

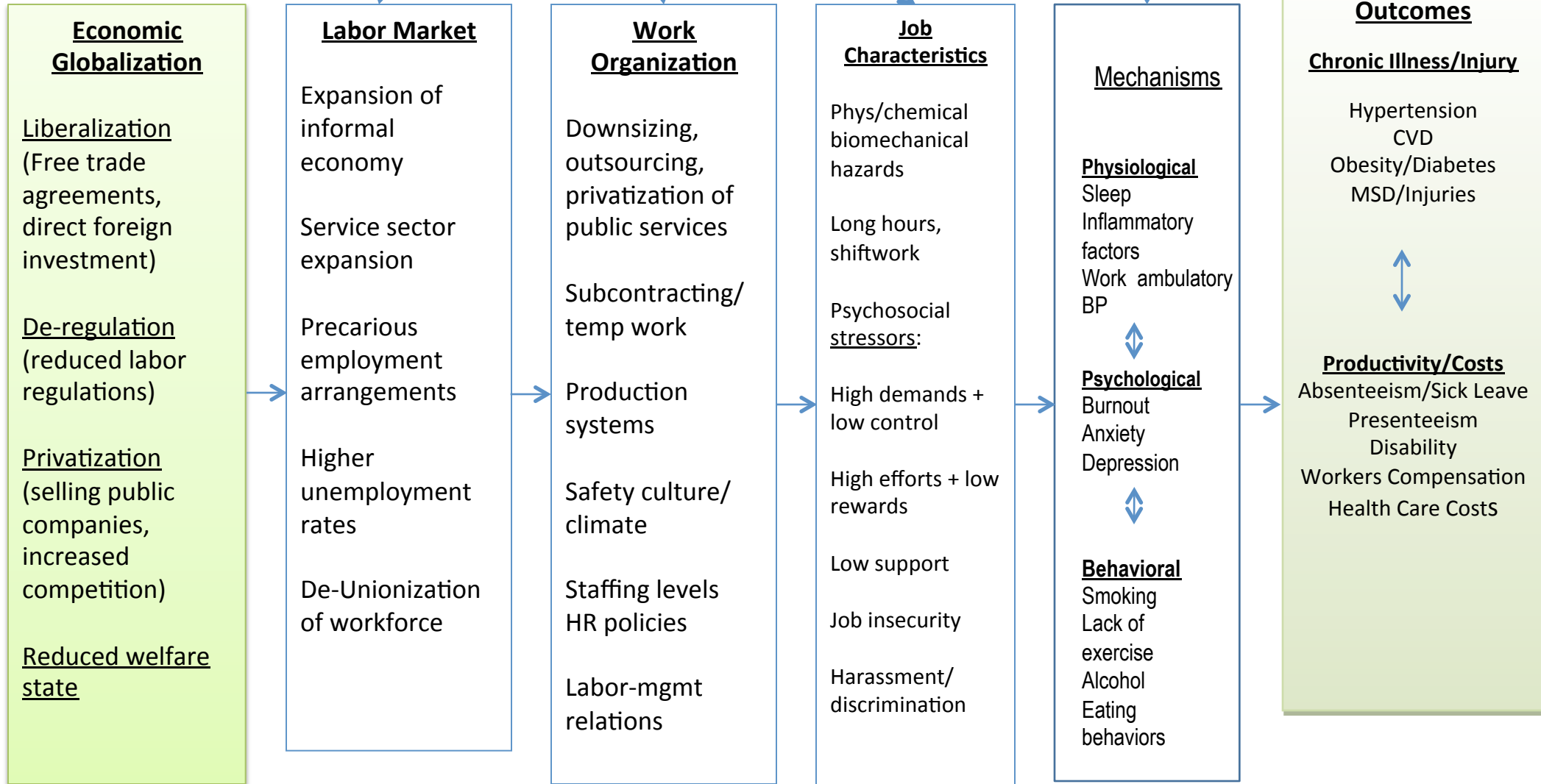
**Session VI: Assessing health
outcomes with a focus on
cardiovascular risk factors and CVD**

**Peter Schnall
Paul Landsbergis
Karen Belkic'**

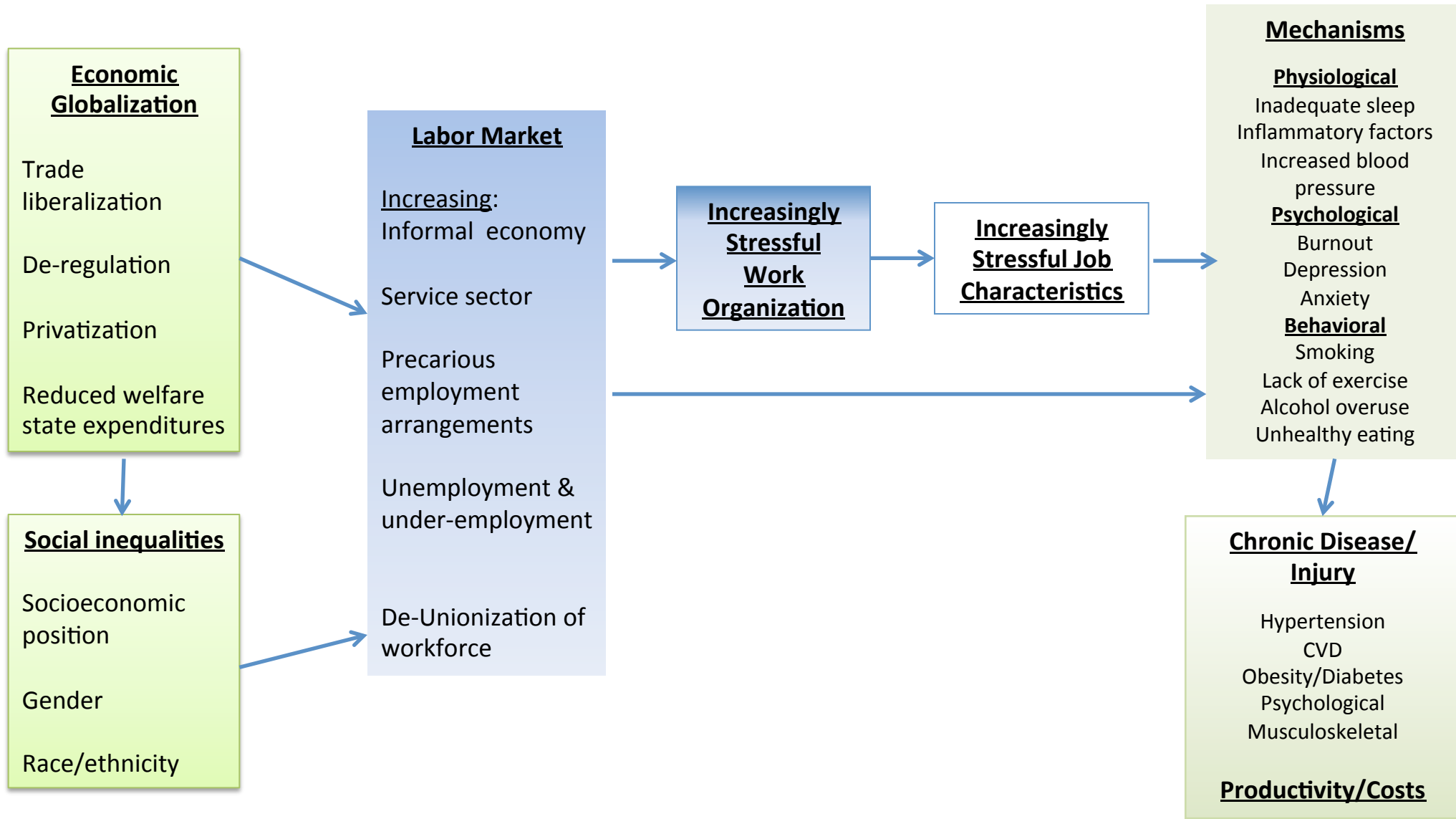
**UCLA Work and Health
CHS 278/EHS 270
May 7, 2014**

Globalization, the Changing Nature of Work and Health

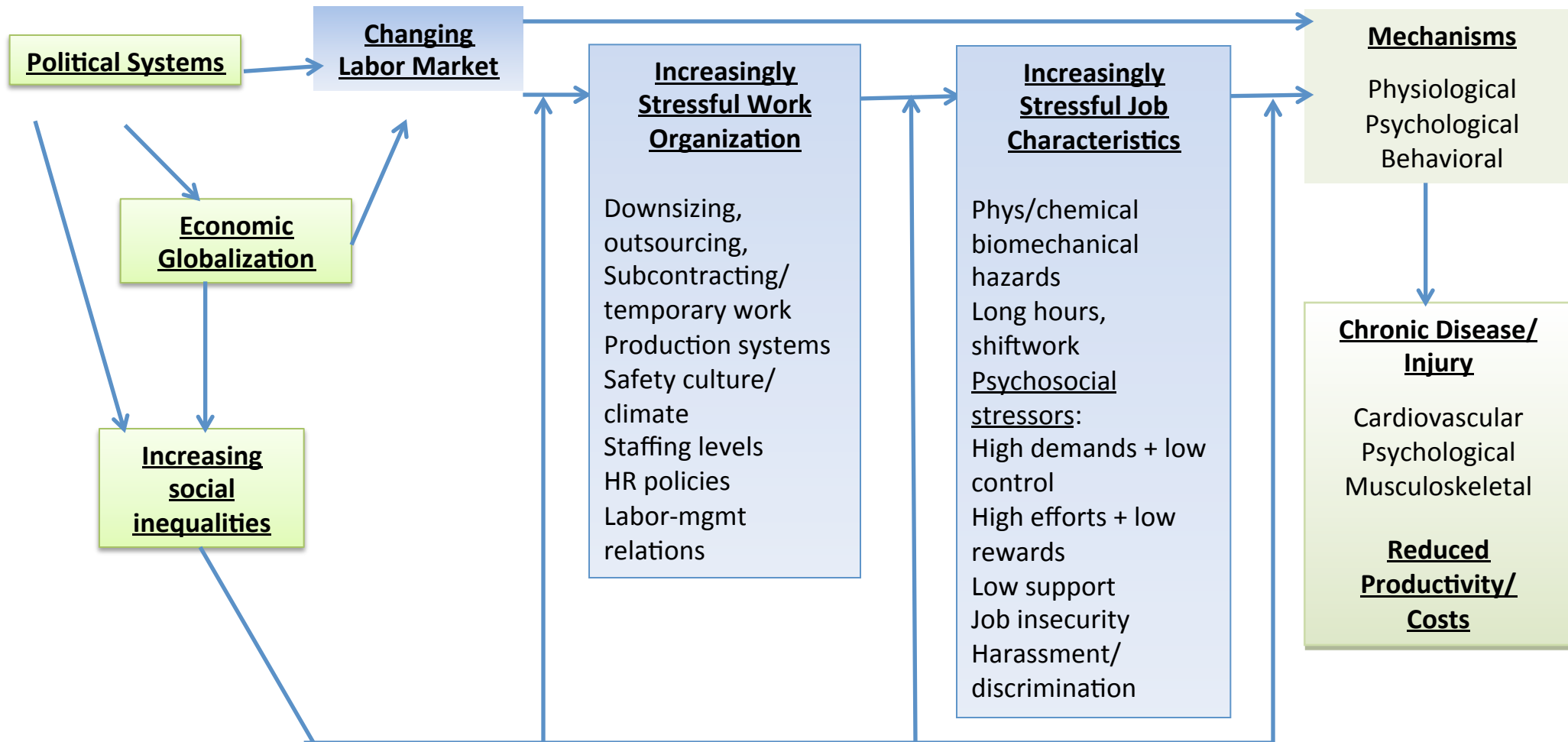
Social inequalities: Gender, race/ethnicity, class/education, age, geographic region



Macro Model of Globalization, the Changing Nature of Work and Health



Micro Model of Globalization, Changing Nature of Work and Health



OCCUPATIONAL STRESS AND HEALTH

WORK ORGANIZATION and JOB DESIGN

Job demands
Skill levels
Decision authority
Social support
Job security
TAV
ERI
Shift Work
Long Working Hours
Physical environment
Technology



DISEASE OUTCOMES

Cardiovascular Disease
Psychological Distress
Musculoskeletal Disorders
Others

Empirical findings: Psychosocial workplace factors and health outcomes

CARDIOVASCULAR DISEASE

- Job strain studies
 - Cornell NYC Work Site Blood Pressure Study
- Effort-reward imbalance studies
- Shiftwork, overtime
- Threat-avoidant vigilant work
- Population attributable risk for workplace risk factors

PSYCHOLOGICAL DISTRESS

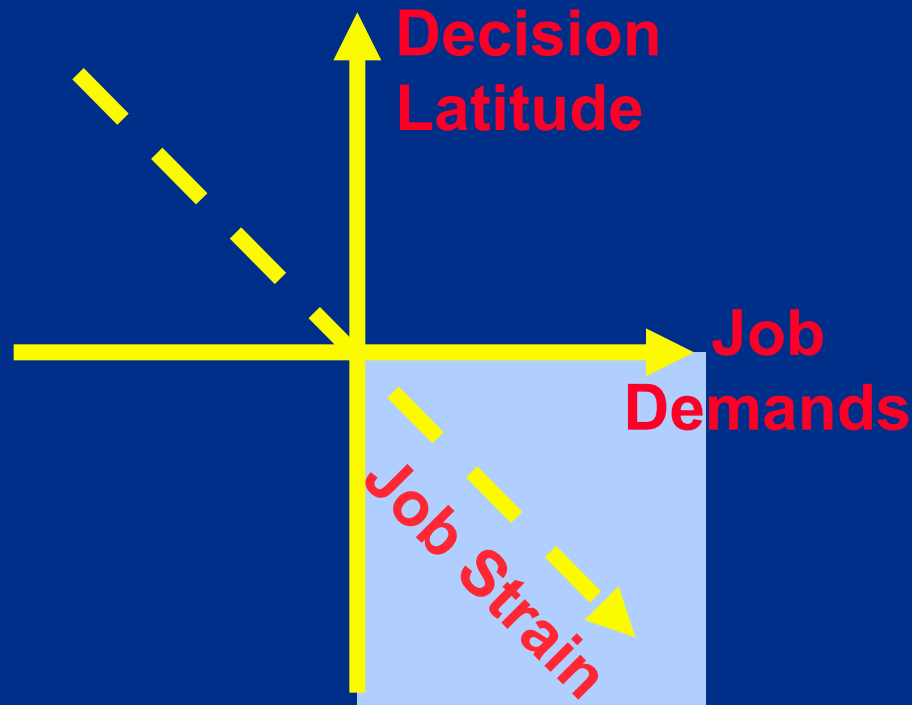
MUSCULOSKELETAL DISORDERS

CURRENT TRENDS: Job strain, CHD

CRITERIA FOR EVALUATING RESEARCH STUDIES

Job Strain (Karasek)

Definition: The combination of HIGH Job Demands and LOW Decision Latitude



Studies of Job Strain and Coronary Heart Disease

- **34 studies published between 1981 and 2002**
 - 16 from Sweden (many using national data bases)
 - 7 from U.S. (2 using national data bases)
 - Also: Czech Republic, Denmark, England, Finland, Japan

| | Significant positive associations | Mixed positive and null associations | Total # of studies |
|--------------------------------|--|---|---------------------------|
| Cohort studies | 8 | 3 | 17 |
| Case-control studies | 6 | 0 | 9 |
| Cross-sectional studies | 4 | 0 | 8 |

Job Strain and Cardiovascular Risk Factors other than Blood Pressure

(n=15 total studies)

| | <u>Significant positive associations</u> | <u>Mixed positive and null associations</u> | <u>Total # of studies</u> |
|---|--|---|-----------------------------------|
| cigarette smoking | 3 | 6 | 11 |
| serum cholesterol or high fat intake | 0 | 2 | 7 |
| sedentary behavior | 1 | 1 | 3 |
| body mass index | 1 | 2 | 5 |
| plasma fibrinogen | 2 | 1 | 4 |

Population attributable risk % for CVD due to Job Strain

| <u>Study population</u> | <u>Study</u> | | <u>% Job Strain</u> | | <u>PAR%</u> |
|---------------------------|--------------|----------------|---------------------|-----------|-------------|
| | <u>Years</u> | <u>Outcome</u> | <u>Exposure</u> | <u>RR</u> | |
| New York City men | 1985-8 | High BP | 21 | 2.8 | 27.4 |
| U.S. men - HES | 1960-2 | MI | 21.8 | 2.48 | 24.4 |
| U.S. men - HANES | 1971-5 | MI | 23.2 | 3.28 | 34.6 |
| Swedish men | 1976-86 | CVD | 20 | 1.9 | 15.3 |
| European men and women | 1996 | CVD | 30 | 1.5-2.0 | 13-23 |
| | | | <u>%exposed</u> | | |
| Swedish men | 1977-90 | CVD | 75 ¹ | 1.72 | 35 |
| Danish men | 1991 | CVD | 6 ² | 2 | 6 |
| Danish women | 1991 | CVD | 16 ² | 2 | 14 |

¹ exposed to medium and low work control

² exposed to monotonous high-paced work

New York City Worksite Ambbp Study

1985-2001

Dr. Thomas Pickering

Dr. Peter Schnall

Dr. Joseph Schwartz

Dr. Paul Landsbergis

The New York City Work Site Blood Pressure (BP) Study

- Based at Weill Medical College of Cornell University-
New York Hospital
- Began in 1985 as a case-control study
- 283 men initially enrolled at 8 large NYC work sites
- Funding became available (after studying 7 sites) to:
 - conduct a prospective study (evaluate Ss every 3-4 yrs)
 - enroll women
- Currently, 472 subjects enrolled at 10 sites (38% women)
 - maximum of 4 evaluations & 10 years of follow-up

The New York City Work Site BP Study: First 8 participating work sites

- Newspaper typography department
- Federal health agency
- Stock brokerage firm
- Liquor marketer
- Private hospital
- Sanitation collection and repair facility
- Department store warehouse
- Insurance company

The New York City Work Site BP Study: Enrollment procedures

Initial BP screening

- 3 sitting readings of BP using the AHA protocol (used average of last 2 readings)
- $\geq 75\%$ of employees in a dept had to participate in order to be eligible for the study
- eligibility determined

Recruitment BP measurements (4-6 weeks later)

- to confirm **cases** (>85 DBP on both occasions or meds) and **controls** (≤ 85 DBP on both occasions)

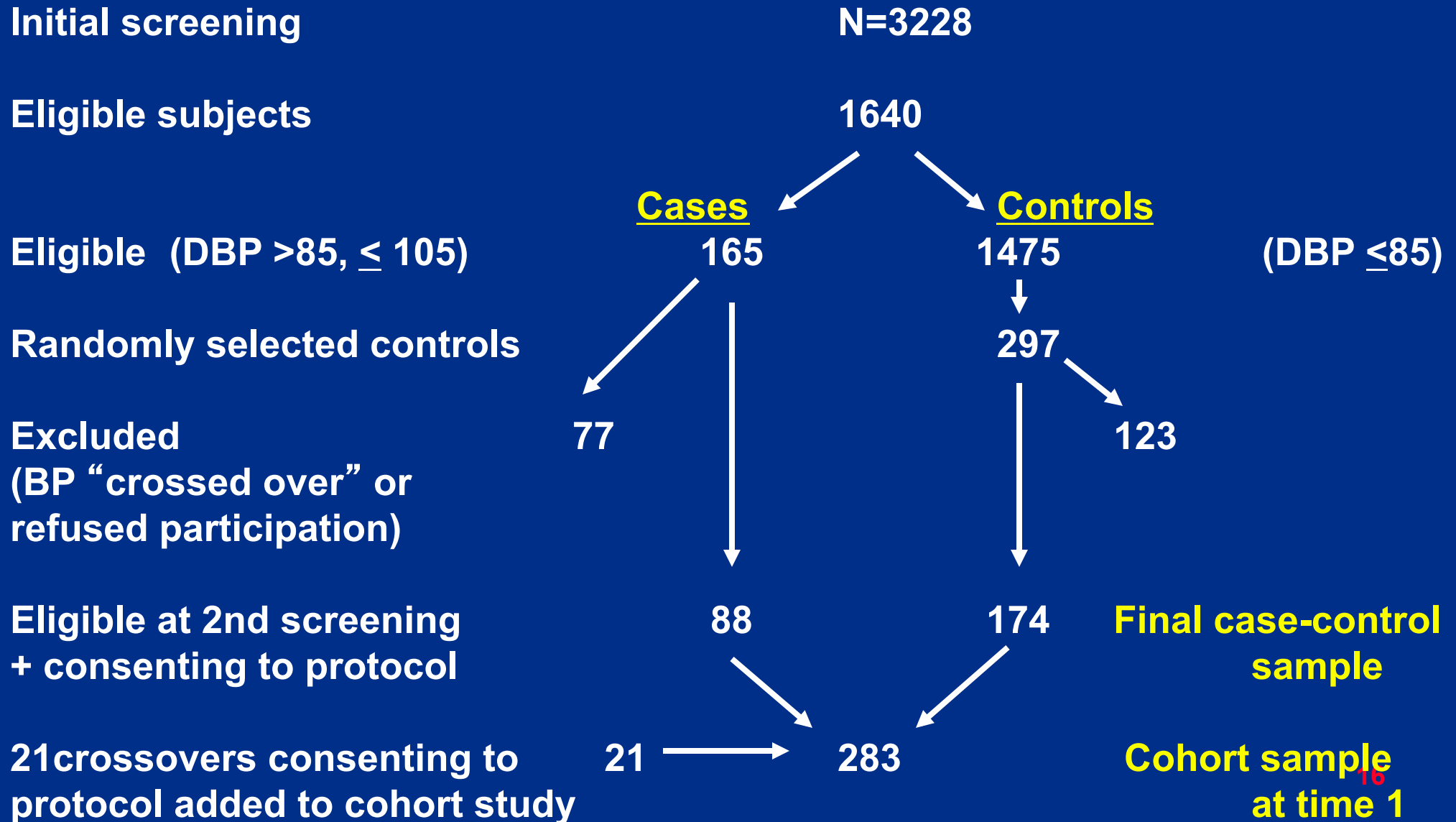
Stratified sampling of cases (only first 7 sites)

