Work and Obesity in US Workers

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Outline

- Definitions, measures, and risk of obesity
- Recent US obesity statistics
- Work and obesity: Mechanisms
- Empirical studies using a US national dataset (MIDUS data) and in firefighters
- CDC/NIOSH obesity prevention programs
- Worksite obesity intervention studies

DEFINITIONS, MEASURES, AND RISK OF OBESITY

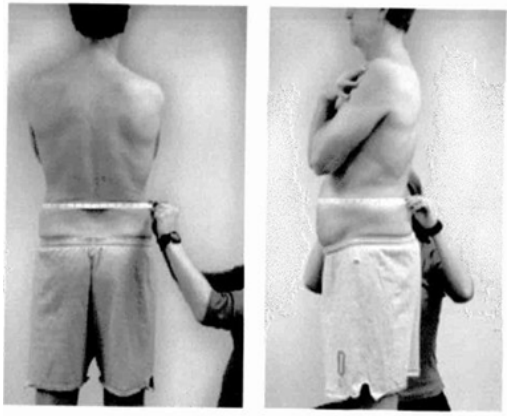
Definitions of Obesity

- "A condition of abnormal or excessive fat accumulation in adipose tissue to the extent that health may be impaired" (WHO, 2000)

- Obesity as a disease (American Medical Association, 2013)?
  - Pros
    - Doctors' more attention/Reducing stigmas of obesity
    - Spur more insurers to pay for treatments
  - Cons
    - Medicalization – more drugs and surgeries than lifestyle changes: two new drugs – Qsymia and Belviq entered the market in 2012
    - No specific symptoms/Uncertainty with body mass index (BMI)

Field anthropometric methods

- **Height and weight:** Body Mass Index (BMI, kg/m2) – general obesity (r = 0.7-0.8 with body fat %)
- **Waist circumference:** central obesity (40 inches for men and 35 inches for women; WHO, 2000)
- **Skinfold thickness:** body fat % (> 25% for men and > 35-40% for women)



How is BMI calculated?

http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/

Measurement Units	Formula and Calculation
Kilograms and meters (or centimeters)	**Formula: weight (kg) / [height (m)]^2** With the metric system, the formula for BMI is weight in kilograms divided by height in meters squared. Since height is commonly measured in centimeters, divide height in centimeters by 100 to obtain height in meters. Example: Weight = 68 kg, Height = 165 cm (1.65 m) Calculation: $68 \div (1.65)^2 = 24.98$
Pounds and inches	**Formula: weight (lb) / [height (in)]^2 x 703** Calculate BMI by dividing weight in pounds (lbs) by height in inches (in) squared and multiplying by a conversion factor of 703. Example: Weight = 150 lbs, Height = 5'5" (65") Calculation: $[150 \div (65)^2] \times 703 = 24.96$

Classification of overweight and obesity in adults according to BMI (WHO, 2000)

Classification	BMI (kg/m²)	Risk of co-morbidities
Underweight	<18.5	Low (but risk of other clinical problems increased)
Normal range	18.5–24.9	Average
Overweight	25.0–29.9	Mildly increased
Obese	**>30.0**	
Class I	30.0–34.9	Moderate
Class II	35.0–39.9	Severe
Class III severe (or 'morbid obesity' or 'super obesity')	>40.0	Very severe

Source: International Obesity Task Force

Risk of Obesity (WHO, 2000)

- Relative risk, ≥ 3
  - Type 2 diabetes, Insulin resistance
  - Gallbladder disease
  - Dyslipidemia
  - Sleep apnea and respiratory problems
- Relative risk, 2-3
  - Coronary heart disease
  - Hypertension
  - Osteoarthritis (knees)
  - Gout
- Relative risk, 1-2
  - Menstrual irregularities and infertility
  - Some cancers (endometrial, breast, and colon)
  - Low back pain

