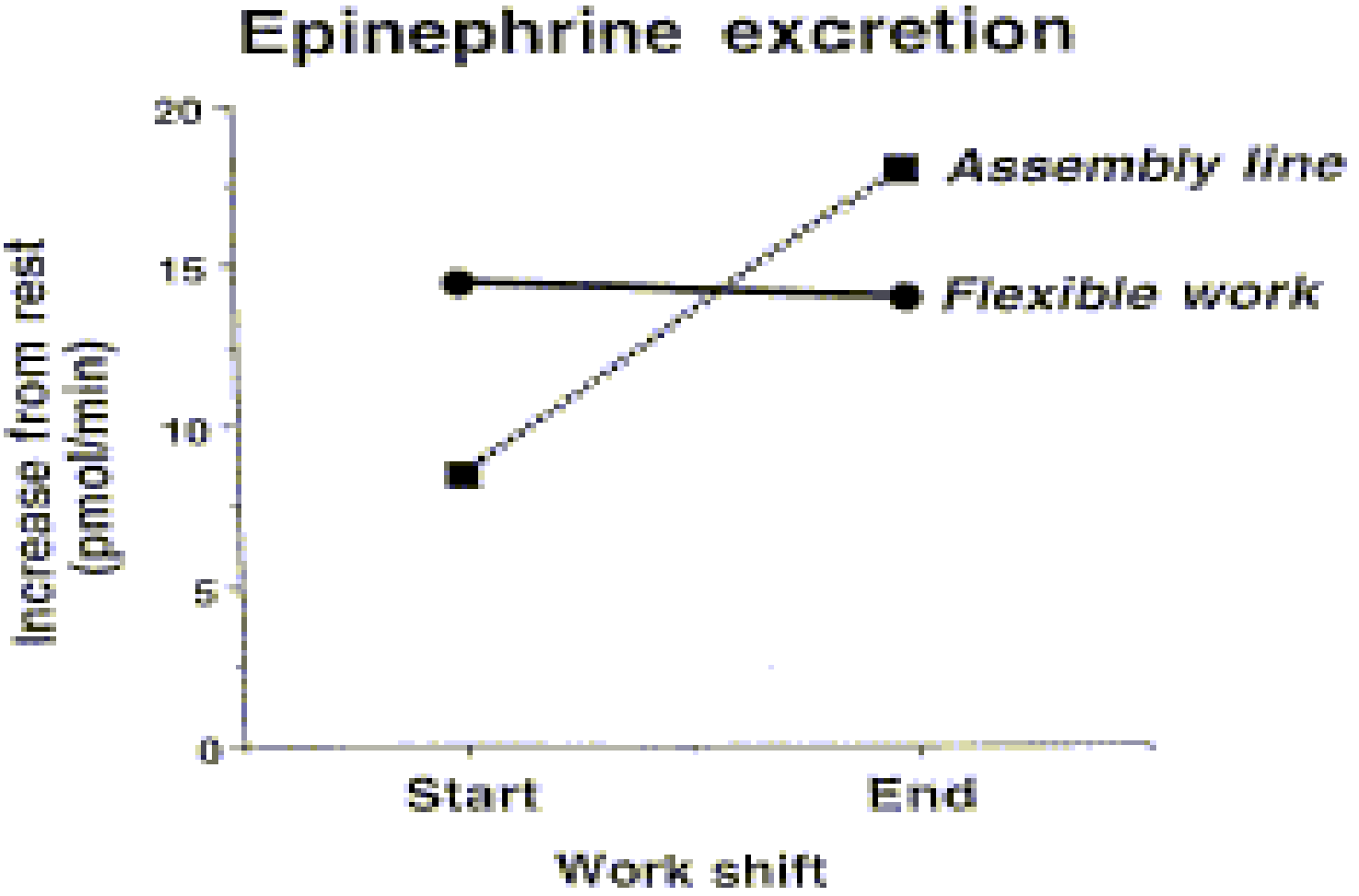


Figure 3. Epinephrine excretion during work at the assembly line and the flexible form of work organization

Source: Melin B, Lundberg U, Soderlund J, Granqvist M. Psychophysiological stress reactions of male and female assembly workers: a comparison between two different forms of work organization. *Journal of Organizational Behavior* 1999;20:47-61.