- All cases & a random sample of controls
- case-control ratio 2:3

The New York City Work Site BP Study: Eligibility criteria

- aged 30-60 at recruitment
- full-time employee (30+ hours/wk)
- no second job requiring more than 15 hours/wk
- no evidence of CHD
- screening BPs less than 160/105 mm Hg
- able to read and speak English
- body mass index ≤ 32.5 kg/m² at screening
- at current worksite ≥ 3 yrs before recruitment and before Dx of high BP (only 1 yr at 8th site)

The New York City Work Site BP Study: Men selected from first 8 work sites



Potential effects of sample selection on study results

Temporal bias

- Hypertensives select into high strain jobs?
 - 3 yr job tenure requirement
 - selection out of high stress jobs

Selection bias

- Due to non-participation
 - comparison of participants & non-participants
 - 75% of dept screening requirement

Reduced statistical power

- Reduced variation in
 - exposure (mgmt resistance, logistics, language)
 - outcome (exclude severe HPTs, CHD, high BMI)

The New York City Work Site BP Study: Protocol

1. Job Content Questionnaire (Karasek) + detailed psychosocial + health behavior questionnaire
2. Wear an ambulatory BP monitor for 24 hours, including a work shift, plus diary
3. Complete cardiovascular work-up
 - physical exam
 - blood sample (cholesterol)
 - EKG
 - echocardiogram
 - exercise stress test

Ambulatory BP monitoring: Improving validity of outcome measures

1. The portable monitor automatically records BP every 15 min. during waking hours, and every 30 min. during sleep.
2. Ambulatory BP (AmBP) is more reliable and valid than casual (office) BP measurements.
 - a. Reliability:
 - no observer bias
 - increased number of readings
 - b. Validity:
 - BP measured during normal daily activities
 - AmBP more highly correlated with target organ damage (e.g, LVH) & CVD

Job Content Questionnaire Items (Karasek)

Definition: Job Strain is the combination of

HIGH Job Demands and LOW Job Decision Latitude

Psychological Workload Demands

1. My job requires working very fast
2. My job requires working very hard
3. I am not asked to do an excessive amount of work *
4. I have enough time to get the job done *
5. I am free from conflicting demands others make *

* item reverse coded

Job Content Questionnaire (cont' d)

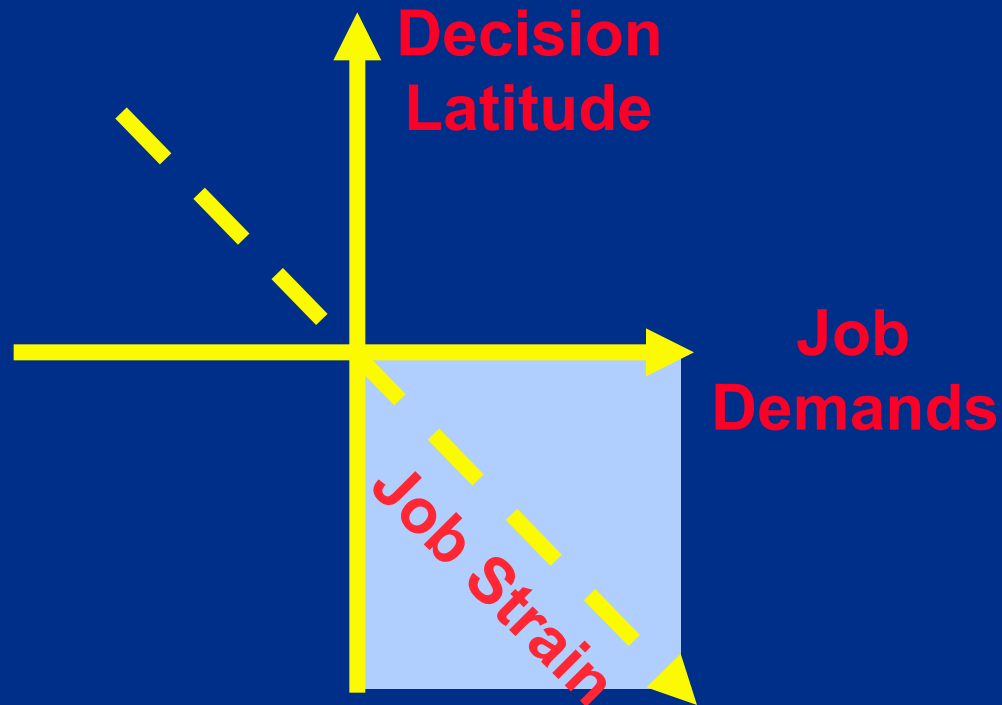
Job Decision Latitude

1. My job requires that I learn new things
2. My job requires me to be creative
3. My job requires a high level of skill
4. I get to do a variety of things on my job
5. I have a lot to say about what happens on my job
6. My job involves a lot of repetitive work *
7. My job allows me to make a lot of decisions on my own
8. On my job, I am given a lot of freedom to decide how I do my work
9. I have a lot to say about what happens on my job

* item reverse coded

Job Strain

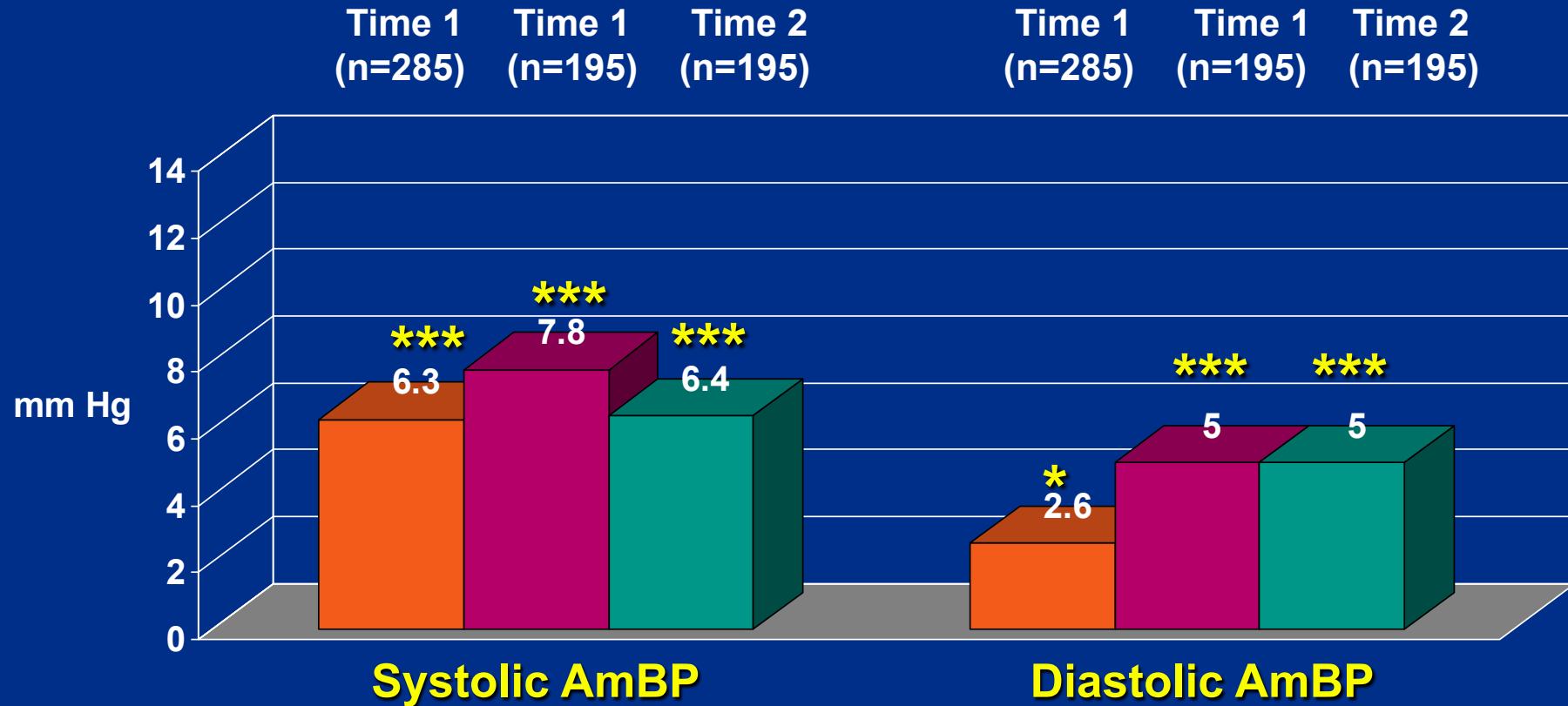
Combination of HIGH Psychological Job Demands + LOW Job Decision Latitude (decision-making authority and skill use)



The New York City Work Site BP Study: Cohort study sample, time 1 to time 2

| | | |
|-------------------------------------|------------|---|
| Eligible at time 1 | 283 men | |
| Ineligible at time 2 | -24 | 3 deceased 6 CVD 15 unemployed, disabled, retired |
| Lost to follow-up | -64 | 10 could not be located 44 refused 10 did not complete protocol |
| Cohort sample with complete data | <u>195</u> | |

Effect of Job Strain on Work Ambulatory BP (men, Time 1 and Time 2)

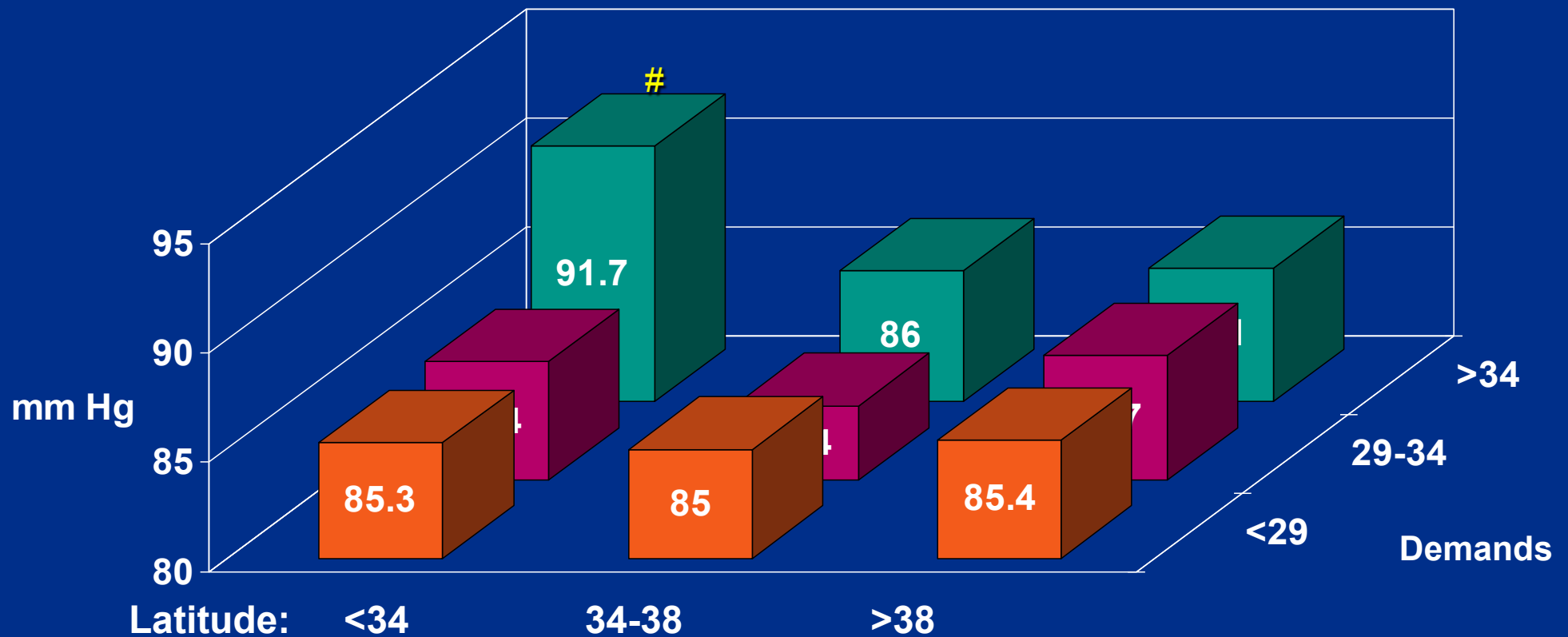


controlling for age, education, body mass index, race, smoking, alcohol use, work site

***p<.001, **p<.01, *p<.05

Work Ambulatory Diastolic BP by Job Demands and Job Decision Latitude

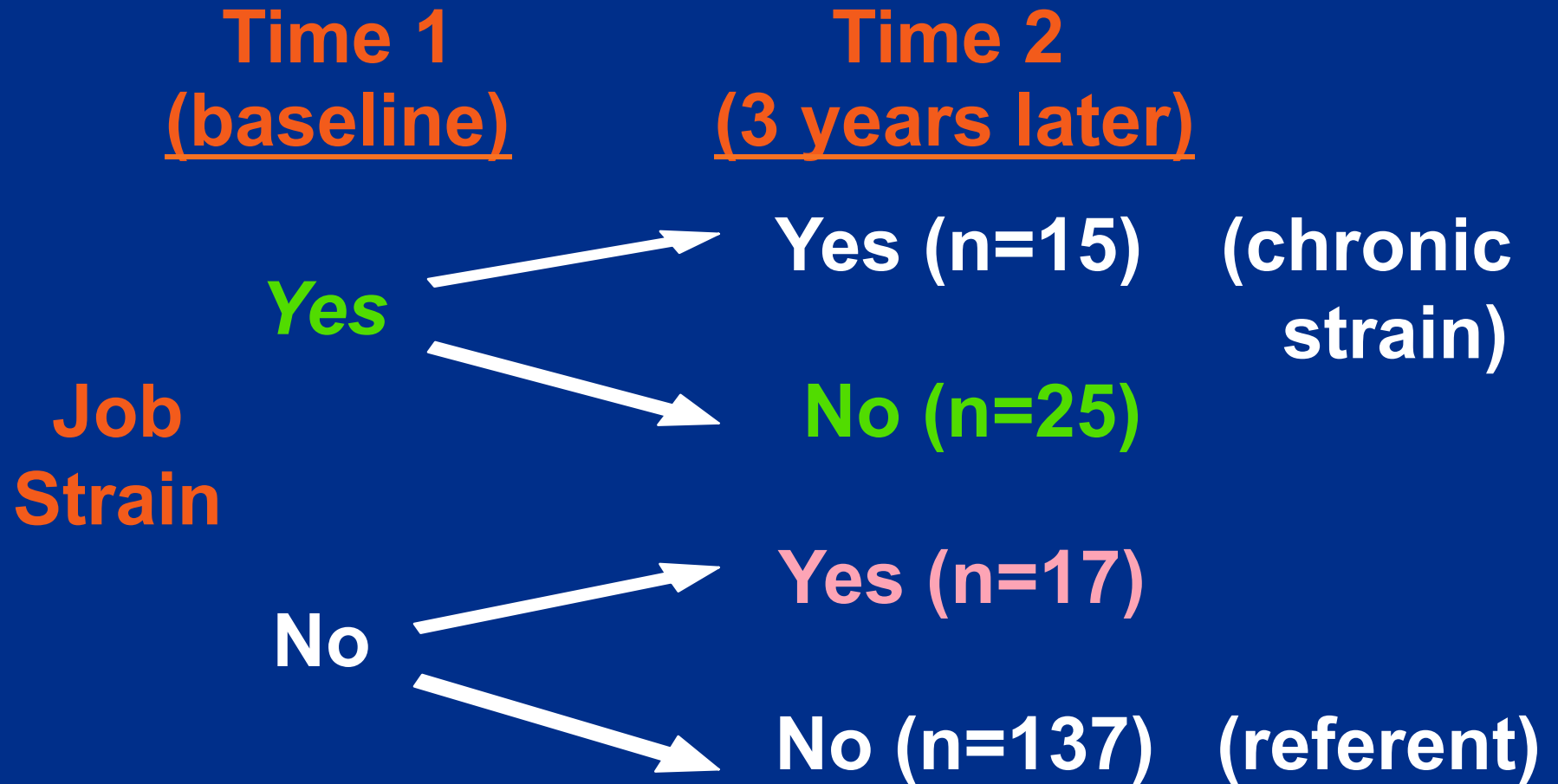
(n=208 men, Time 3)



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

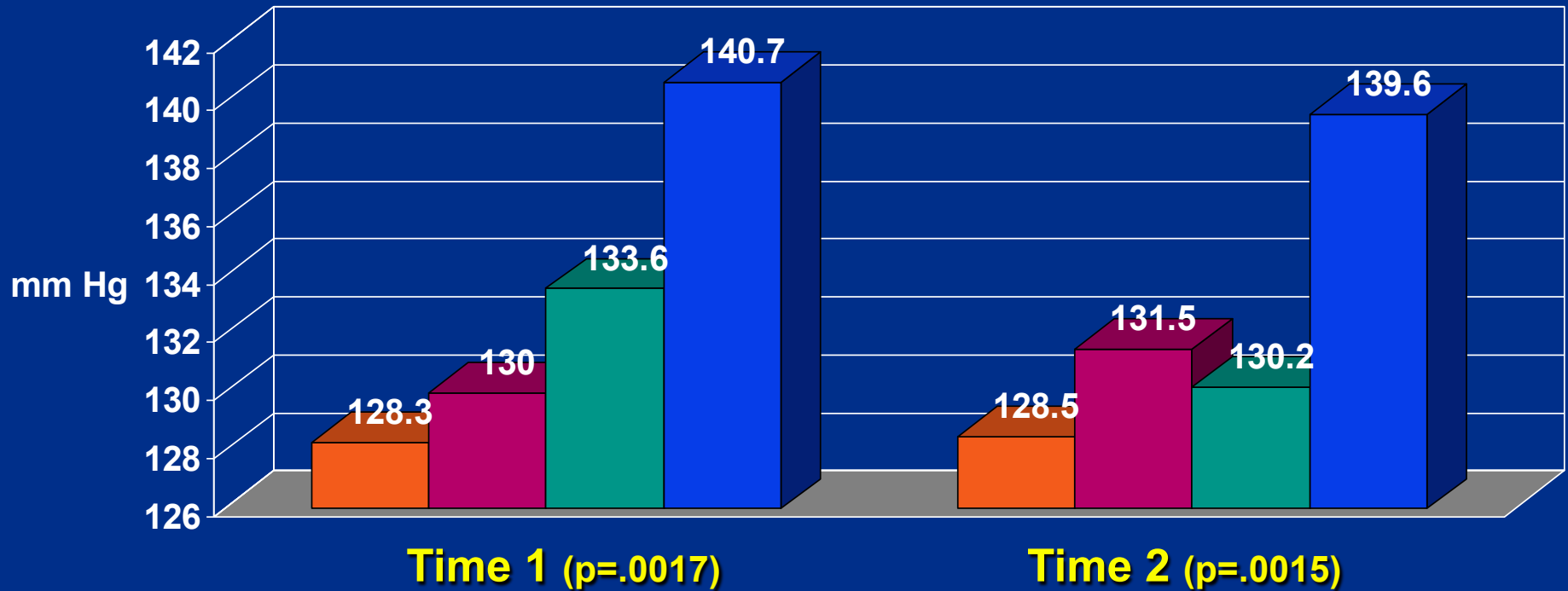
#p<.10 (vs mean of other 8 cells)

Job Strain Change Variable



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

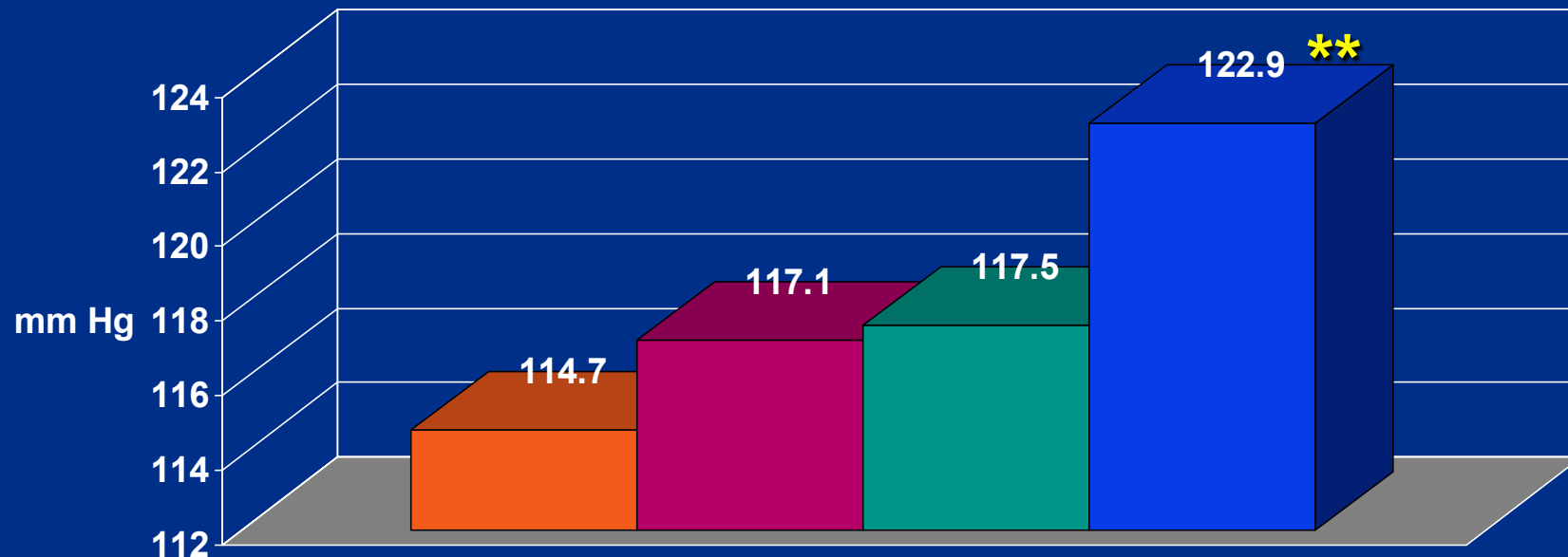
| | | | | | | | | |
|------------|----|-----|-----|-----|----|-----|-----|-----|
| Strain-T1: | no | no | yes | yes | no | no | yes | yes |
| Strain-T2: | no | yes | no | yes | no | yes | no | yes |



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

Job Strain change and Time 2 work systolic AmBP (n=71 Quebec white-collar women with a University degree)

| | | | | |
|-----------------------|----|-----|-----|-----|
| Strain-T1: | no | no | yes | yes |
| Strain-T2 (+14 mon.): | no | yes | no | yes |



controlling for age, smoking, OC use

(Laflamme N et al. *Scand J Work, Environ Health* 1998;24(5):334-343.)