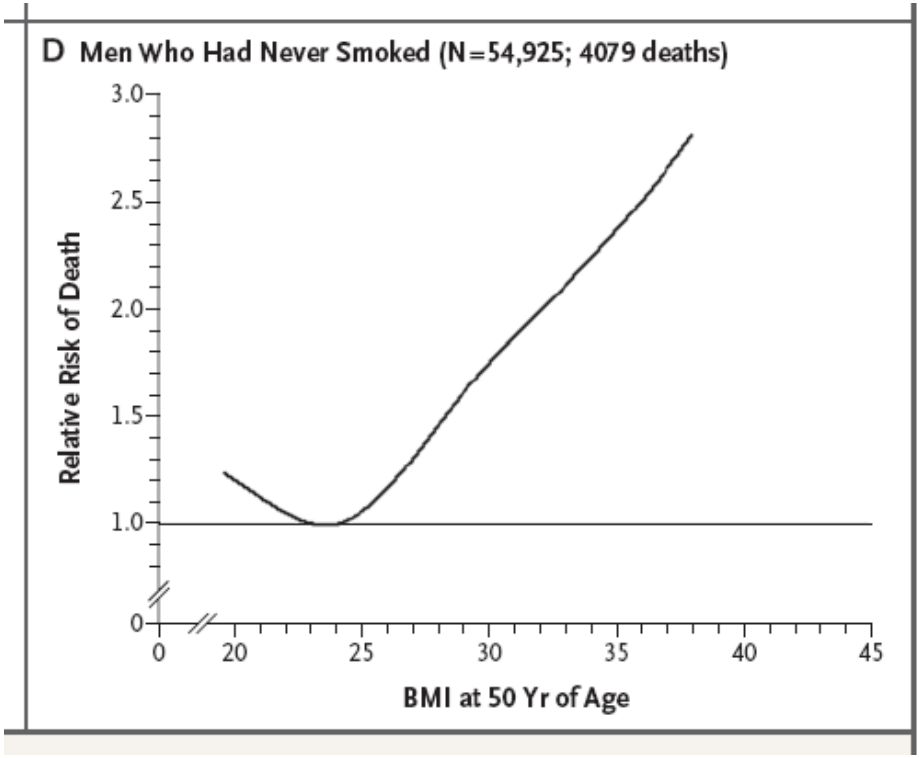
The NEW ENGLAND JOURNAL of MEDICINE

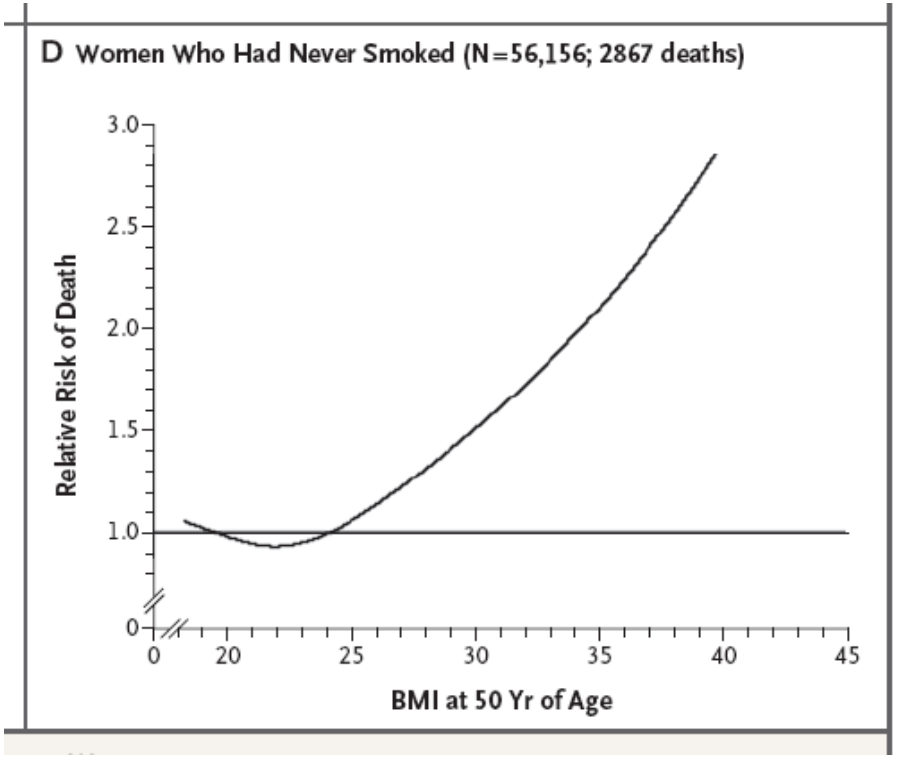
ESTABLISHED IN 1812 AUGUST 24, 2006 VOL. 355 NO. 8