Relief man, passing,
relief man, passing!

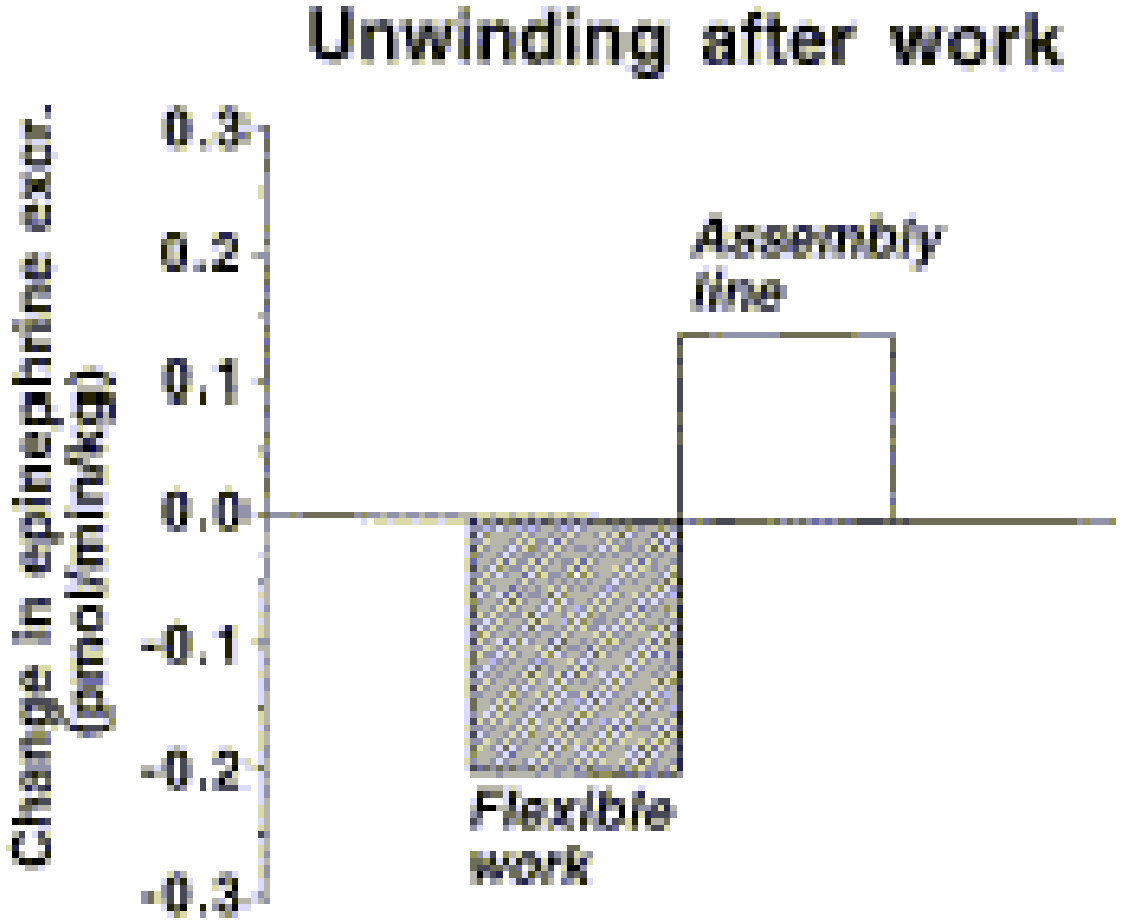


Figure 6. Epinephrine excretion after work at the assembly line and the flexible form of work organization

Source: Melin B, Lundberg U, Soderlund J, Granqvist M. Psychophysiological stress reactions of male and female assembly workers: a comparison between two different forms of work organization. *Journal of Organizational Behavior* 1999;20:47-61.