**p<.01 vs. ref.

Belstress Study 2007

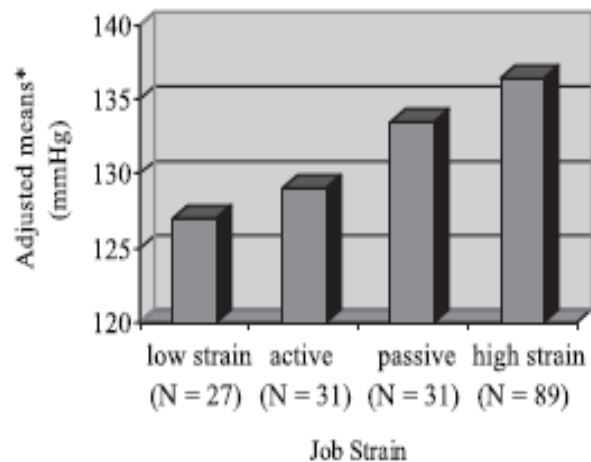


Fig. 1. Adjusted association between quadrant groups of job strain and mean systolic blood pressure at work (mm Hg). *Adjusted for gender, age, body mass index, smoking, high physical demands of the job, high stress outside work, mean level of physical activity prior to blood pressure measurements, and occupation.

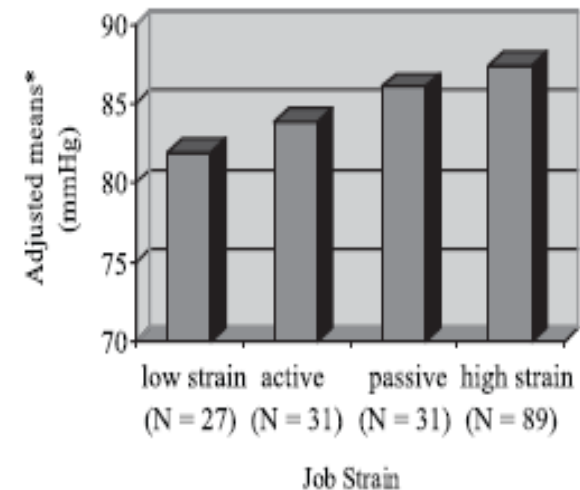
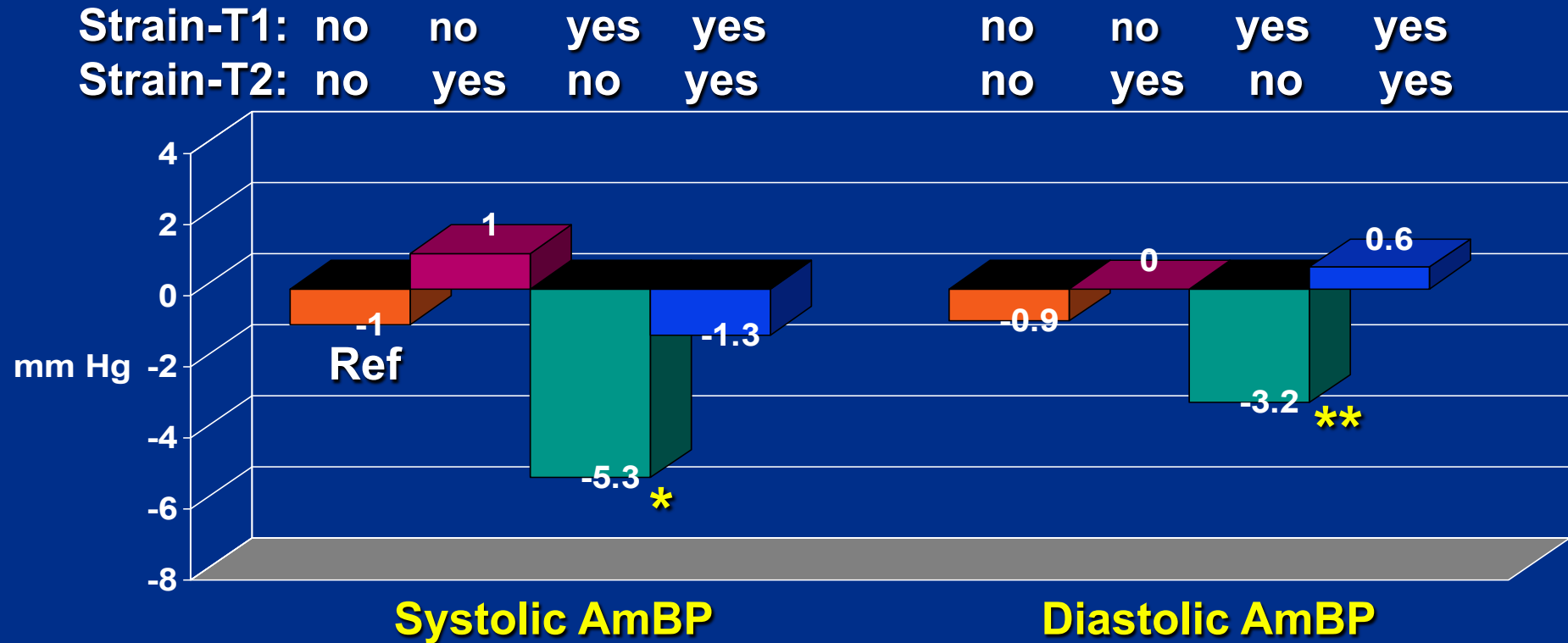


Fig. 2. Adjusted association between quadrant groups of job strain and mean diastolic blood pressure at work (mm Hg). *Adjusted for gender, age, body mass index, smoking, high physical demands of the job, high stress outside work, mean level of physical activity prior to blood pressure measurements, and occupation.

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)

New hypotheses to be tested

Cumulative exposure (work history substudy)

H1: The chronic exposure group has a greater history of past job strain than other exposure groups

H2: Past job strain will be associated with Time 1 BP independent of Time 1 job strain

Job strain-SES interaction

H3: The association between job strain & BP will be greater among lower SES men (blue-collar, lower education or lower income) than higher SES men

H4: The association of past job strain with Time 1 BP will be greater among lower SES men

Work history questionnaire: sample of questions from JCQ

Questions asked for every past job (n=379):

“On that job, did you have...”

Job Demands

1. To work very hard
2. An excessive amount of work

Job Decision Latitude

3. A lot of say about what happened on the job
4. A high level of skill

Questions added after pilot testing (n=291):

Job Decision Latitude

5. A lot of freedom to decide how I do my work
6. The chance to be creative

Work history substudy: Description of sample

Full-time employees at 10 New York City work sites

| | <u>Men</u> | <u>Women</u> |
|--|------------|--------------|
| Avg. number of past full-time jobs at entry into study | 4.9 | 3.8 |
| Length of work history (years) | | |
| Mean | 22.6 | 17.8 |
| Range | 6-43 | 6-43 |
| Age (years) | | |
| 1-41 | | |
| Mean | 44.2 | 41.7 |
| Range | 30-60 | 30-60 |

WHQ Reliability

Internal consistency

Job demands: alpha =.81 (2-item)

Job decision latitude: alpha =.60 (2-item)

Job decision latitude: alpha =.82 (4-item)

WHQ Validity

WHQ recall of job at entry into study vs. full JCQ at entry:

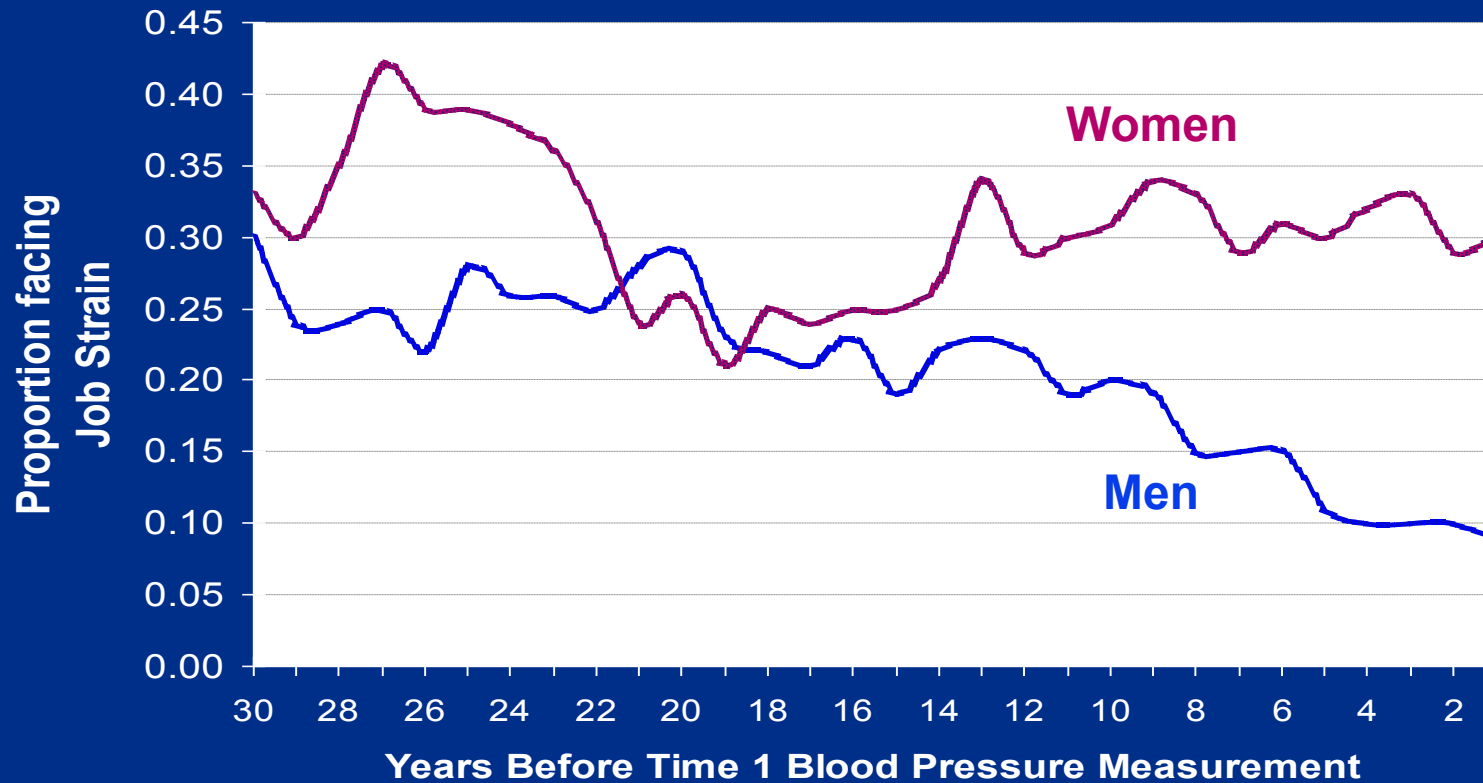
Job demands (r =.50)

Job decision latitude: 2-item (r =.52); 4-item (r=.57)

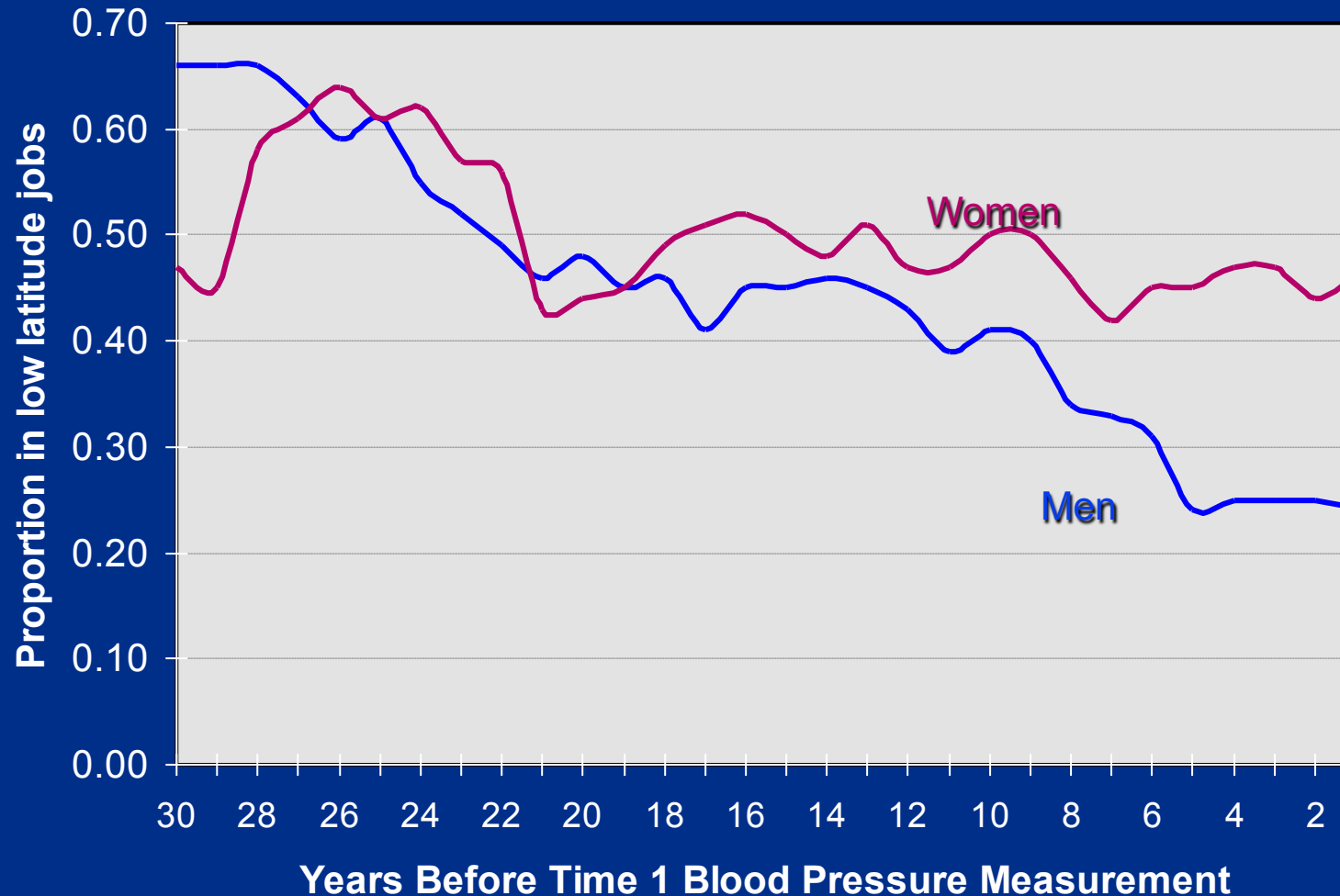
WHQ recall of job strain at entry vs. AmBP at entry:

| | <u>Men</u> | <u>Women</u> |
|--------------------|------------|--------------|
| Work AmSBP (mm Hg) | 5.7 | 2.3 |
| Work AmDBP (mm Hg) | -0.2 | 2.3 |

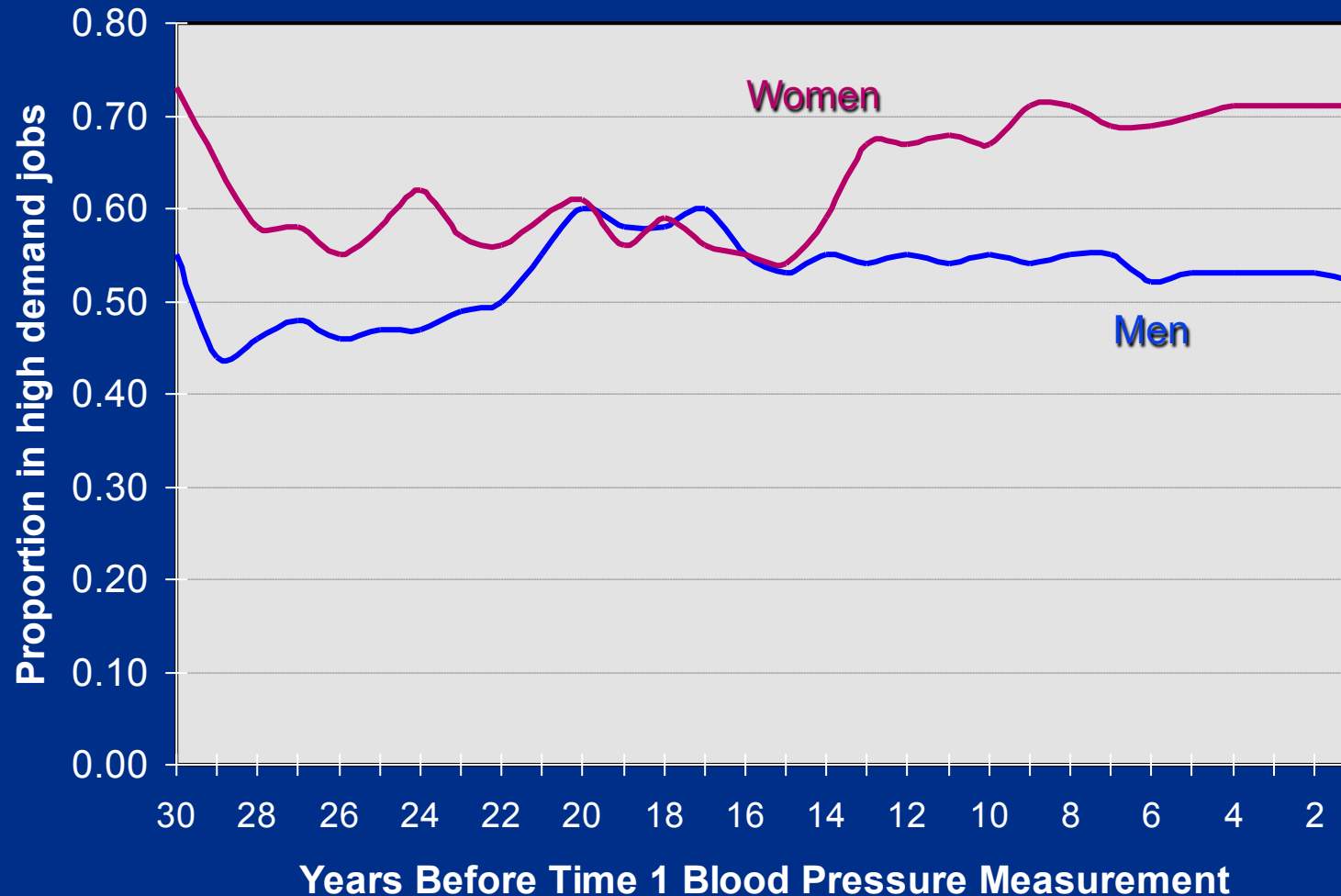
Proportion of participants facing Job Strain in prior jobs (n = 213 men, 157 women)