Overweight, Obesity, and Mortality in a Large Prospective Cohort of Persons 50 to 71 Years Old

Kenneth F. Adams, Ph.D., Arthur Schatzkin, M.D., Tamara B. Harris, M.D., Victor Kipnis, Ph.D., Traci Mouw, M.P.H., Rachel Ballard-Barbash, M.D., Albert Hollenbeck, Ph.D., and Michael F. Leitzmann, M.D.

N Engl J Med 2006;355:763-78.





models are adjusted for age, race or ethnic group, level of education, alcohol consumption, and physical activity.

Limitations of BMI

(Prentice and Jebb, 2001)

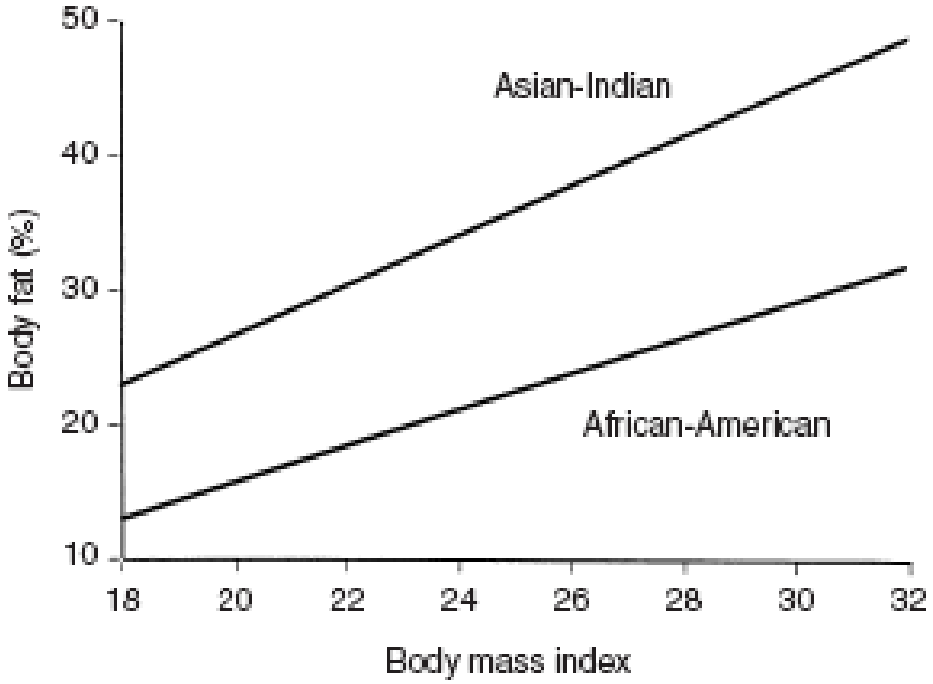


Figure 2 Racial differences in the relationship between body mass index (BMI) and body fat.