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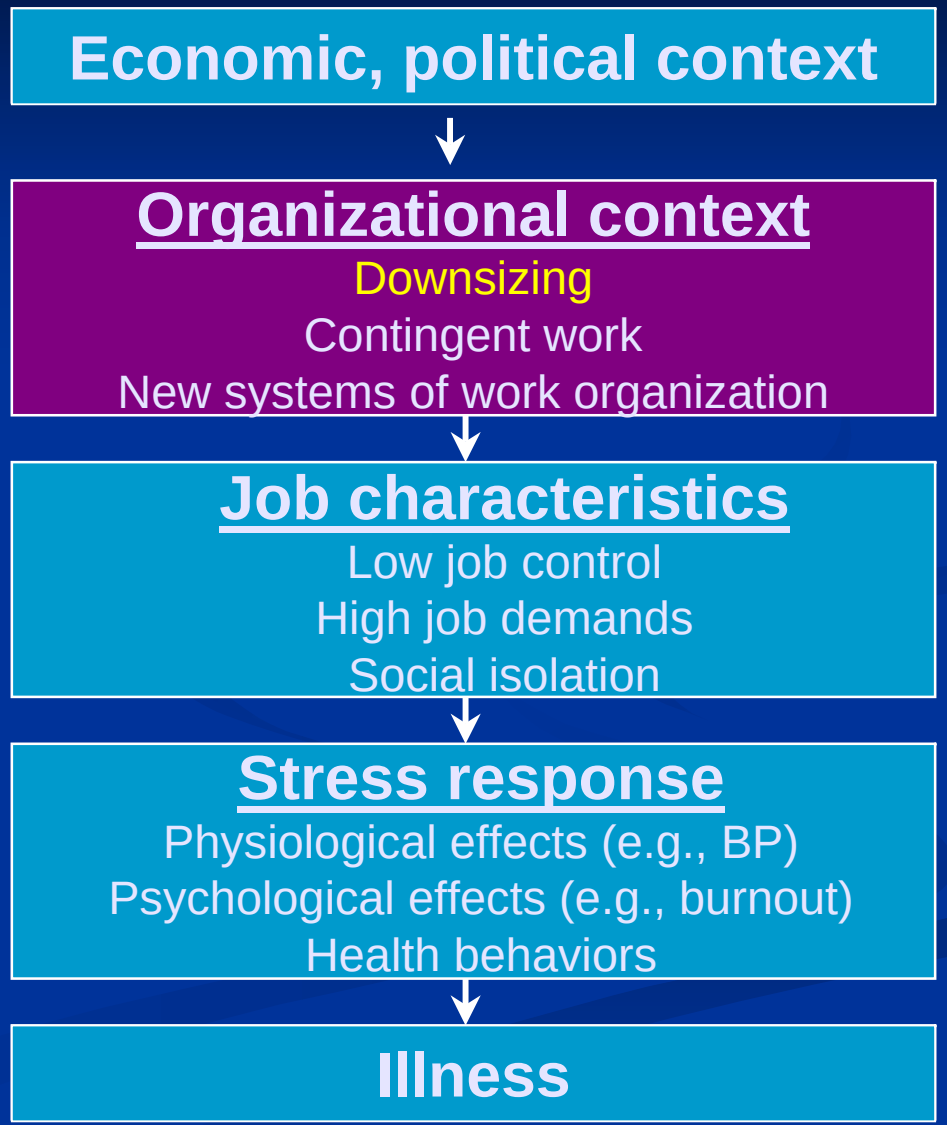
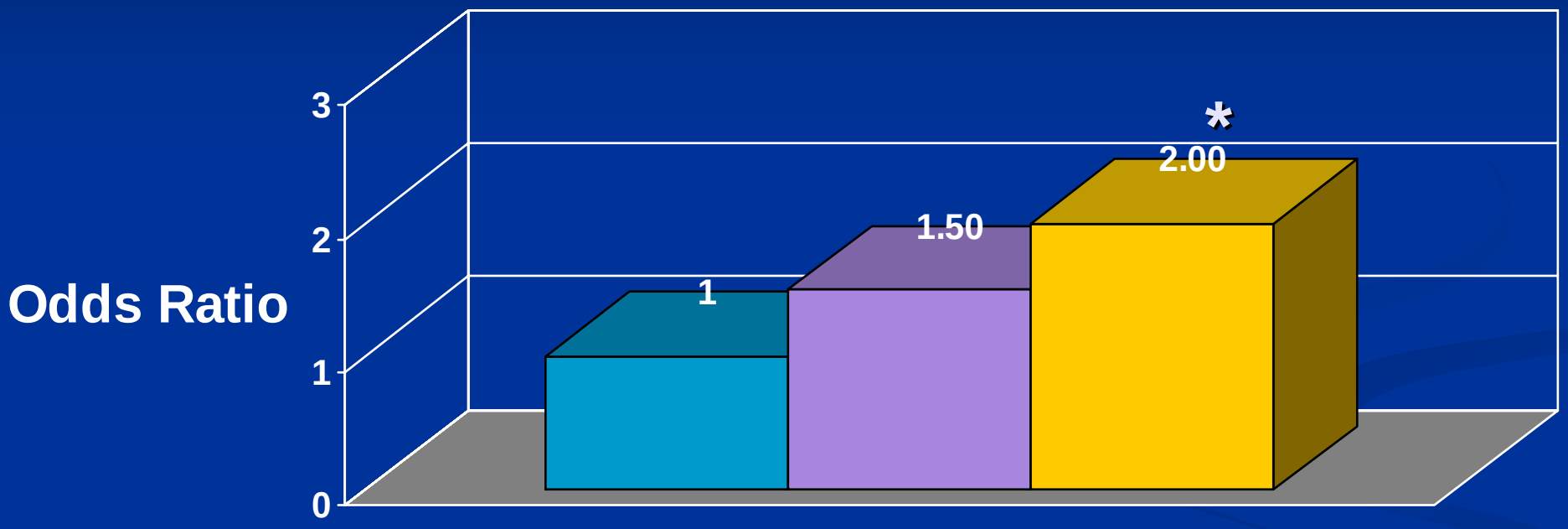