Proportion of participants facing low latitude in prior jobs (n = 213 men, 157 women)



Proportion of participants facing high demands in prior jobs (n = 213 men, 157 women)



Cumulative burden of exposure: Results

- 1) Little or no association with diastolic BP
- 2) Association with systolic BP, independent of JS at entry
-- but only for men with 20+ years on the job
- 3) Effect of 50% of work life exposed vs. 0% (if employed 25 yrs):
work SBP (mm Hg): 5.2 (+5.5 due to T1 JS = 10.7 combined)
home SBP (mm Hg): 8.2* (+7.2 due to T1 JS = 15.4 combined)
- 4) Stronger associations for low SES vs. high SES men:
-- but not if sample restricted to 25+ yrs employed
 (small sample sizes)
 (few high SES men with exposure & long-term employment)
-- low SES: >N of past yrs exposed, >N yrs employed
 (not necessarily a greater effect per yr exposed)

Induction/Recovery Periods: Results

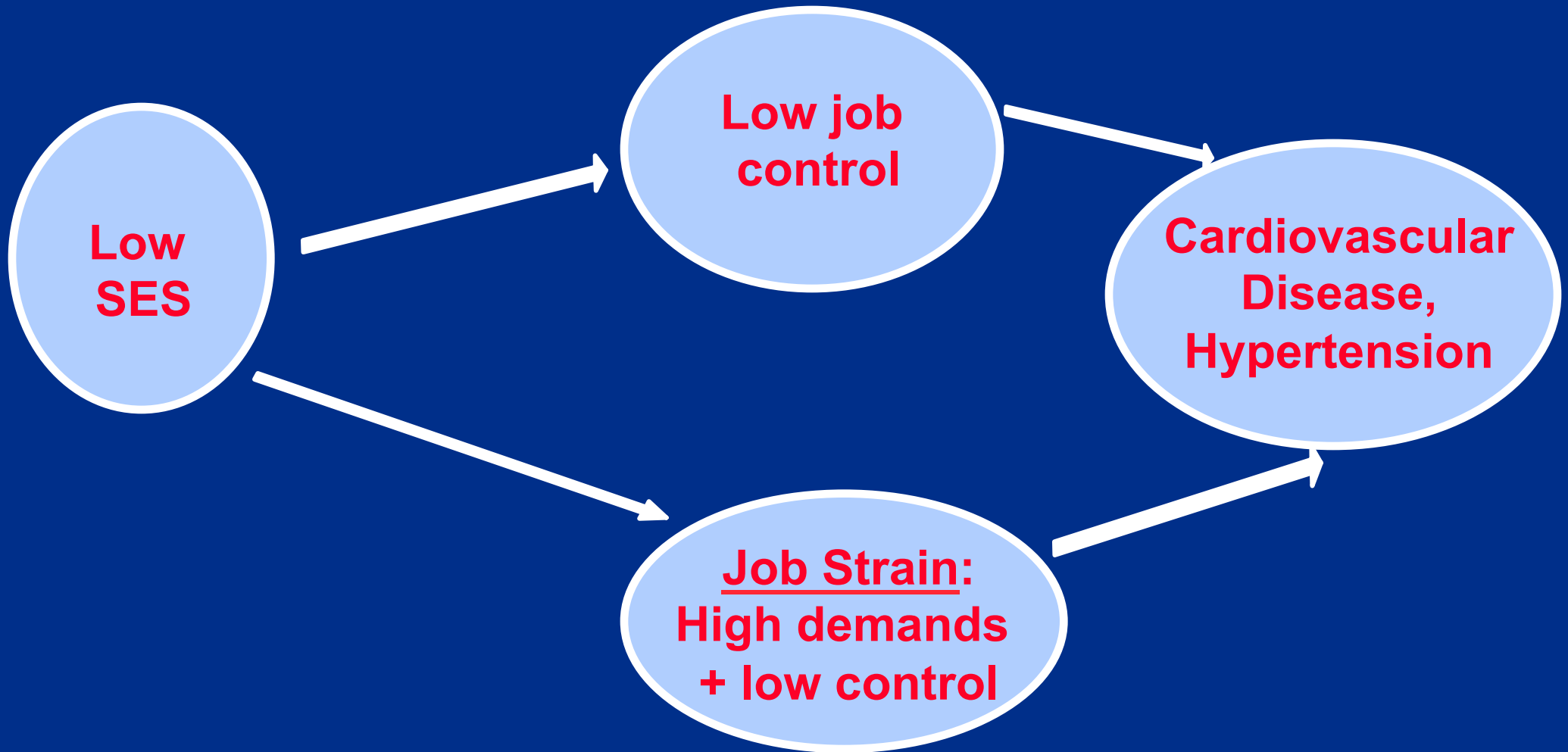
Induction

- 1) Very weak associations of systolic BP w/ distant past exposure
- 2) Substantial associations with past 0-5 yr. exposure
-- but only if employed 25+ yrs
- 3) For men with low SES, and 25+ years on the job:
-- substantial associations with past 5-20 yr. exposure windows
After adjustment for other time windows:
-- substantial associations with 0-5 yr window (home SBP), and
6-10 & 16-20 yr windows (work SBP)
High correlation between exposures in adjacent time windows

Recovery

- 1) Some effect of past exposure but reduced after adjust for other time windows (collinearity between time windows?)

Low SES, CVD and hypertension: Potential workplace pathways



Job Strain, CVD and CVD risk factors: Main Effects

- Low Job Decision Latitude
 - some positive associations in 35 of 46 studies
- High Job Demands
 - some positive associations in 14 of 40 studies
 - inverse associations in 5 recent studies!
(positive in HANES x-sectional; inverse in HANES follow-up)
- Low Social Support
 - positive in 5 of 13 studies

Job Strain, CVD and CVD risk factors: Effect Modification

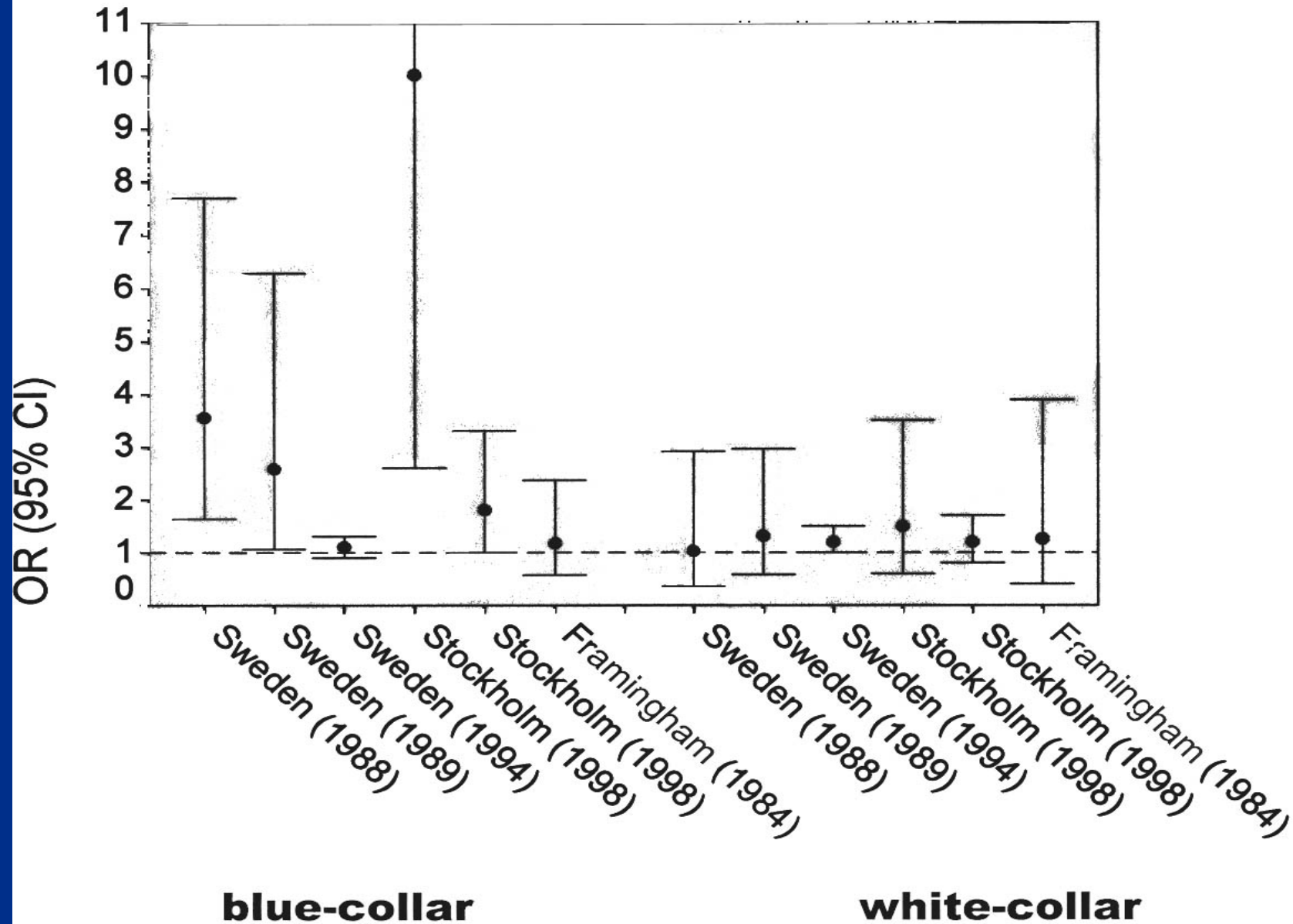
Stronger effects if:

- Older Age
 - in 4 of 5 studies
- Lower Socioeconomic Status (e.g., blue-collar workers)
 - in 8 of 14 studies (but, 3 stronger for white collar)
- Low Social Support
 - positive in 5 of 6 studies

Similar effects for men and women:

- in 20 studies, similar effect sizes
- stronger for men in 9, while stronger for women in 9

Job strain-CVD associations by SES -- men



Job strain and AMBP: A meta-analysis

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30th International Congress of Occupational Health, Cancun Mexico
A1327, March 19th, 2012

Background

- **27 years of studies of work stress and blood pressure or hypertension.**
- **Consistently null associations between work stress exposures and casual office BP**
- **No quantitative meta-analysis conducted because of variation in exposures and blood pressure outcomes.**

Objectives of current review

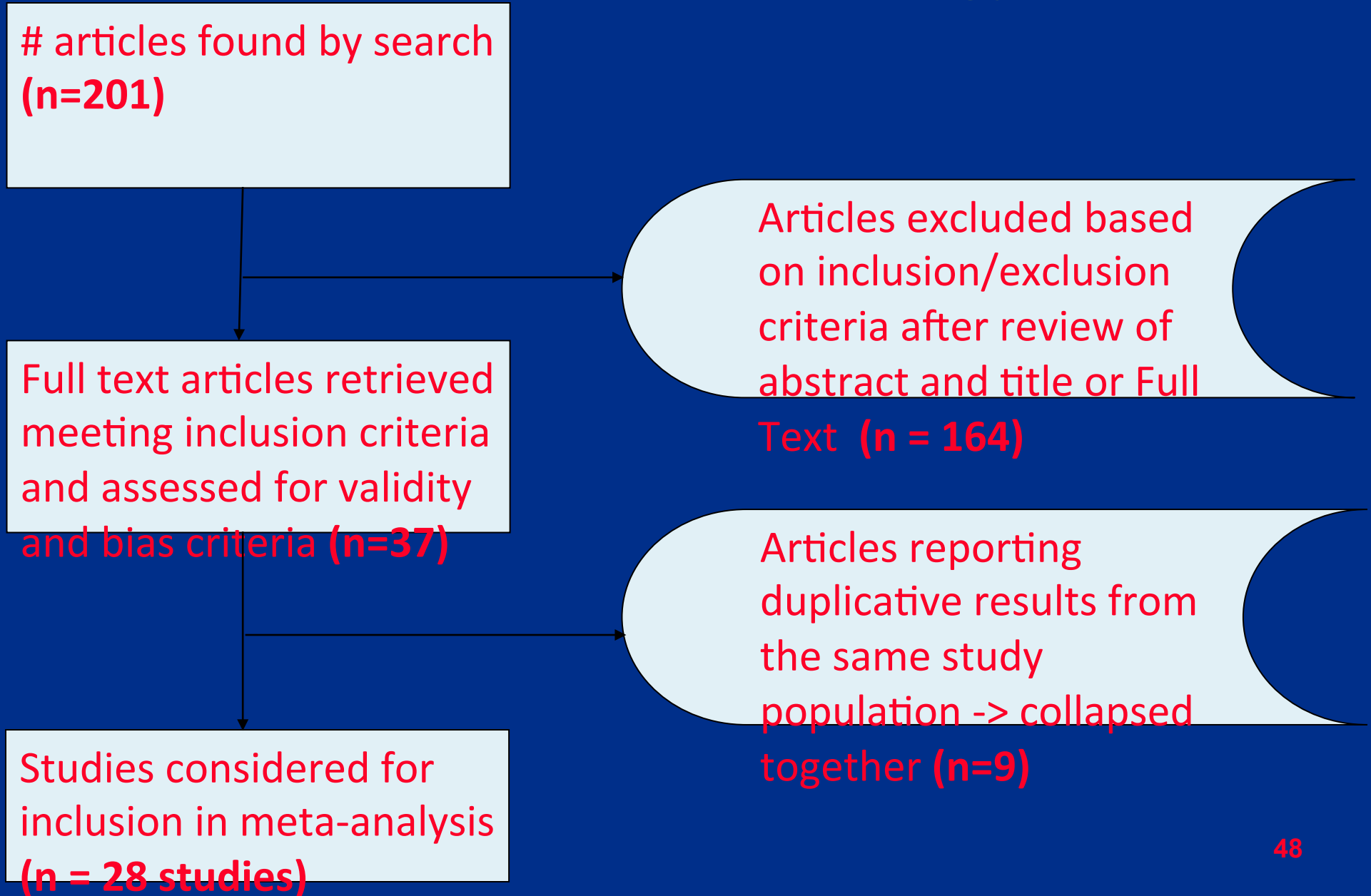
- Conduct a quantitative meta-analysis of published studies to assess magnitude & global significance of association by:
 - Focusing on ONE work exposure: job strain (high workload demands + low decision latitude)
 - Focusing on ONE BP outcome (ambulatory blood pressure)
 - Examine the role of potential moderators (e.g., gender, population-based vs. single occupation studies, self-report of exposure vs. imputation etc.)
 - Systematically assess quality of studies

Inclusion/Exclusion Criteria

Online search of PubMed and CSA Psychinfo databases with dates ranging from 1984 to May, 2011.

- i. Exposure to job strain assessed for 2 major dimensions: workload demands + any of the following: decision latitude, skill discretion, decision authority or decision control.
- ii. Dependent variable: ABP (working, 24 hour, leisure time/ evening, sleep), hypertension status (if measured by ABP).
- iii. Case-control, cross-sectional or cohort design
- iv. Empirical/not laboratory study
- v. Complete study published in English as full-length article in peer-reviewed journal.
- vi. Excluded: Casual/office blood pressure studies

Results of Search Strategy

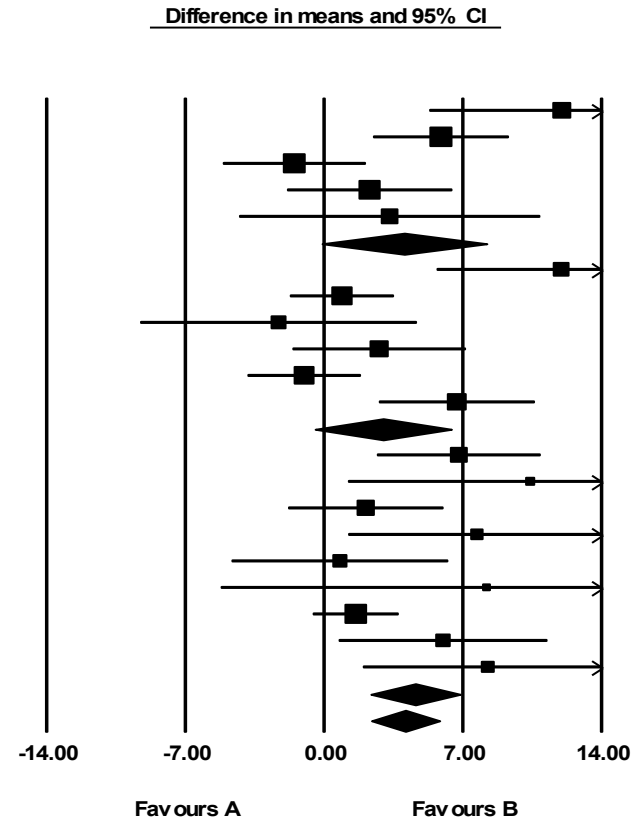


Inclusion in quantitative meta-analysis

- **28 studies considered**
- **Excluded (9):**
 - 4 due to unavailable data (all x-sectional)
 - 3 longitudinal ABP change studies – variable time periods
 - 3 cumulative exposure studies (Schnall et al 1998 also longitudinal)
- **Included: 19 (22 samples) cross-sectional studies with single exposure to job strain**

Meta Analysis

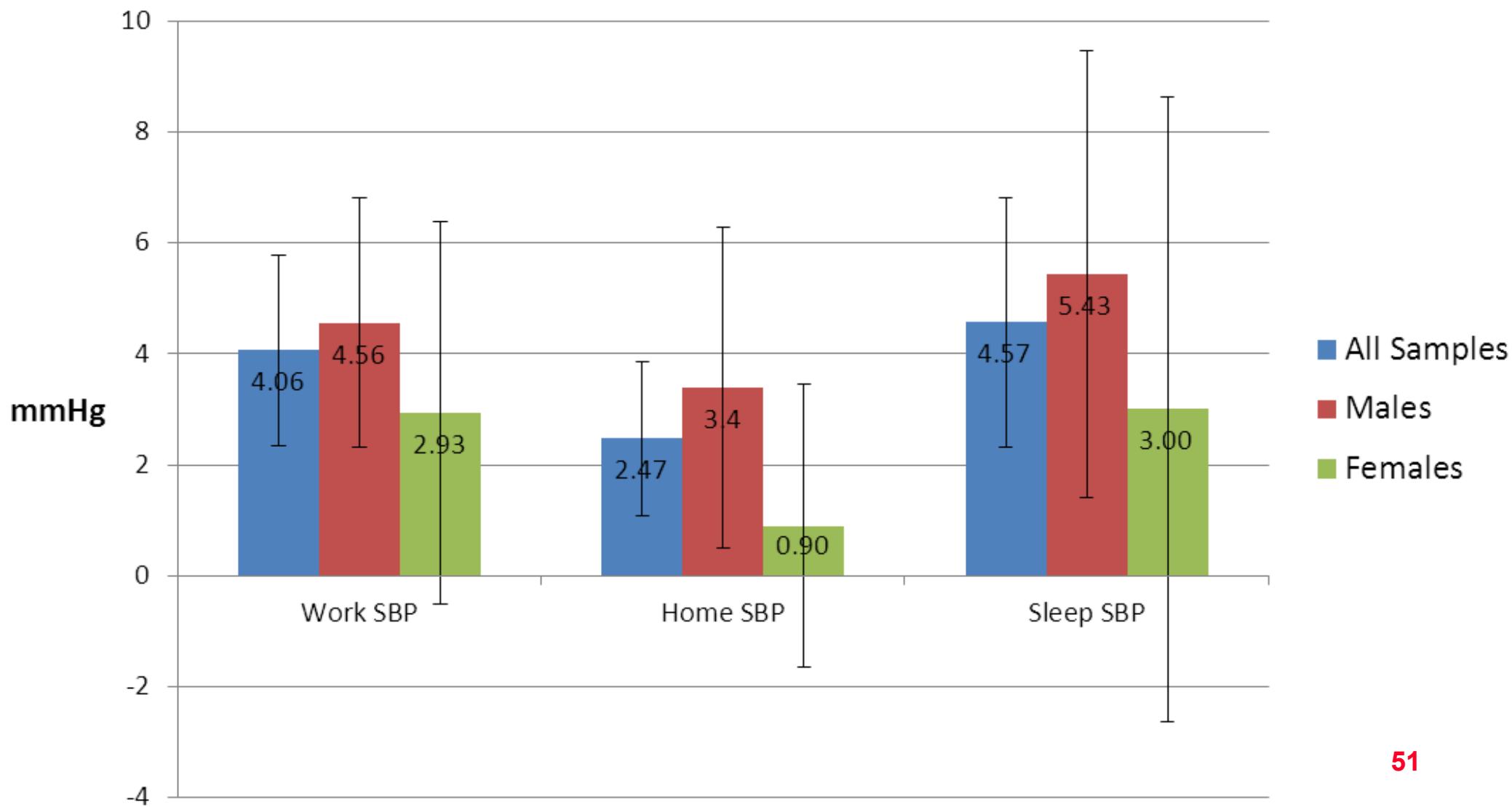
| <u>Group by</u> Gender | <u>Study name</u> | <u>Comparison</u> | <u>Outcome</u> | <u>Difference in means</u> | <u>p-Value</u> |
|---------------------------|-----------------------------|-------------------|----------------|----------------------------|----------------|
| Both | Van Egeren 1992 | JS-ALL | Work systolic | 12.000 | 0.000 |
| Both | Clays 2007 | JS-ALL | Work systolic | 5.900 | 0.001 |
| Both | Steptoe 1999 | JS-ALL | Work systolic | -1.500 | 0.419 |
| Both | Fauvel 2001 | JS-ALL | Work systolic | 2.300 | 0.283 |
| Both | Maina 2010 | High-Low | Work systolic | 3.313 | 0.395 |
| Both | | | | 3.997 | 0.059 |
| Female | Rau 2004 | High-Low | Work systolic | 11.970 | 0.000 |
| Female | Brisson 1999 La Flamme 1998 | JS-ALL | Work systolic | 0.900 | 0.507 |
| Female | Brown 2003 | JS-ALL | Work systolic | -2.300 | 0.520 |
| Female | Tobe 2005 female | JS-ALL | Work systolic | 2.781 | 0.216 |
| Female | Light 1992 female | JS-ALL | Work systolic | -1.000 | 0.497 |
| Female | Theorell 1993 | High-Low | Work systolic | 6.700 | 0.001 |
| Female | | | | 2.933 | 0.094 |
| Male | Schnall 1992 | JS-ALL | Work systolic | 6.800 | 0.001 |
| Male | Melamed 1998 | High-Low | Work systolic | 10.400 | 0.027 |
| Male | Cesana 1996 | High-Low | Work systolic | 2.100 | 0.296 |
| Male | Tobe 2005 male | JS-ALL | Work systolic | 7.718 | 0.021 |
| Male | Theorell 1985 normotensive | JS-ALL | Work systolic | 0.800 | 0.775 |
| Male | Theorell 1985 hypertensive | JS-ALL | Work systolic | 8.200 | 0.232 |
| Male | Theorell 1991 | High-Low | Work systolic | 1.600 | 0.153 |
| Male | Light 1992 male | JS-ALL | Work systolic | 6.000 | 0.026 |
| Male | Rau 2001 | JS-ALL | Work systolic | 8.260 | 0.010 |
| Male | | | | 4.563 | 0.000 |
| Overall | | | | 4.061 | 0.000 |