Public health

Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies

*WHO expert consultation**

A WHO expert consultation addressed the debate about interpretation of recommended body-mass index (BMI) cut-off points for determining overweight and obesity in Asian populations, and considered whether population-specific cut-off points for BMI are necessary. They reviewed scientific evidence that suggests that Asian populations have different associations between BMI, percentage of body fat, and health risks than do European populations. The consultation concluded that the proportion of Asian people with a high risk of type 2 diabetes and cardiovascular disease is substantial at BMIs lower than the existing WHO cut-off point for overweight (≥25 kg/m²). However, available data do not necessarily indicate a clear BMI cut-off point for all Asians for overweight or obesity. The cut-off point for observed risk varies from 22 kg/m² to 25 kg/m² in different Asian populations; for high risk it varies from 26 kg/m² to 31 kg/m². No attempt was made, therefore, to redefine cut-off points for each population separately. The consultation also agreed that the WHO BMI cut-off points should be retained as international classifications. The consultation identified further potential public health action points (23·0, 27·5, 32·5, and 37·5 kg/m²) along the continuum of BMI, and proposed methods by which countries could make decisions about the definitions of increased risk for their population.

Lancet 2004; **363:** 157–63

	Overweight		Obesity	
	Point analyses*	ANCOVA†	Point analyses*	ANCOVA†
China	24	25	29	30
China (Hong Kong)	23	22	27	27
Indonesia	24	22	26	27
Japan	25	24	30	29
Singapore	22	23	27	27
Thailand (urban)	25	23	30	28
Thailand (rural)	27	25	31	30

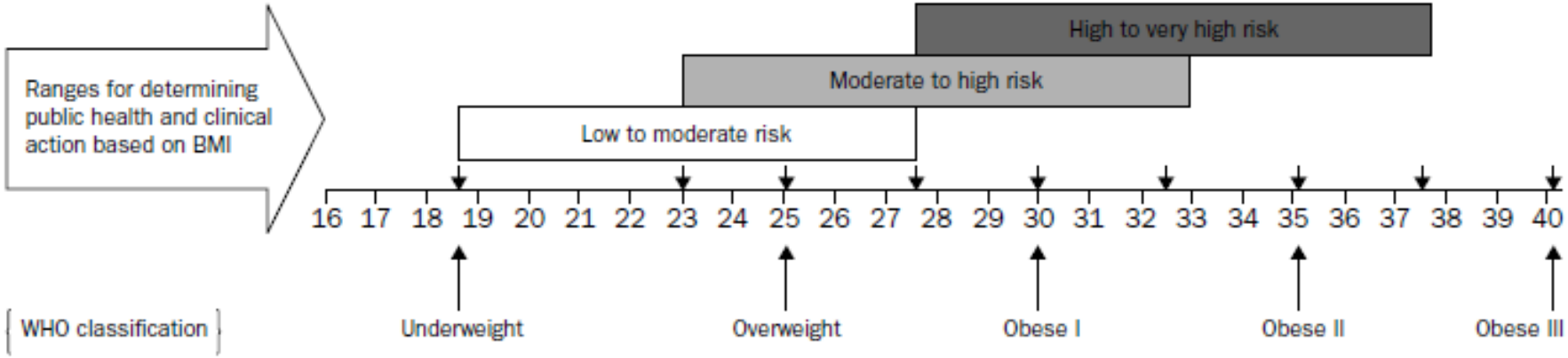


Figure 2: **Body-mass index (BMI) cut-off points for public health action**

3 For many Asian populations, additional trigger points for public health action were identified as 23 kg/m² or higher, representing increased risk, and 27·5 kg/m² or higher as representing high risk. The suggested categories are as follows: less than 18·5 kg/m² underweight; 18·5–23 kg/m² increasing but acceptable risk; 23–27·5 kg/m² increased risk; and 27·5 kg/m² or higher high risk.