Downsizing and 7.5 yr CVD mortality

(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

Vahtera J, Kivimaki M, Pentti J, Linna A, Virtanen M, Virtanen P, Ferrie JE. *BMJ* 2004; 328:555.

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)

Ash M, Seago JA. The effect of registered nurses' unions on heart attack mortality. *Industrial and Labor Relations Review* 2004; 57:422.

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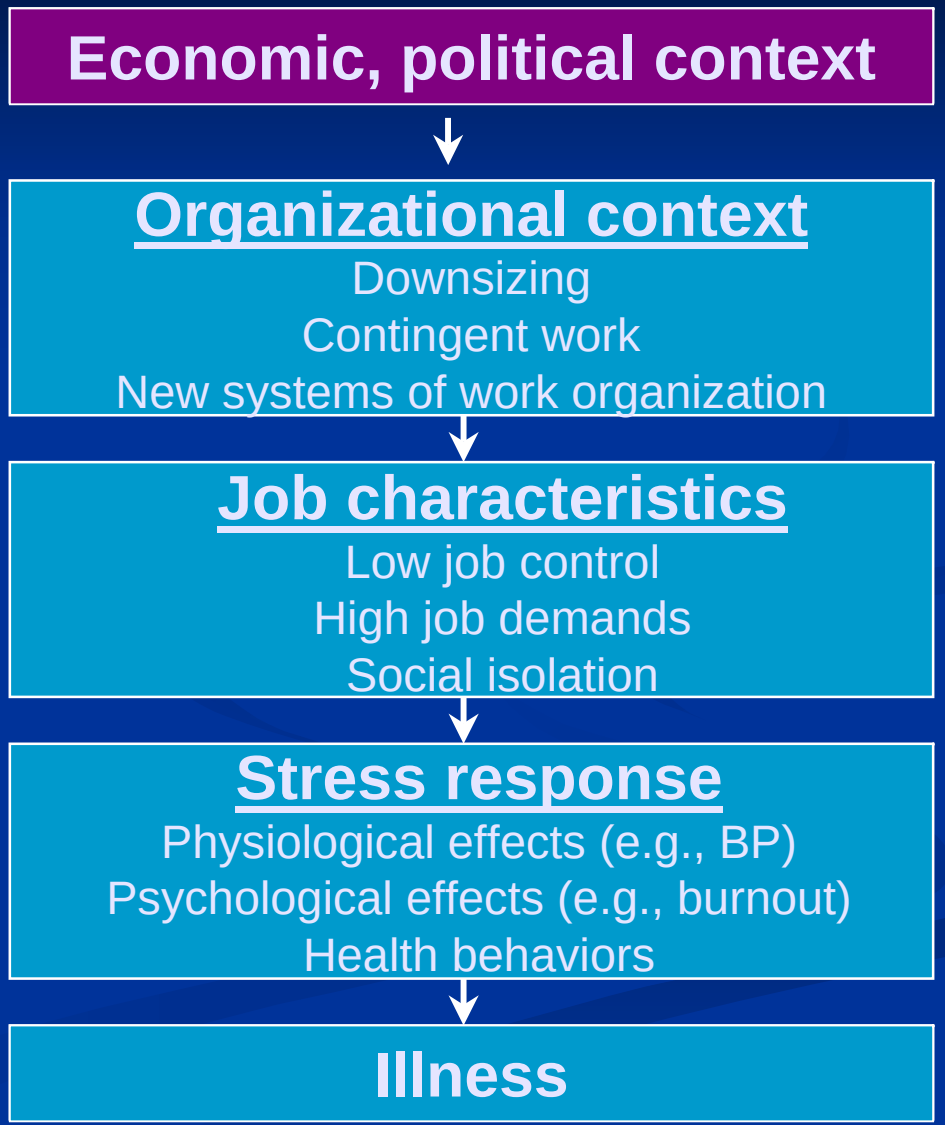


Legislative & regulatory efforts

- **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 Commission Guidance on work-related stress (2000)**
- **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

Belkic K, Schnall P, Landsbergis P, Baker D. Conclusions and thoughts for a future agenda regarding the workplace and cardiovascular health. Occupational Medicine: State of the Art Reviews. 2000;15(1):307-321.

Ambulatory (Upper Arm) Blood Pressure (ABPM) Monitoring ("gold standard")