Meta Analysis

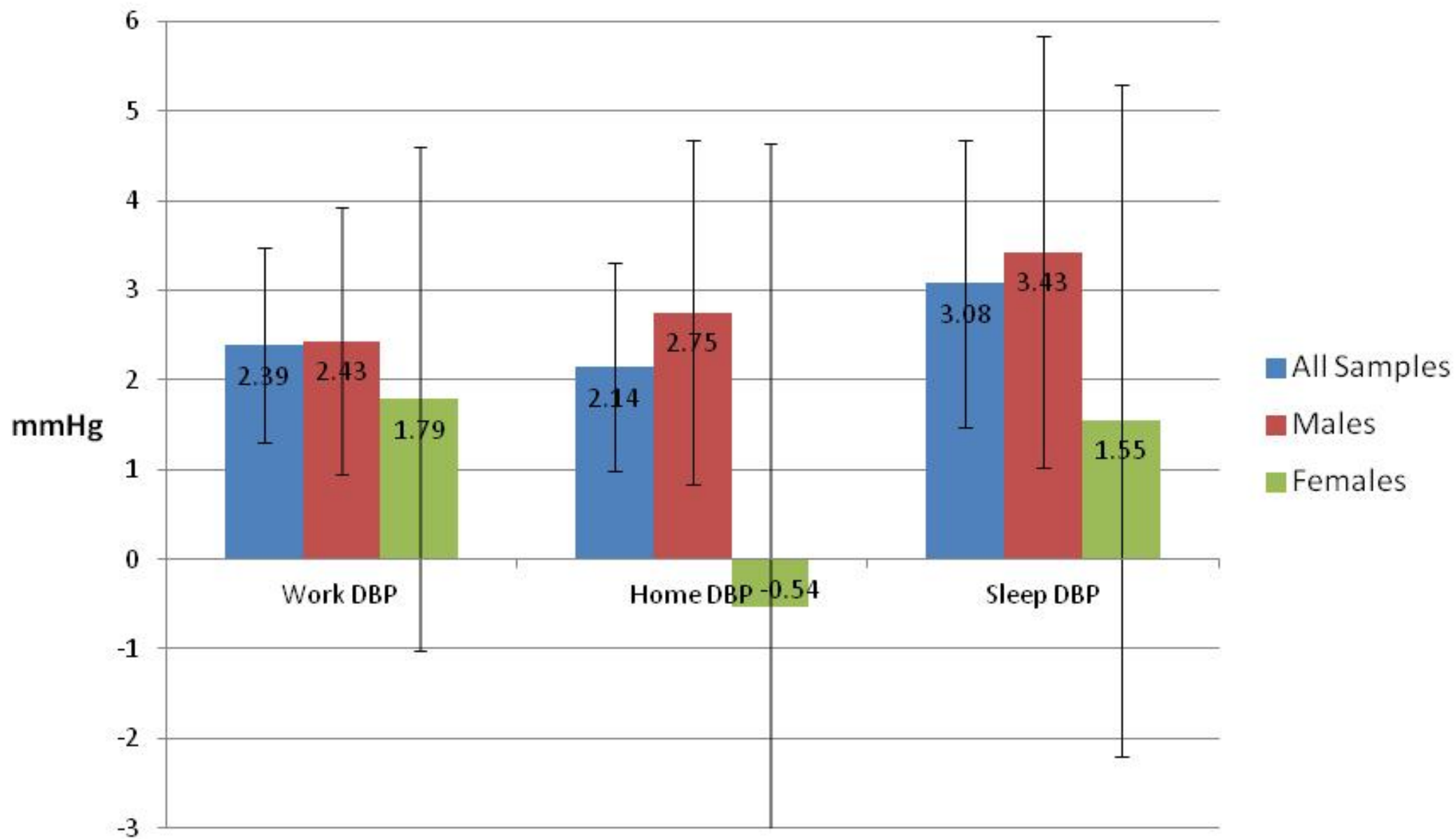
Job strain & systolic ambulatory blood pressure

(20 samples from 17 studies, mm Hg, 95% CI)



Job strain & diastolic ambulatory blood pressure

(20 samples from 17 studies, mm Hg, 95% CI)



Job Strain Exposure Contrasts

Work SBP/DBP (mm Hg):

2.4/1.9 (p<.001, n=14 samples)

4.1/4.6 (p<.001, n=6 samples)

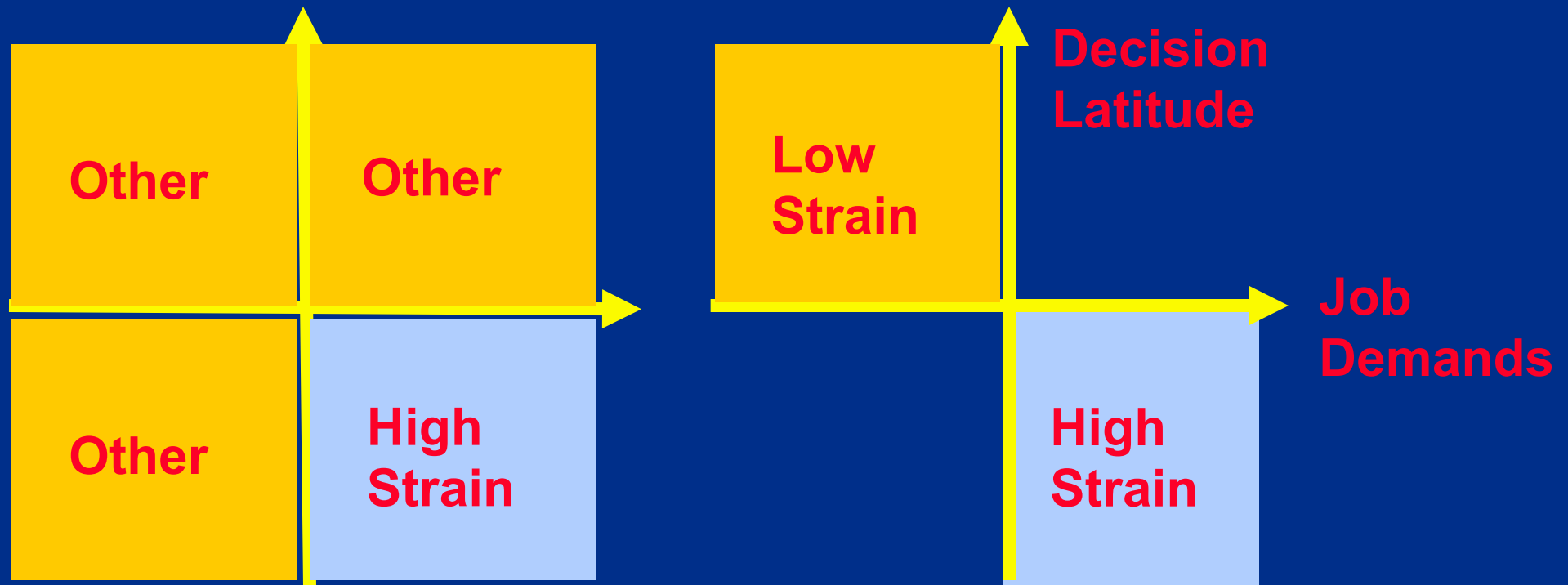


Table 4. Number of studies reporting a statistically significant deleterious effect / total number of studies having these methodological characteristics ^(reference number) reporting a deleterious effect of effort-reward imbalance (ERI) on blood pressure (BP) according to gender, study designs (cross-sectional, prospective or case-control), BP measurements (office or ambulatory) and outcome (hypertension or BP level).

| | Cross-sectional studies (N=11) | | Prospective study (N=1) | | Total |
|--------------|--|--|----------------------------|--|-------|
| | Office BP (N=8/11) | Ambulatory BP (N=3/11) | Office BP (N=0/1) | Ambulatory BP (N=1/1) | |
| Women | | | | | |
| Hypertension | 0 / 3 ^(149, 185, 190) | 0 / 0 | 0/0 | 1 ⁽¹⁹¹⁾ / 1 ⁽¹⁹¹⁾ | 1 / 4 |
| BP level | 1 ⁽¹⁸⁹⁾ / 2 ^(183, 189) | 0 / 0 | 0/0 | 1 ⁽¹⁹¹⁾ / 1 ⁽¹⁹¹⁾ | 2 / 3 |
| Men | | | | | |
| Hypertension | 4 ^(184-186, 190) / 4 ^(184-186, 190) | 0 / 0 | 0/0 | 0 / 1 ⁽¹⁹¹⁾ | 4 / 5 |
| BP level | 0 / 0 | 1 ⁽¹⁸⁸⁾ / 1 ⁽¹⁸⁸⁾ | 0/0 | 0 / 1 ⁽¹⁹¹⁾ | 1 / 2 |

IPD Study: Job strain and CVD Findings

Study found

- **HR=1.23**
- **This effect estimate was higher in published (1.43, 1.15–1.77) than unpublished (1.16, 1.02–1.32) studies**
- **PAR%=3.4%**

IPD Study: Strengths → efforts to reduce bias

- **Cohort studies only**
- **Include unpublished studies**
- **Population-based studies: broad occupational variance**
- **Exclude events within 3 or 5 years from baseline**
 - To reduce possible selection to shorter work hours due to sub-clinical disease
- **Other study strengths**
 - Control for confounders
 - Sub-group analyses

IPD Study

Limitations → sources of bias towards the null value (not acknowledged in article)

- Exposure misclassification due to use of median cutpoints for job demands & job decision latitude
- Job strain measured once: selection out of high strain jobs during follow-up
 - While working
 - Due to retirement
- Therefore, HR=1.23 and PAR%=3.4% may be underestimates

IPD Conclusions

The IPD authors conclude that:

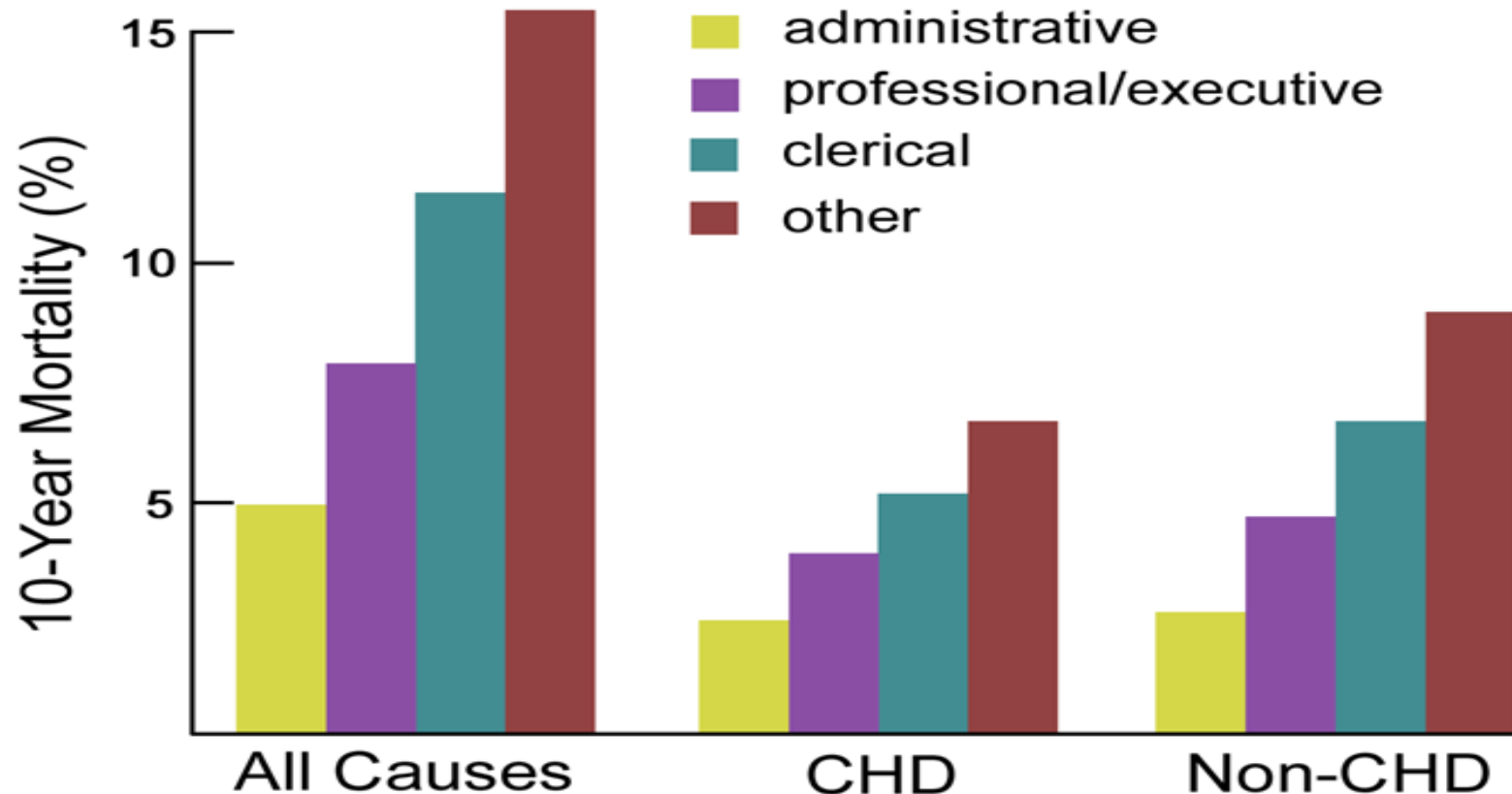
“Our findings suggest that prevention of workplace stress might decrease disease incidence; however, this strategy would have a much smaller effect than would tackling of standard risk factors, such as smoking.

Has the prevalence of job strain declined in developed countries as they have de-industrialized?

- **Job strain model is best suited to industrial work**
 - **Other models, such as:**
 - the effort-reward imbalance model
 - job insecurity (downsizing)
 - factors related to social capital and emotions
- are likely to be of major importance in the future**
- **The present economic crisis will almost certainly increase this importance**

The social class “gradient” in disease

Age-adjusted percent of men dying in 10 years from all causes, from coronary heart disease, and from non-coronary heart diseases.

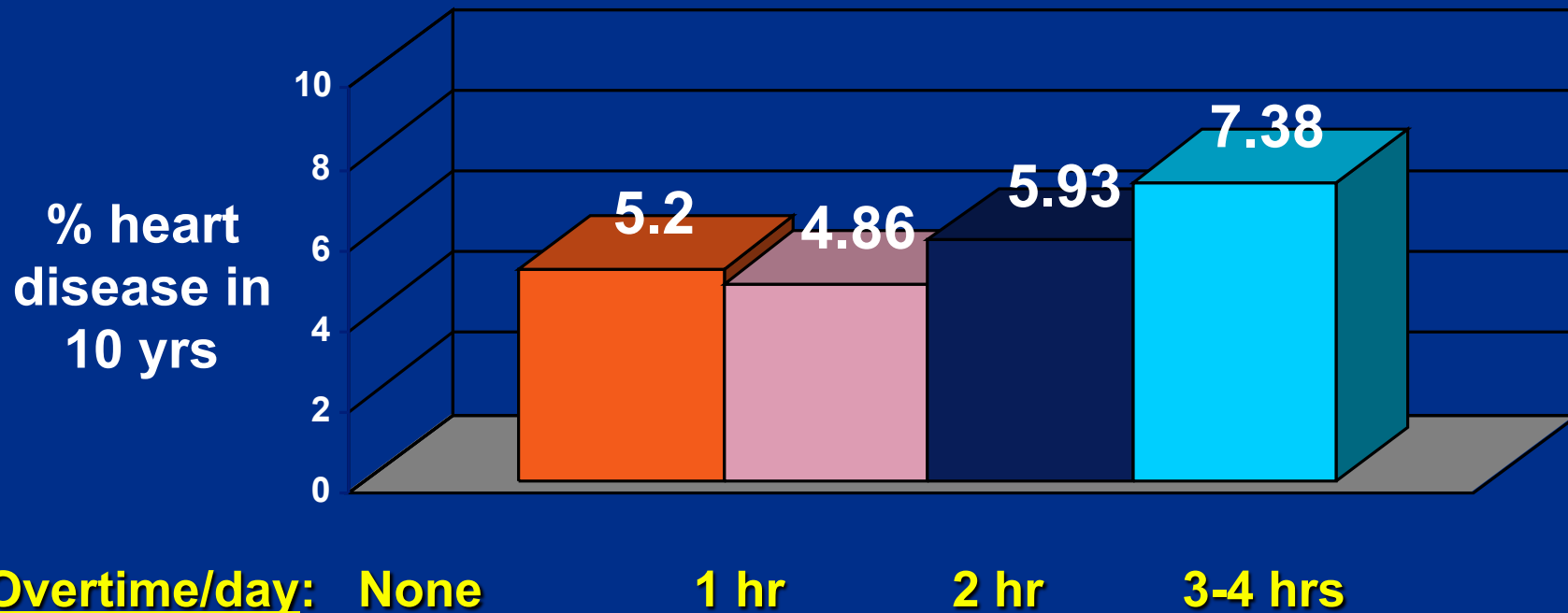


Subjects were British civil servants

Marmot et al


Long work hours increase heart disease risk

(6,014 British govt workers, men & women, age 39-61, followed 11 yrs, 369 cases)



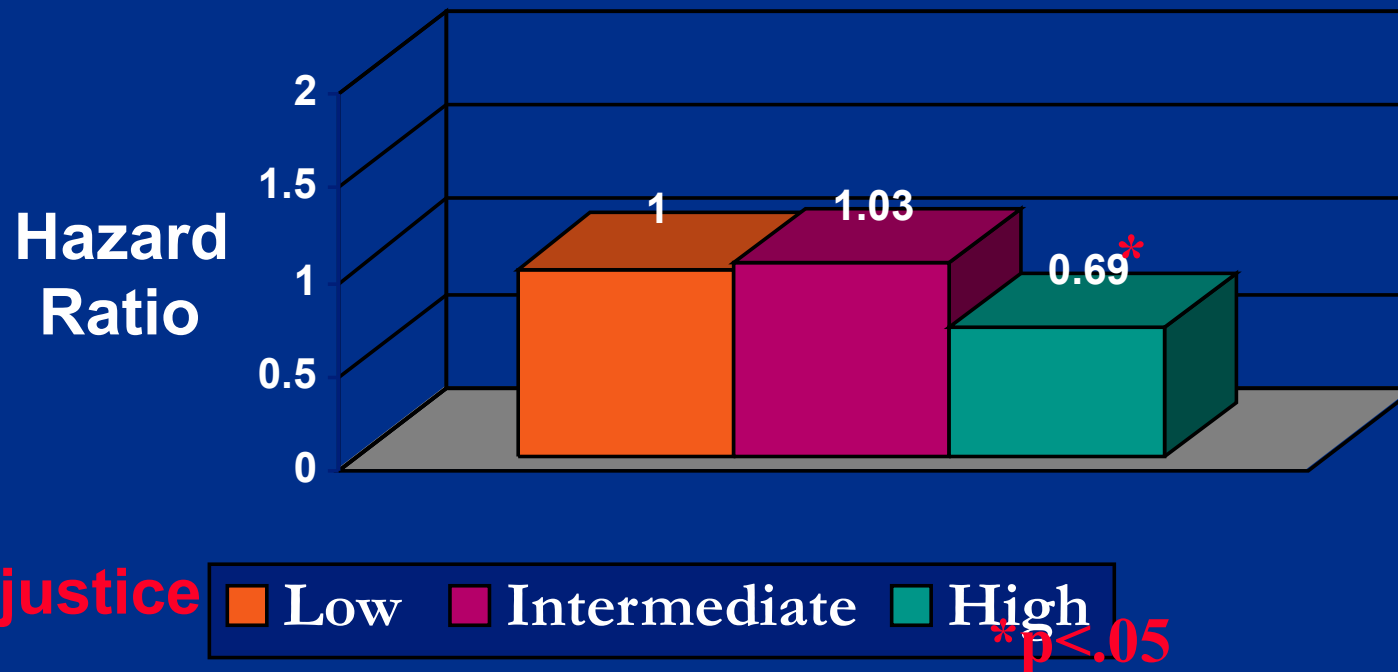
Similar pattern if control for age, gender, marital status, job status, diabetes, blood pressure, cholesterol, smoking, alcohol use, fruit and vegetable consumption, exercise, body mass index, sleeping hours

Organizational justice

- Relational justice (Whitehall II Study, =.72)
 - Do you ever get criticized unfairly (reverse scored)?
 - Do you get consistent information from line management (your superior)?
 - Do you get sufficient information from line management (your superior)?
 - How often is your superior willing to listen to your problems?
 - Do you ever get praised for your work?