Spearman correlations between three adiposity measures among 347 male FFs

	BMI (cont.)	Waist Circumference (cont.)	Body Fat % (cont.)
BMI	1.00		
WC	.83*	1.00	
Body fat %	.70*	.82*	1.00

* $p < 0.001$

Overweight and obesity prevalence among male FFs (N=347) by three adiposity measures

Adiposity categories	BMI (kg/m^2)	Waist circumference (inches)	Body fat %
Normal	19.6% (BMI < 25)	51.3% (WCs < 37)	40.3% (body fat < 17*)
Overweight	33.7% (BMIs: 25-27.4) 23.6% (BMIs: 27.5-29.9)	24.5% (WCs: 37-40), action level I	39.2% (body fat: 17-24*)
Obese	23.1% (BMIs ≥ 30)	24.2% (WCs > 40), action level II	20.5% (body fat > 24*)
Overweight + Obese	**80.4%**	**48.7%**	**59.7%**

Literature (NVFC, 2011): BMI-based overweight and obesity prevalence: 73-88%, Obesity prevalence: 30-40% among FFs. * American College of Endocrinology (1998) suggested 25%, but here used 24% (we used 17 rather than 18) considering a possible underestimation of obesity by skinfold body fat % (Clark et al., 1993; Oreopoulos et al., 2011; Stout et al., 1994)

The ORs of overweight and obesity by three measures for CVD risk factors among male FFs (N=347):