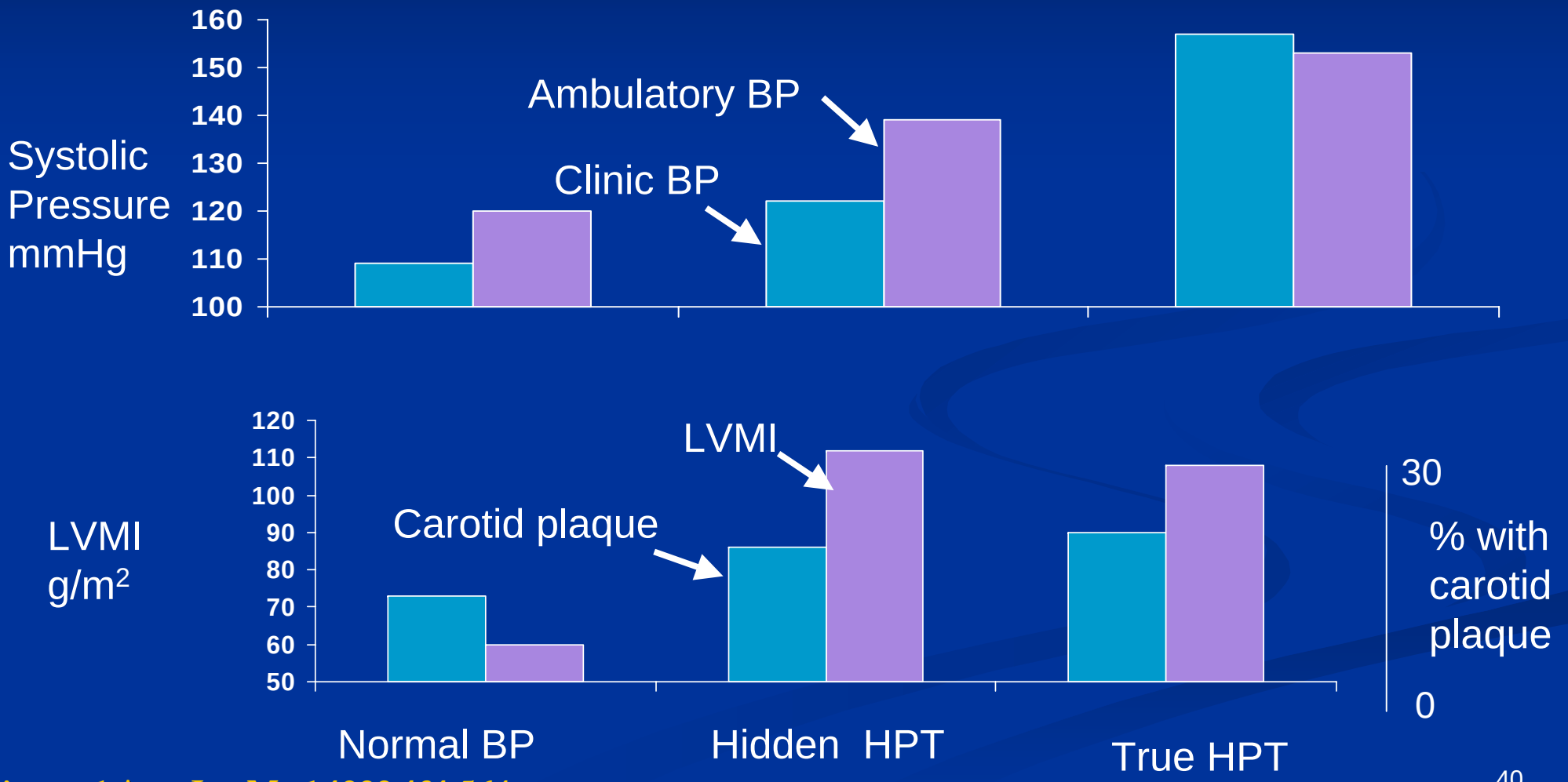
- Monitor automatically measures BP at preset intervals (can monitor for 24+ hrs)
- Validity improved due to:
  - Repeated measures
  - Patients go about normal activities
- ABPM predicts cardiovascular morbidity better than clinic BP
- Expensive
  - Alternative: wrist monitor

Pickering TG. Ambulatory monitoring and blood pressure variability. London: Science Press; 1991.

Hidden (“occult”) hypertension

- Normal clinic (office) BP
- + elevated ambulatory BP

Hidden ("occult") Hypertension is associated with higher LV Mass & more carotid plaque



Liu et al Ann Int Med 1999;131:564

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

	Prevalence		Cutpoint
MEN	%	N	
Mt. Sinai Work & Health study	10.3%	3/29	DBP >85
Mt. Sinai Work & Health study	5.9%	2/34	SBP >140
NYC Work Site BP study	20.6%	36/175	DBP >85
WOMEN			
Mt. Sinai Work & Health study	12.3%	13/106	DBP >85
Mt. Sinai Work & Health study	6.0%	7/117	SBP >140
Kent Ohio residents	27.2%	28/103	SBP >140

Belkic K, Schnall P, Landsbergis P, et al.: Hypertension at the workplace: An occult disease? The need for work site surveillance. In Theorell T (ed), *Everyday Biological Stress Mechanisms: Advances in Psychosomatic Medicine*. Basel, Switzerland: Karger, 2001, 116–38.
Gallo LC et al. Job characteristics, occupational status and ambulatory cardiovascular activity in women. *Ann Behav Med* 2004;28(1): 62-73.

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/