Relational justice (fair treatment by supervisors) decreases risk of heart disease

(Whitehall II study, 6,442 men, age 35-55, 8.7 yr follow-up)

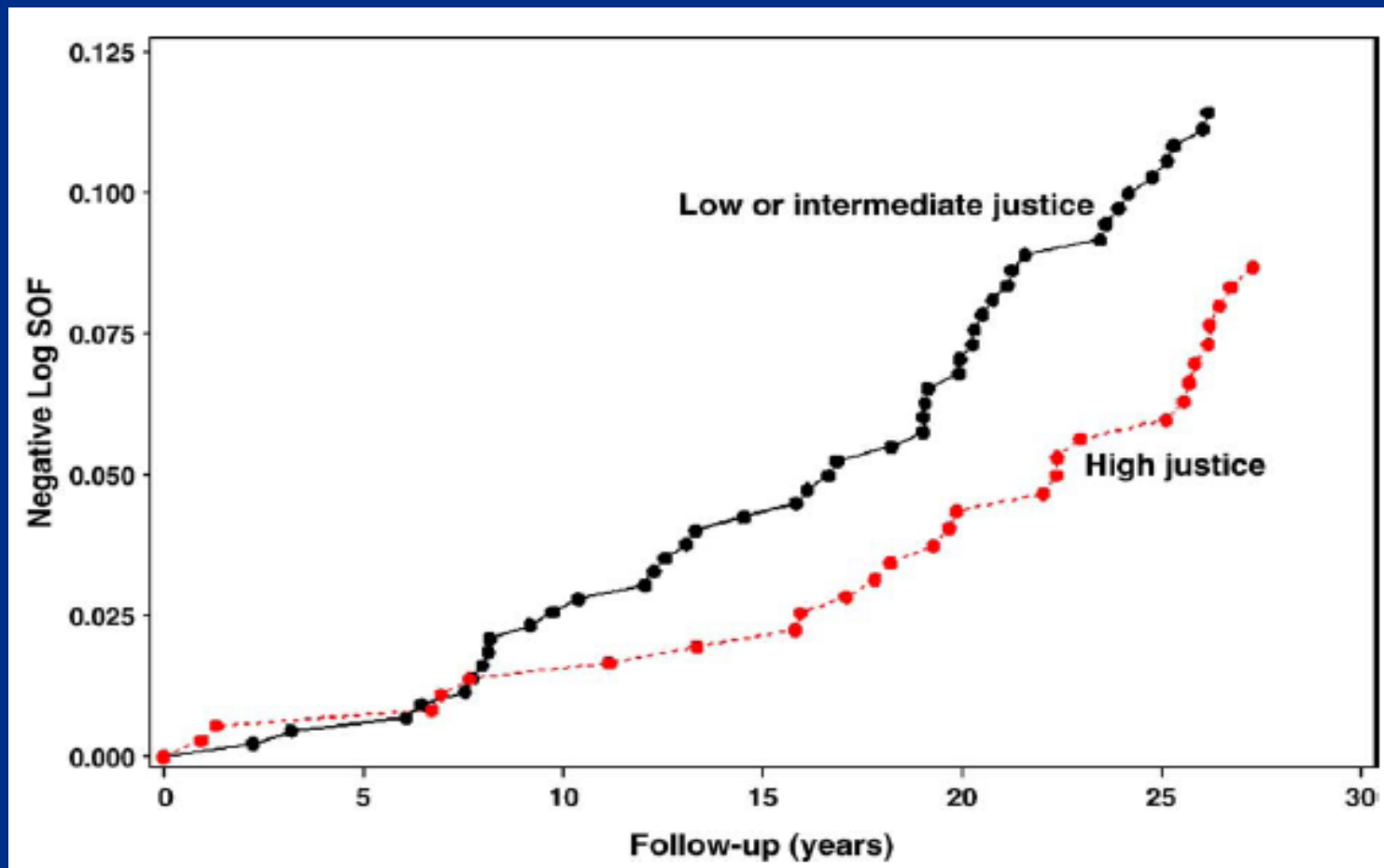


Controlling for age, occupational status, BMI, cholesterol, smoking, hypertension, alcohol, physical activity, job strain, effort-reward imbalance

Relational justice and coronary heart disease

Finnish factory workers, 540 men, 264 women, 25.6 yr follow-up

“My supervisor treats me fairly”



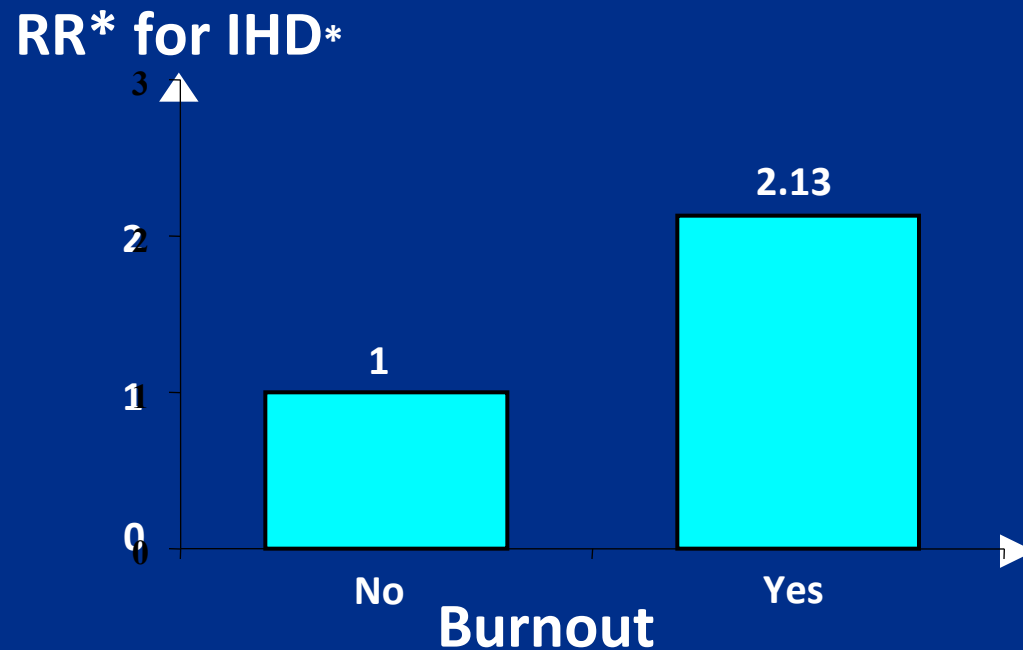
Shorter sleeping hours

- **An important pathway to illness:**
 - Lack of sleep → higher blood pressure, heart rate
 - 4-6 (vs. 7-8) hrs/day of sleep → increased risk of heart disease

Burnout predicts ischaemic heart disease

A 4.2 years' follow-up study of 3,877 Dutch male employees from Rotterdam

"Have you ever been burned out?" No = 74%, Yes=26%



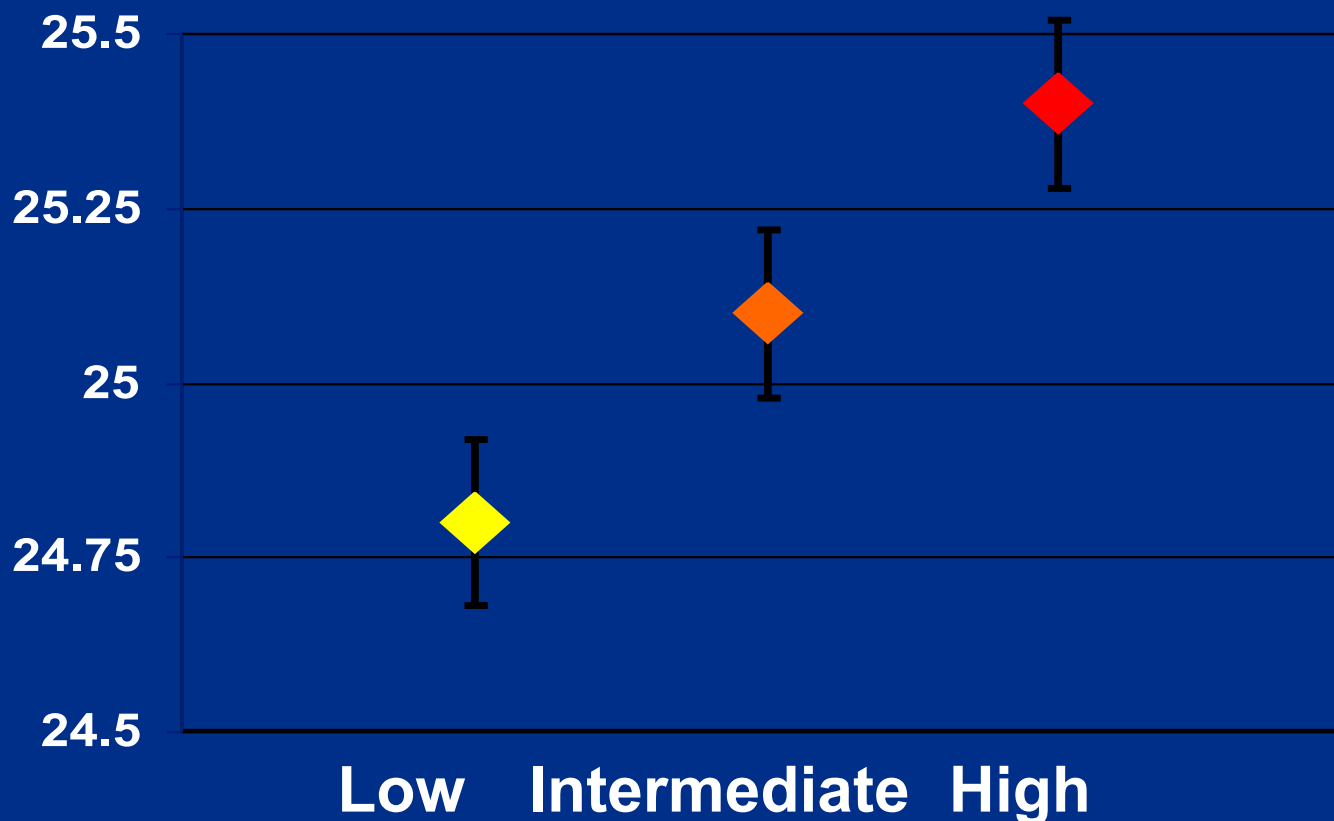
* Controlled for age, BP, smoking, cholesterol. 59 cases.

Appels & Schouten. Behav Med 1991;Summer:53-59

Effort-reward imbalance predicts increase in body mass index at 10-yr follow-up*

(N=902 male and female industrial workers, Finland)

BMI

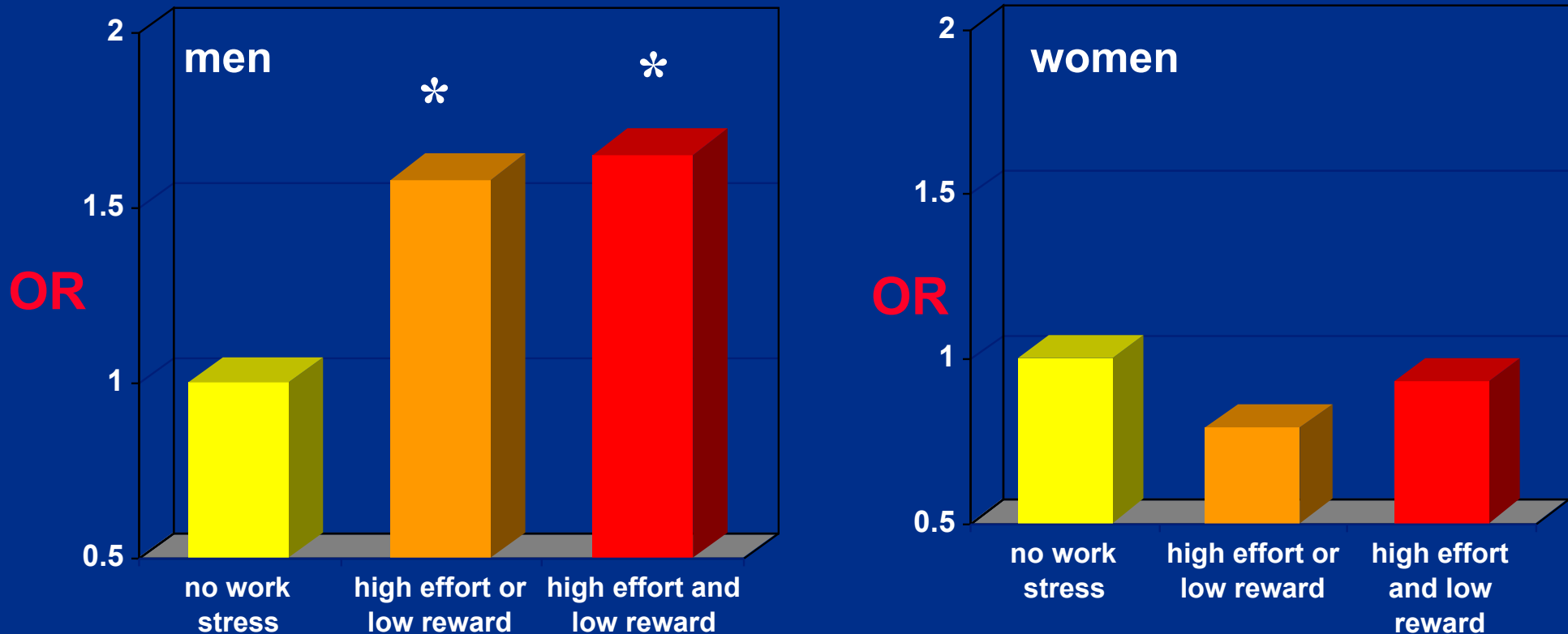


*adj. for age, sex and baseline value

p = .002

Effort-reward imbalance increases risk of incident type 2 diabetes in men

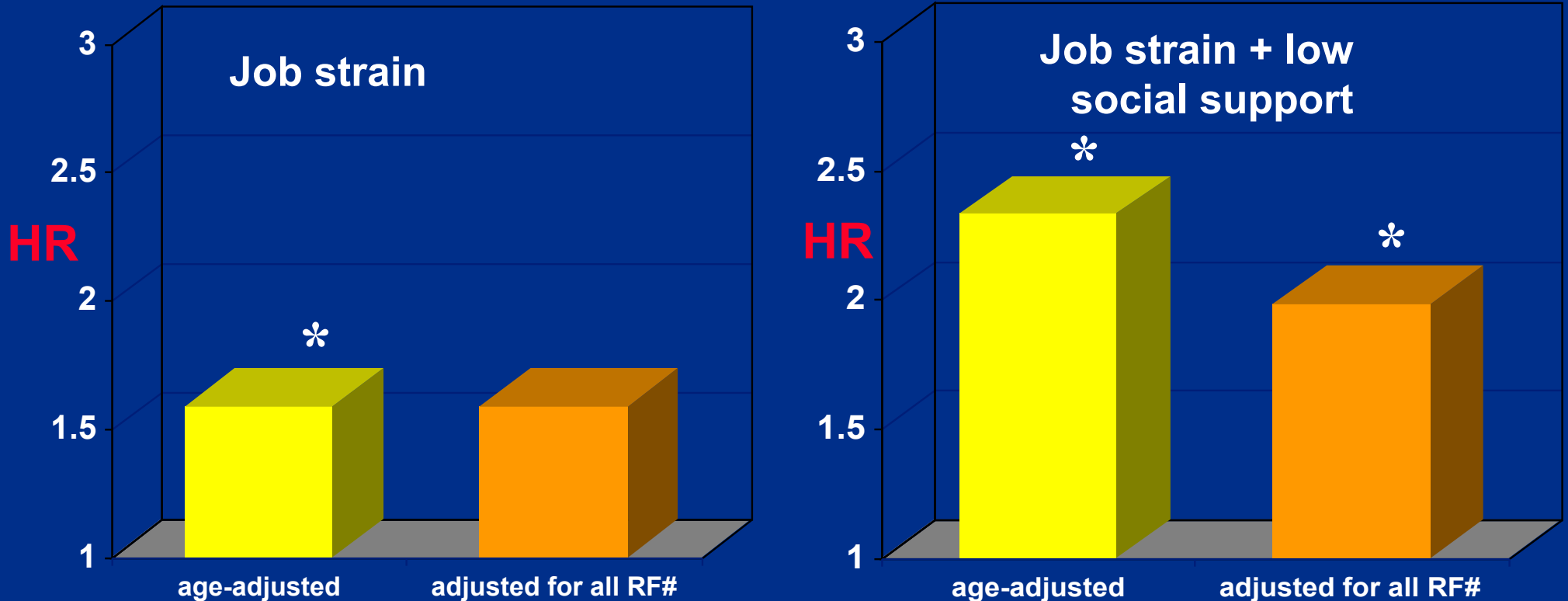
(British Whitehall II-Study; N=8067, mean follow-up: 12.5 yrs)



ORs adjusted for age, employment grade, ethnic group, length of follow up, ECG abnormalities, family history of diabetes, BMI, height, SBP, exercise, smoking, life events

Work stress increases risk of incident type 2 diabetes in women

(British civil servants; N=1729 women, mean follow-up: 11.6 yrs)

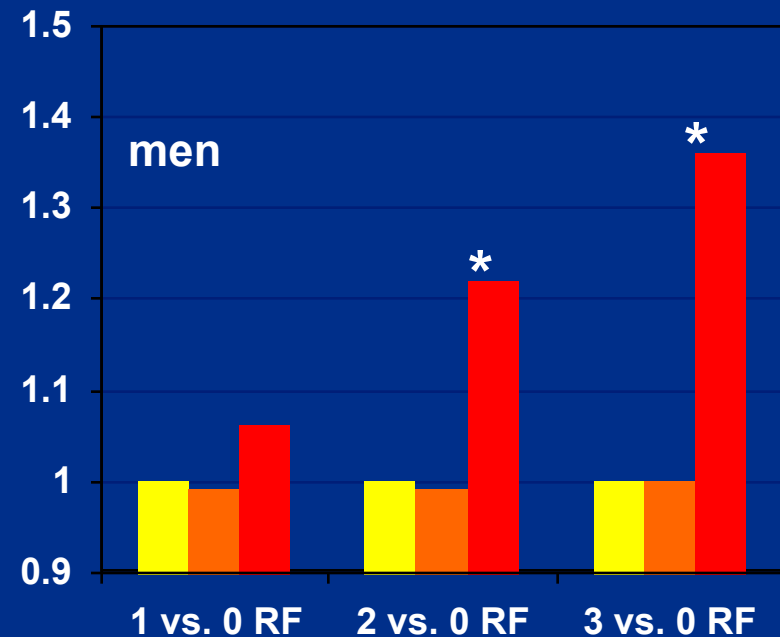
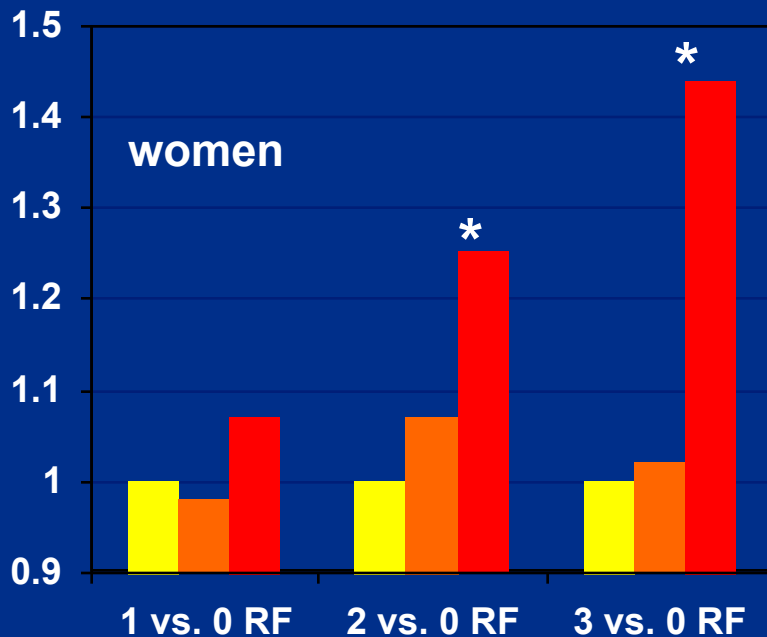


Hazard Ratios adjusted for diet, physical activity, alcohol, smoking, employment grade, life events, BMI, systolic BP, triglycerides, HDL cholesterol, CRP

Effort-reward imbalance associated with co-manifestation of behavioural CHD risk factors

(N=28,844 women and 7,233 men, public service, Finland)

Risk factors (RF): BMI \geq 25, smoking, heavy alcohol use, physical inactivity; Odds ratios, adj. for age, SES, marital status



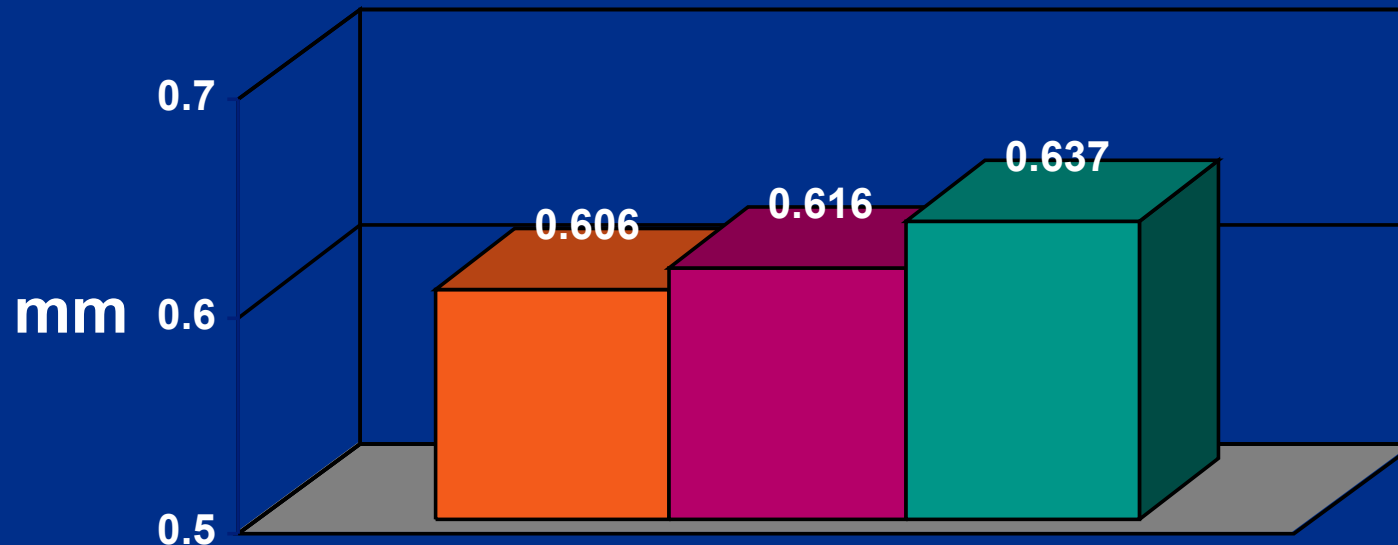
Effort-reward imbalance

no

medium

high

Job strain associated with carotid artery intima-media thickness, controlling for pre-employment risk factors (Finnish men, age 33-39)



Job strain

Low

Intermediate

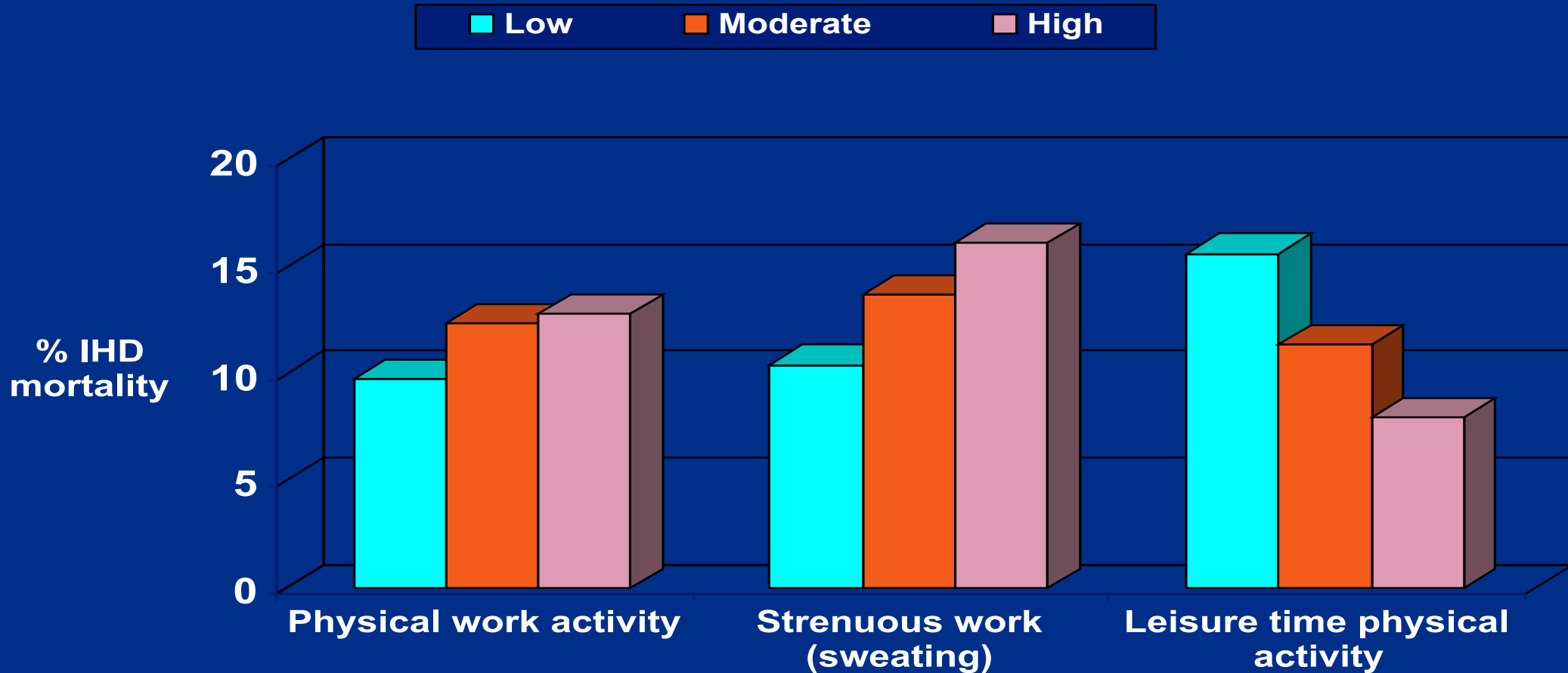
High

$p(\text{trend})=.03$

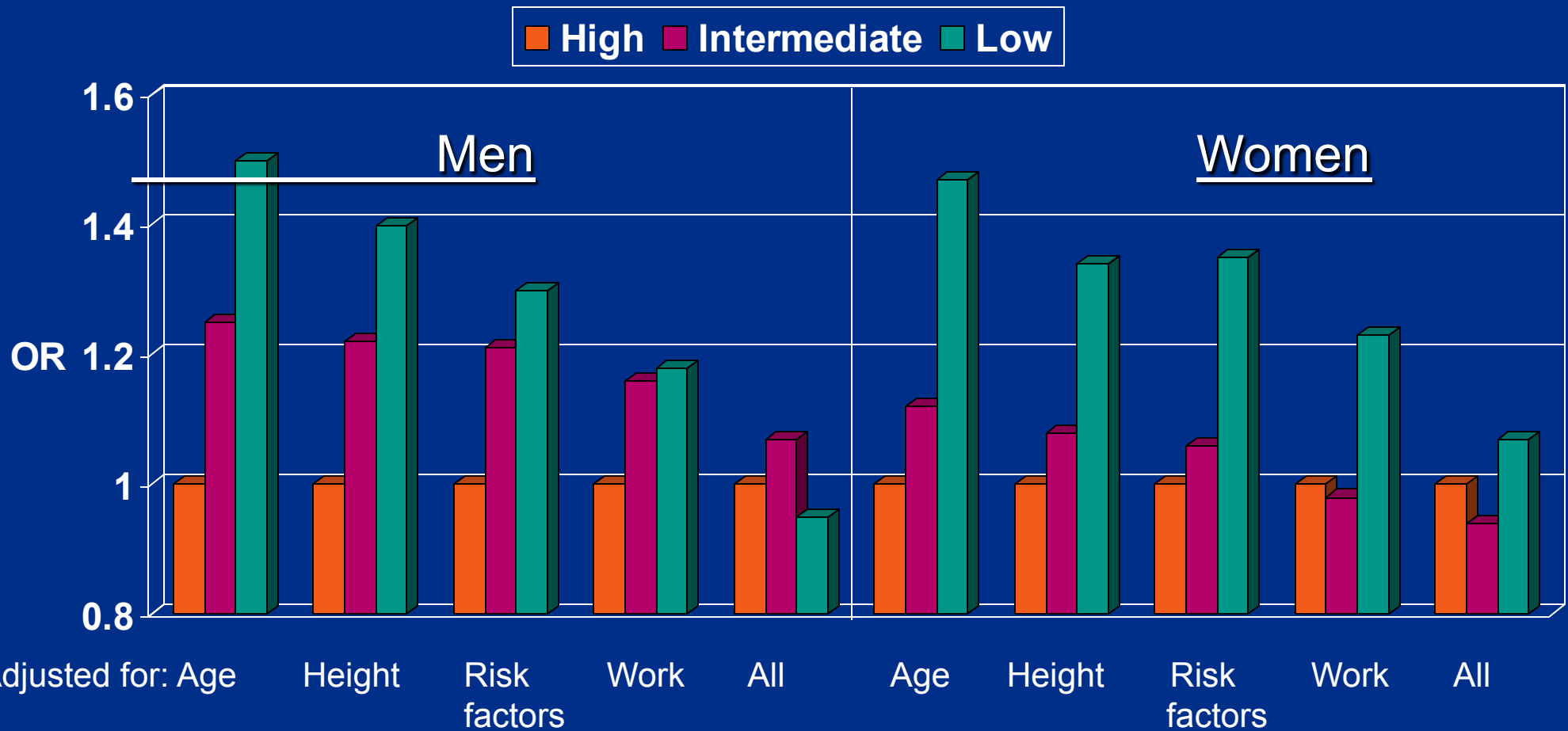
Controlling for age & risk factors assessed at age 12-18: BMI, HDL & LDL cholesterol, triglycerides, systolic BP, smoking, family history of CHD, parents occupational position

Physical work activity increases, leisure-time physical activity decreases IHD mortality

(5249 employed Copenhagen men age 40-59, 30 yr f/u, 1971-2001)



Odds ratios for new CHD in Whitehall II by employment grade



Job Strain and Work Ambulatory BP by Education (n=283 men, Time 1)

Systolic BP

Diastolic BP

Job Strain

No Strain

Job Strain

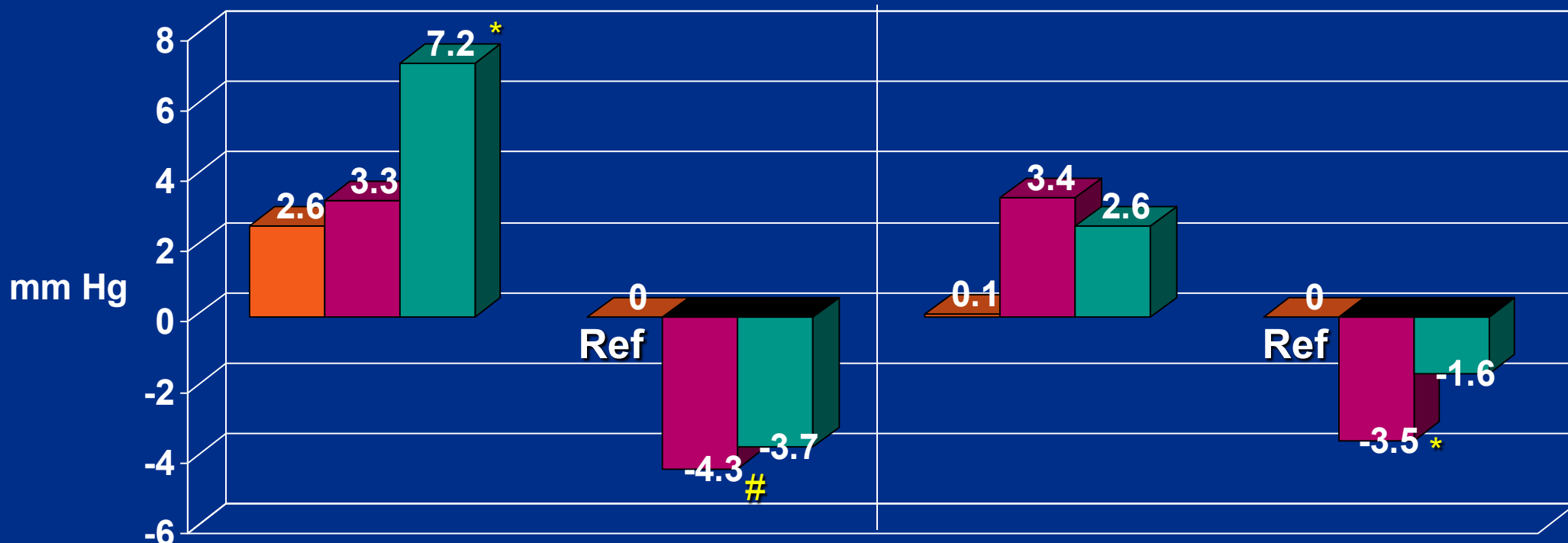
No Strain

EDUC (yrs): 16+ 13-15 ≤12

16+ 13-15 ≤12

16+ 13-15 ≤12

16+ 13-15 ≤12



INTERACTION TERM: $p=.08$

$p=.15$

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

$p<.10$, * $p<.05$, ** $p<.01$, *** $p<.001$ (vs Ref group)

Job Strain and Work Ambulatory BP by Occupational Status

(n=283 men, Time 1)

Systolic BP

Diastolic BP

Job Strain

No Strain

Job Strain

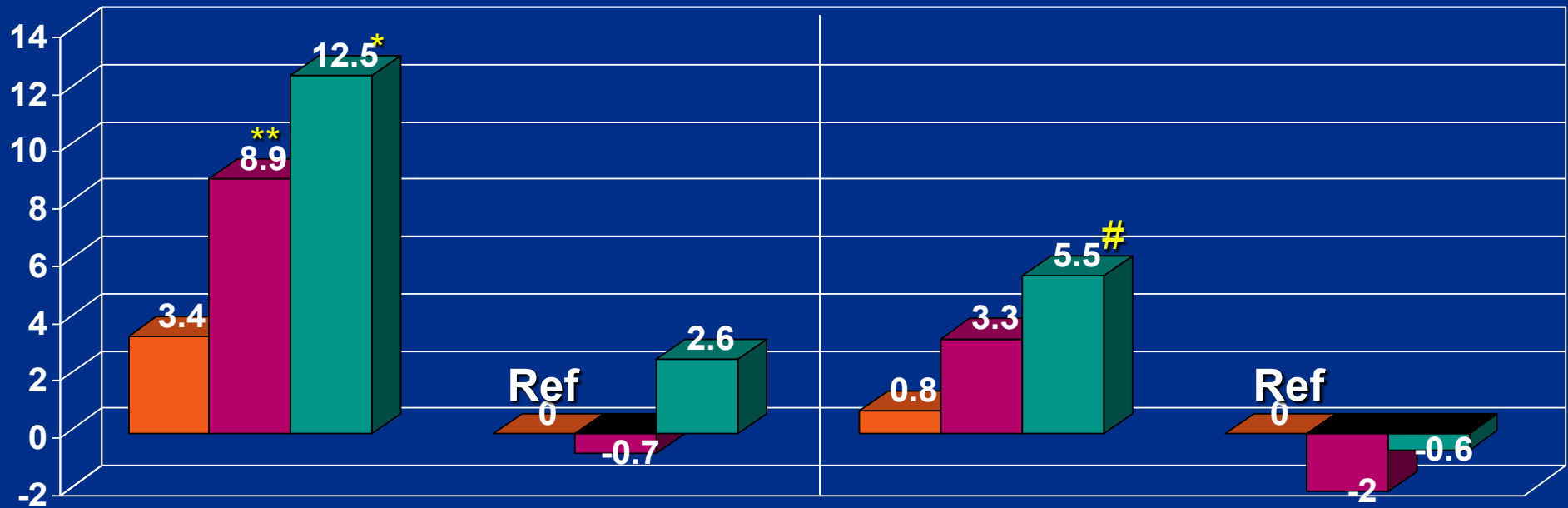
No Strain

COLLAR: White Cler Blue

White Cler Blue

White Cler Blue

White Cler Blue



#p<.10, *p<.05, **p<.01, ***p<.001 (vs Ref group)

Why job strain-low SES interaction?

- Unhealthy behaviors? smoking, lack of physical exertion, BMI (for CAD but not BP)
- Physical and psychosocial working conditions
- Low income/benefits
 - 76% of low-income employees: no paid sick days (vs. 42% U.S. avg)
- Physical non-work exposures
 - air pollution (PM_{2.5})
- Sedentary behavior
 - poor public recreation facilities; unsafe to exercise outdoors
- Unhealthy diet
 - healthy food highly priced or unavailable
- Life stressors
 - unemployment; crime; deteriorating urban physical environment

Lovell V, *No Time to be Sick*. Institute for Women's Policy Research, May 2004.

Isaacs SL, Schroder SA. Class – The ignored determinant of the nation's health. *NEJM* 2004;351(11):1137-1142.

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):

Job Strain, CVD and CVD risk factors: Methodological Issues

- Imputation studies

- Positive in 8 of 12 CVD studies
- Positive in 2 of 10 risk factor studies (+ 2 mixed)

- Use of varied measures of Job decision latitude:

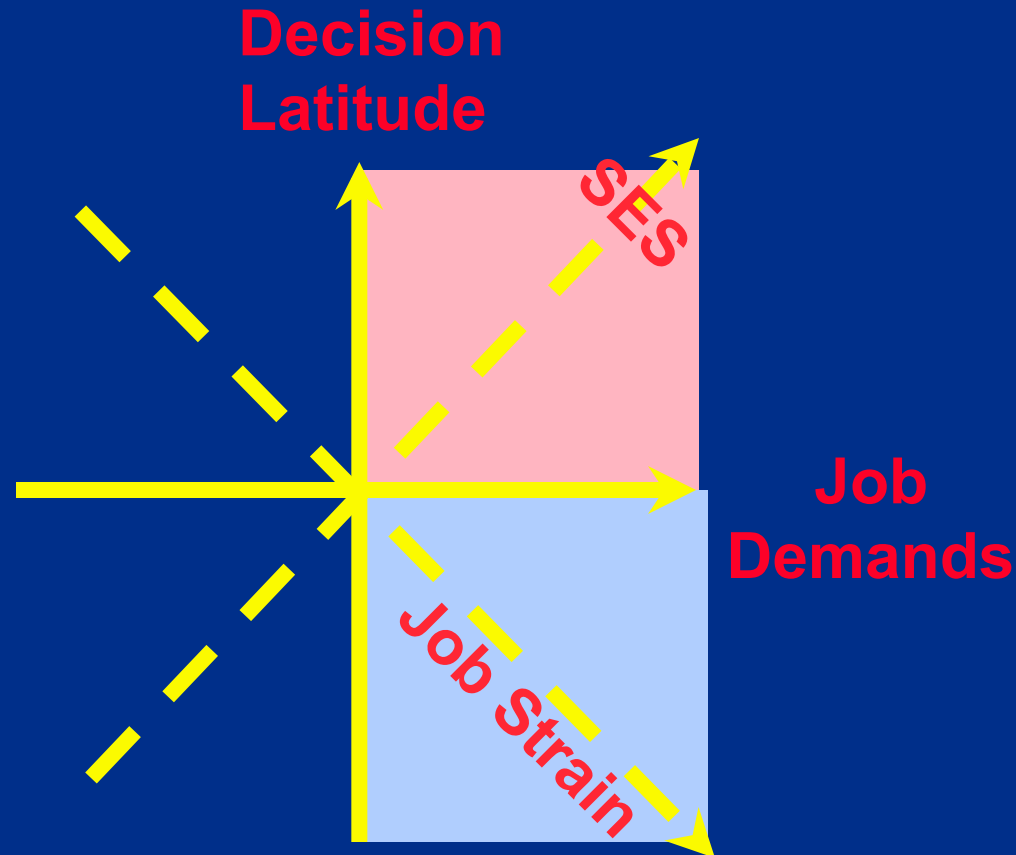
- Low “supervision clarity” (Framingham heart study)
- Low income (Finnish Kuopio heart study)

- Job demands:

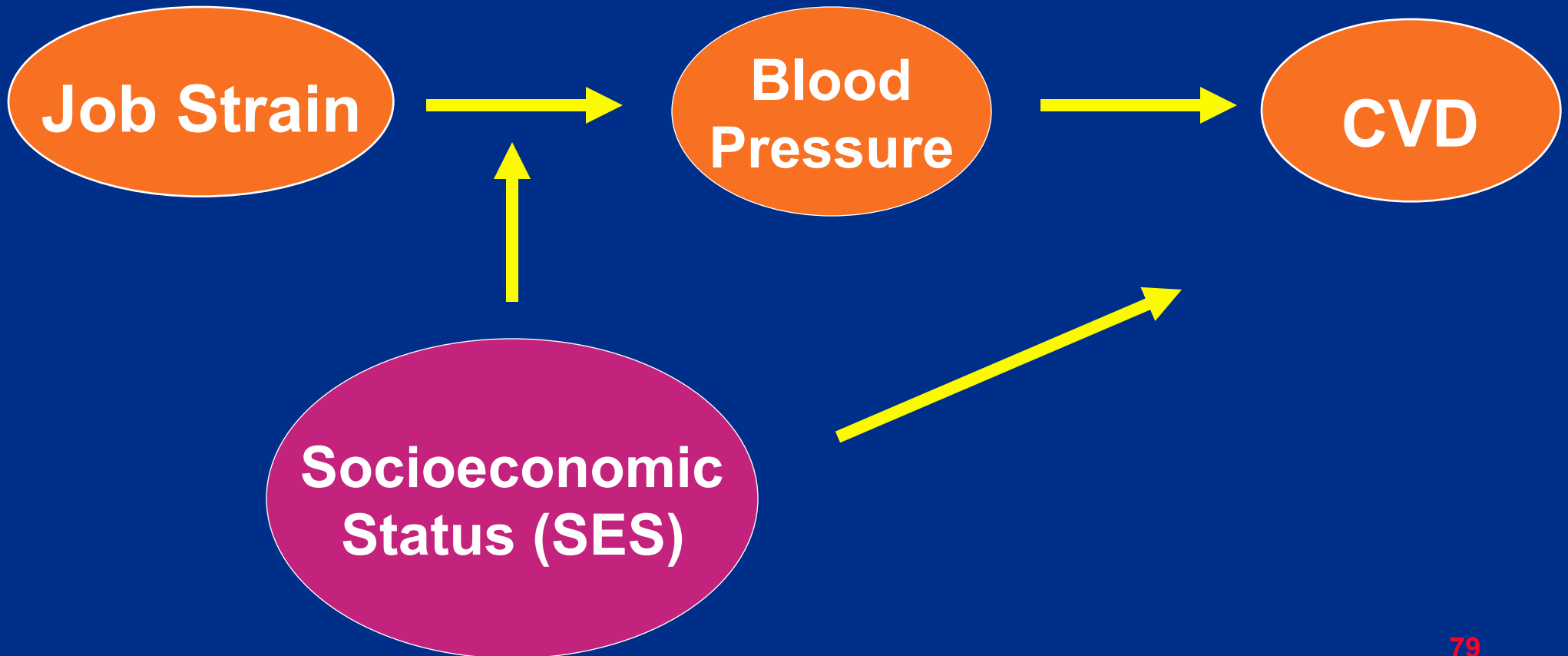
- Physical demands (Finnish factory study)
- Low autonomy & support, responsibility, insecurity, deadlines, mental stress (Kuopio heart study)

Job Strain

Definition: The combination of HIGH Job Demands and LOW Decision Latitude (decision authority + skill use)



Does this occur because of effect modification of the job strain-blood pressure relationship?



Correlation between job characteristics and SES measures (283 men, time 1)

| | <u>Latitude</u> | <u>Demands</u> | | |
|---------------------|-----------------|----------------|----------------------------|------------------------|
| Education | .37 | .32 | | |
| Occupational status | .36 | .36 | | |
| Personal income | .45 | .31 | | |
| Family income | .39 | .28 | | |
| | | | <u>Occupational status</u> | <u>Personal Income</u> |
| | | | | <u>Family Income</u> |
| Education | .57 | .50 | | .51 |
| Occupational status | | .53 | | .58 |
| Personal income | | | | .84 |

Job strain and SES: variables

| | <u>Time 1 (n=283)</u> | | <u>Time 1-2 (n=195)</u> |
|-----------------------------------|-----------------------|--------------|-------------------------|
| | <u>Mean</u> | <u>Range</u> | <u>r</u> |
| Job decision latitude | 35.8 | 17-48 | .64 |
| Psychological workload demands | 31.8 | 14-48 | .64 |
| Age (yrs) | 44.3 | 30-60 | -- |
| Education (yrs) | 14.3 | 6-18 | -- |
| Occupational status | 72.0 | 15-95 | .92 |
| Personal income (\$) | 46,085 | 15-100,000+ | .84 |
| Family income (\$) | 54,390 | 15-100,000+ | .82 |

| | | |
|--|-----------------|-----|
| Job strain | <u>%</u> 22% | .29 |
| (high job demands + low job decision latitude) | | |

Typical job titles (283 men, time 1)

WHITE-COLLAR (46%)

Vice President, Director, Manager, Personnel specialist,
Budget officer, Senior systems analyst

CLERICAL, TECHNICAL, ADMINISTRATIVE (33%)

Electronic publishing technician, Billing clerk, Data
entry clerk, Staff assistant, Personnel supervisor,
Claims examiner, Computer programmer

BLUE-COLLAR (21%)

Auto mechanic, Electrician, Elevator operator,
Machinist, Welder

Association between SES and job strain (high job demands + low job decision latitude) (283 men, time 1)

| | <u>Job strain</u> | <u>No strain</u> | <u>p</u> |
|----------------------|-------------------|------------------|----------|
| Education (yrs) | 14.4 | 14.3 | ns |
| Occupational status | 74.2 | 71.4 | ns |
| Personal income (\$) | 44,304 | 46,577 | ns |
| Family income (\$) | 52,828 | 54,820 | ns |

| | <u>Job strain</u> | <u>Latitude</u> | <u>Demands</u> |
|---------------------|-------------------|-----------------|----------------|
| White-collar | 24% | 38.3 | 34.5 |
| Clerical, technical | 22% | 33.7 | 29.6 |
| Blue-collar | 15% | 33.8 | 29.1 |
| | (ns) | (<.001) | (<.001) |

Why synergy between job strain and SES? Possible explanations:

Interaction of 2 powerful main effects (as with SRF)

Measurement of job demands

- Too non-specific for white-collar workers?

Job strain model not as applicable to white-collar work

- White-collar demands = challenging, mentally active work (protective effect of “active” work in some CHD studies)
- Blue-collar demands = for fast-paced performance
- Able to exercise control in other areas of life?

Study strengths and limitations

Strengths

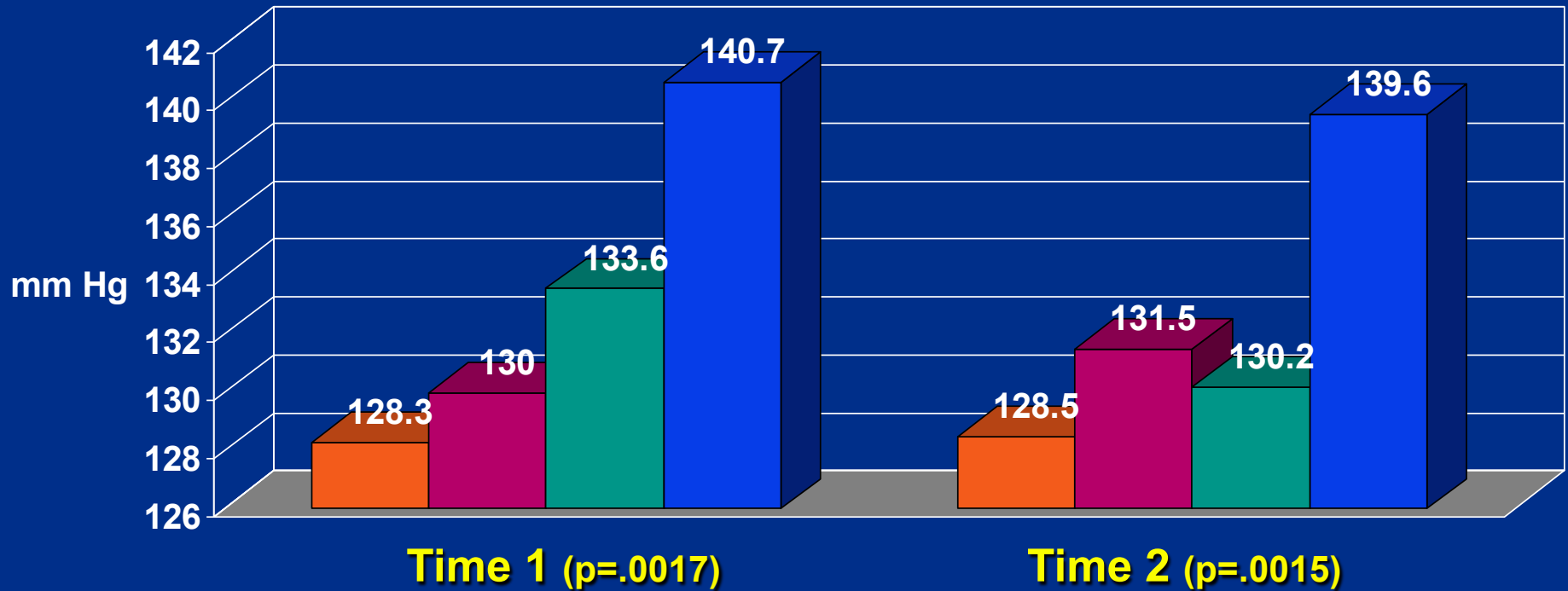
- New technology improves validity of BP measurement
- Widely-used valid exposure measure (JCQ)
- Variance in exposure
- Good measurement and control of confounders
- Assessment of changes in exposure
 - Fair reliability and validity of work history questionnaire
 - Decent power for analyses of recent work history

Limitations

- Potential participation bias
- Initial Cross-sectional analysis
- Limited N, power -- for interaction, analyses of distal work history
- Limits to validity of work history questionnaire
- Excludes highest exposure groups, severe hypertensives

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

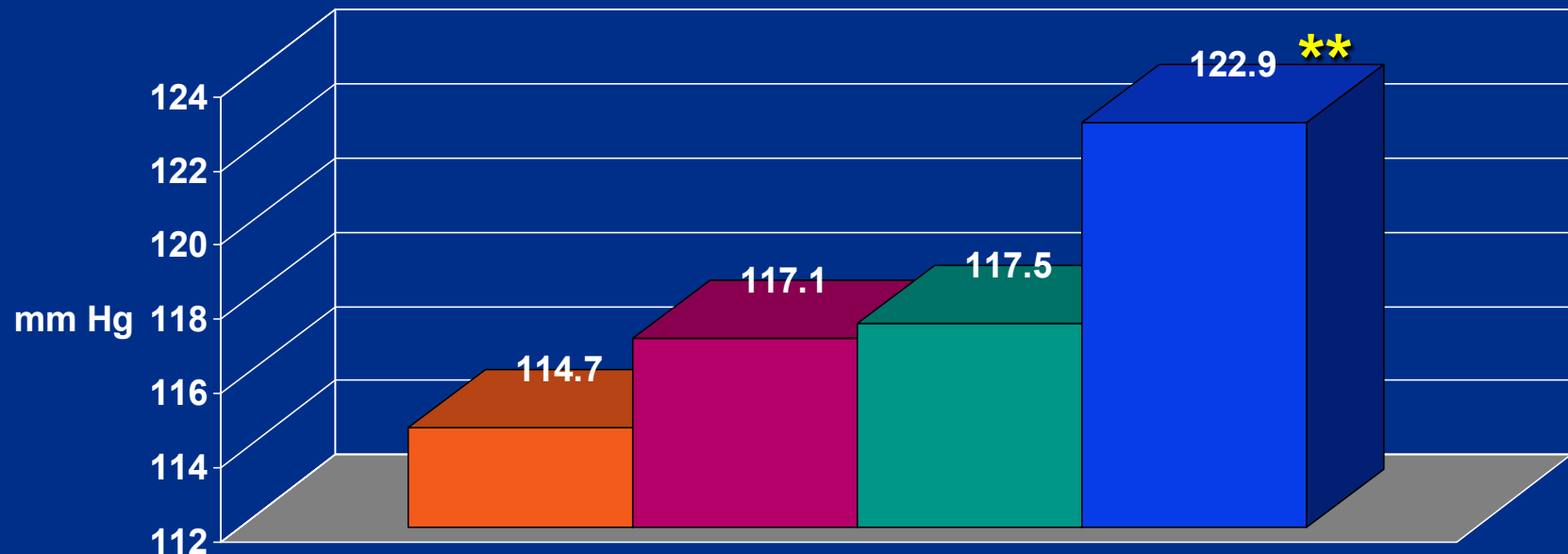
| | | | | | | | | |
|------------|----|-----|-----|-----|----|-----|-----|-----|
| Strain-T1: | no | no | yes | yes | no | no | yes | yes |
| Strain-T2: | no | yes | no | yes | no | yes | no | yes |



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

Job Strain change and Time 2 work systolic AmBP (n=71 Quebec white-collar women with a University degree)

| | | | | |
|-----------------------|----|-----|-----|-----|
| Strain-T1: | no | no | yes | yes |
| Strain-T2 (+14 mon.): | no | yes | no | yes |

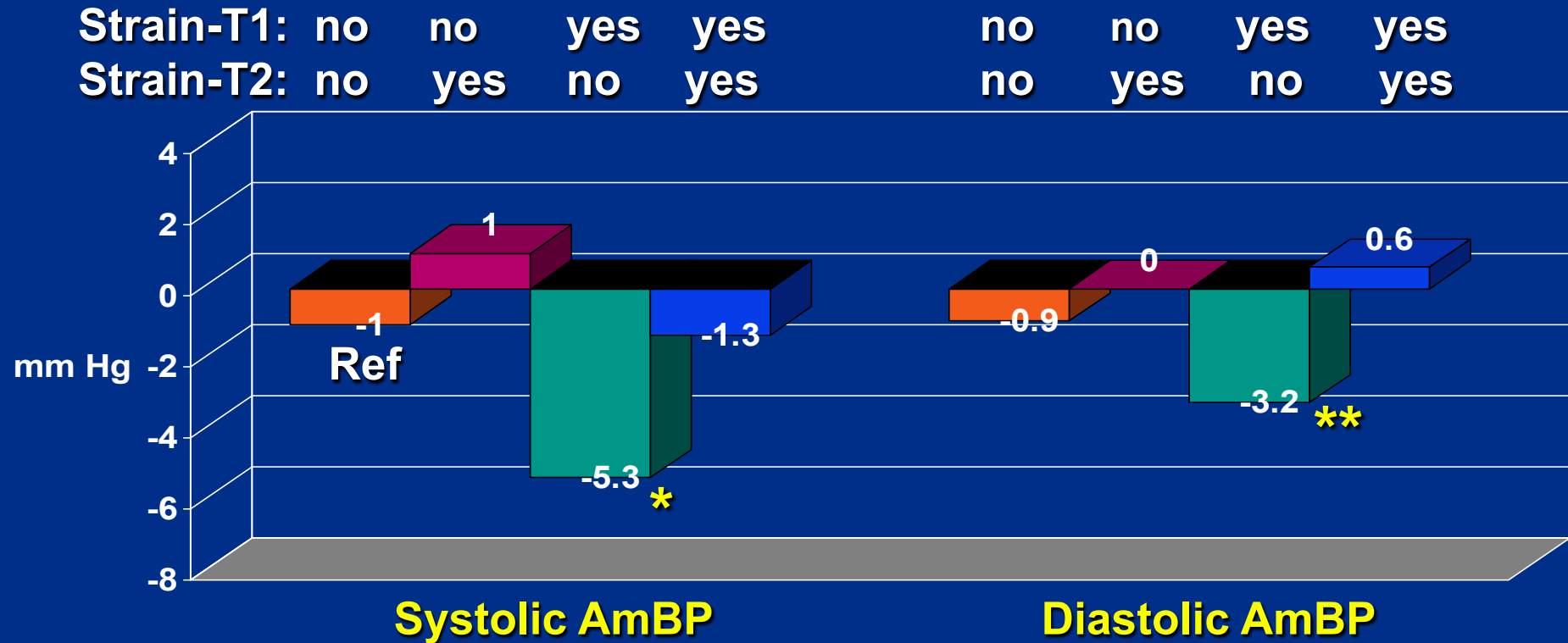


controlling for age, smoking, OC use

(Laflamme N et al. *Scand J Work, Environ Health* 1998;24(5):334-343.)

**p<.01 vs. ref.

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)

Studies of Job Strain and Ambulatory Blood Pressure (updated 6/2006)

| | <u>Significant positive associations</u> | <u>Mixed positive and null associations</u> | <u>Total # of studies</u> |
|----------------------|--|---|---------------------------|
| Ambulatory BP | 9 | 16 | 25 |
| men | 4 | 6 | 10 |
| women | 3 | 4 | 7 |
| both | 2 | 6 | 8 |

Belkić K, Landsbergis P, Schnall P, Baker D, Theorell T, Siegrist J, Peter R, Karasek R. Psychosocial factors: Review of the empirical data among men. *Occupational Medicine: State of the Art Reviews* 2000;15(1):24-46.

Brisson C. Women, work, and CVD. *Occupational Medicine: State of the Art Reviews* 2000;15(1):49-57.

Work hours and Hypertension

TABLE 4. Multivariate Logistic Regression of Self-Reported Hypertension

| Characteristics | OR | 95% CI | P |
|------------------------------------|------|--------------|---------|
| Age group, y | | | |
| 18 to 35 | 1.00 | | |
| 36 to 50 | 2.53 | 2.18 to 2.94 | <0.0001 |
| 51 to 64 | 5.71 | 4.93 to 6.62 | <0.0001 |
| Gender | | | |
| Female | 1.00 | | |
| Male | 1.24 | 1.11 to 1.39 | <0.0001 |
| Race/ethnicity | | | |
| Non-Hispanic white | 1.00 | | |
| Non-Hispanic black | 1.65 | 1.34 to 2.03 | <0.0001 |
| Hispanic | 0.85 | 0.73 to 0.98 | 0.03 |
| Non-Hispanic Asian | 0.89 | 0.77 to 1.02 | 0.10 |
| Education | | | |
| Less than high school | 1.00 | | |
| High school | 0.95 | 0.78 to 1.16 | 0.58 |
| Some college | 1.03 | 0.84 to 1.25 | 0.79 |
| College and higher | 0.81 | 0.67 to 0.98 | 0.03 |
| Household Income | | | |
| 0% to 99% federal poverty level | 1.00 | | |
| 100% to 199% federal poverty level | 0.81 | 0.63 to 1.04 | 0.10 |
| 200% to 299% federal poverty level | 0.84 | 0.62 to 1.14 | 0.27 |
| ≥300% federal poverty level | 0.77 | 0.60 to 0.98 | 0.04 |
| Tobacco consumption status | | | |
| Never smokers | 1.00 | | |
| Past smokers | 1.26 | 1.13 to 1.41 | <0.0001 |
| Current smokers | 1.16 | 1.01 to 1.32 | 0.03 |
| Self-reported diabetes | 2.66 | 2.23 to 3.19 | <0.0001 |
| Sedentary lifestyle | 1.10 | 0.99 to 1.21 | 0.066 |
| Occupation | | | |
| Professional | 1.00 | | |
| Manager | 1.11 | 0.96 to 1.27 | 0.15 |
| Clerical worker | 1.23 | 1.00 to 1.51 | 0.05 |
| Sales worker | 1.00 | 0.85 to 1.18 | 0.97 |
| Service worker | 1.06 | 0.88 to 1.27 | 0.54 |
| Skilled worker | 1.05 | 0.87 to 1.20 | 0.58 |
| Semiskilled worker | 0.97 | 0.78 to 1.20 | 0.75 |
| Unskilled worker | 1.50 | 1.00 to 2.25 | 0.05 |
| Work hours per week | | | |
| 11 to 39 | 1.00 | | |
| 40 | 1.14 | 1.01 to 1.28 | 0.04 |
| 41 to 50 | 1.17 | 1.04 to 1.33 | 0.01 |
| ≥51 | 1.29 | 1.10 to 1.52 | 0.002 |