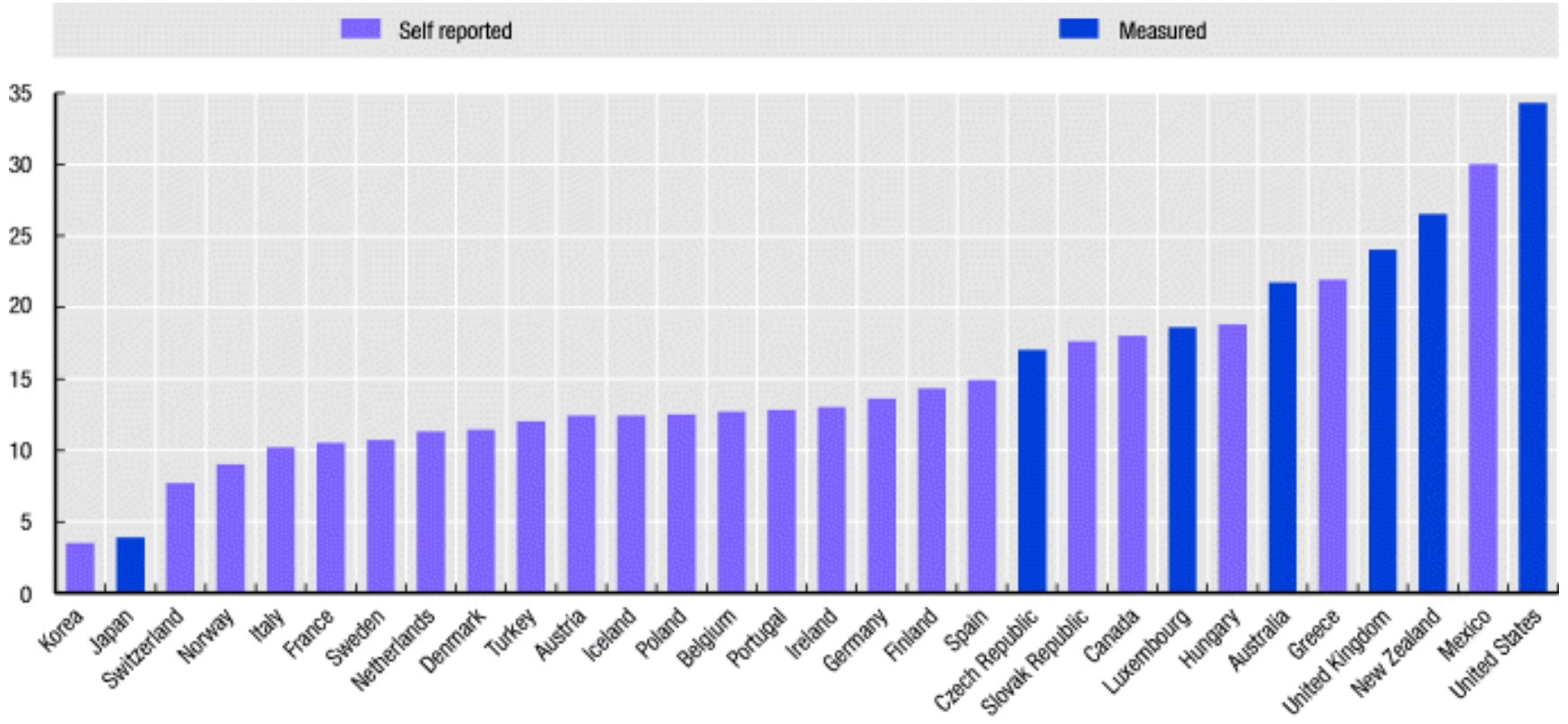
The reference group = normal weight FFs

Adiposity measure	Adiposity categories	Hypertension (11%)	High cholesterol (21%)	Low HDL (46.2%)	High LDL (9.2%)	Low VO^2 max (31.9%)
BMI	**Overweight** (BMIs: 25-27.4)	1.19	1.58	1.89	2.68	1.35
	Overweight (BMIs: 27.5-29.9)	2.51	3.12*	3.54**	3.78	3.93**
Waist Circum.	**Overweight**	2.25	3.06**	4.81**	1.79	4.78**
Body fat %	**Overweight**	5.53**	6.42**	2.85**	2.61	9.59**
BMI	**Obese**	4.32*	4.33**	7.70**	3.80	6.19**
Waist Circum.	**Obese**	3.22**	2.25*	6.89**	1.10	6.85**
Body fat %	**Obese**	10.63**	8.51**	5.54**	4.43**	29.33**

* $p < 0.05$, ** $p < 0.01$. High cholesterol as > 240 mg/dL. Low HDL as < 40 mg/dL. High LDL as > 160 mg/dL. Low VO^2 max as < 42 mL/kg/min

RECENT US OBESITY STATISTICS

Obesity (BMI ≥ 30 kg/m^2) prevalence rates of OECD countries



Source - Organization for Economic Cooperation and Development (OECD) Fact book 2009: Economic, Environmental and Social Statistics - Obese population aged 15 yrs and older

Prevalence of obesity (BMI ≥ 25 kg/m^2) in Korea: Kim et al. (2005)

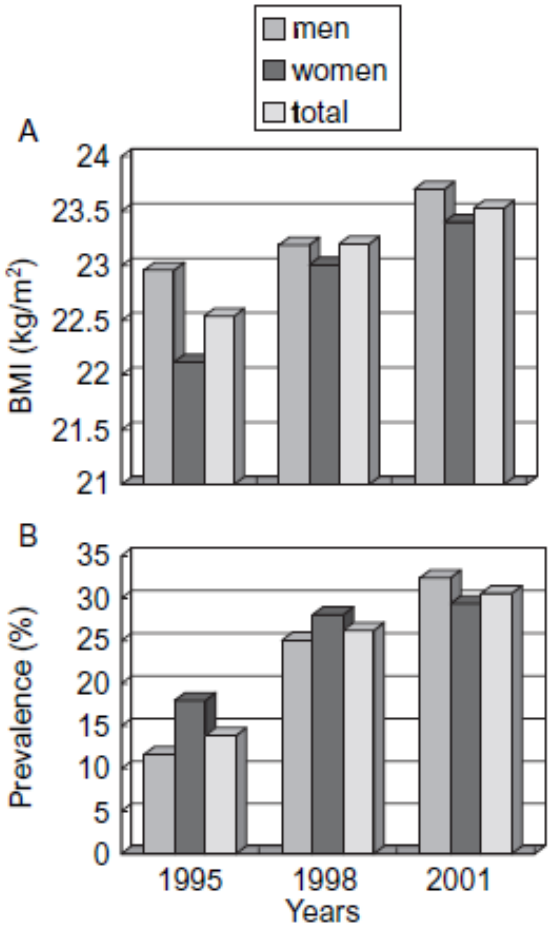
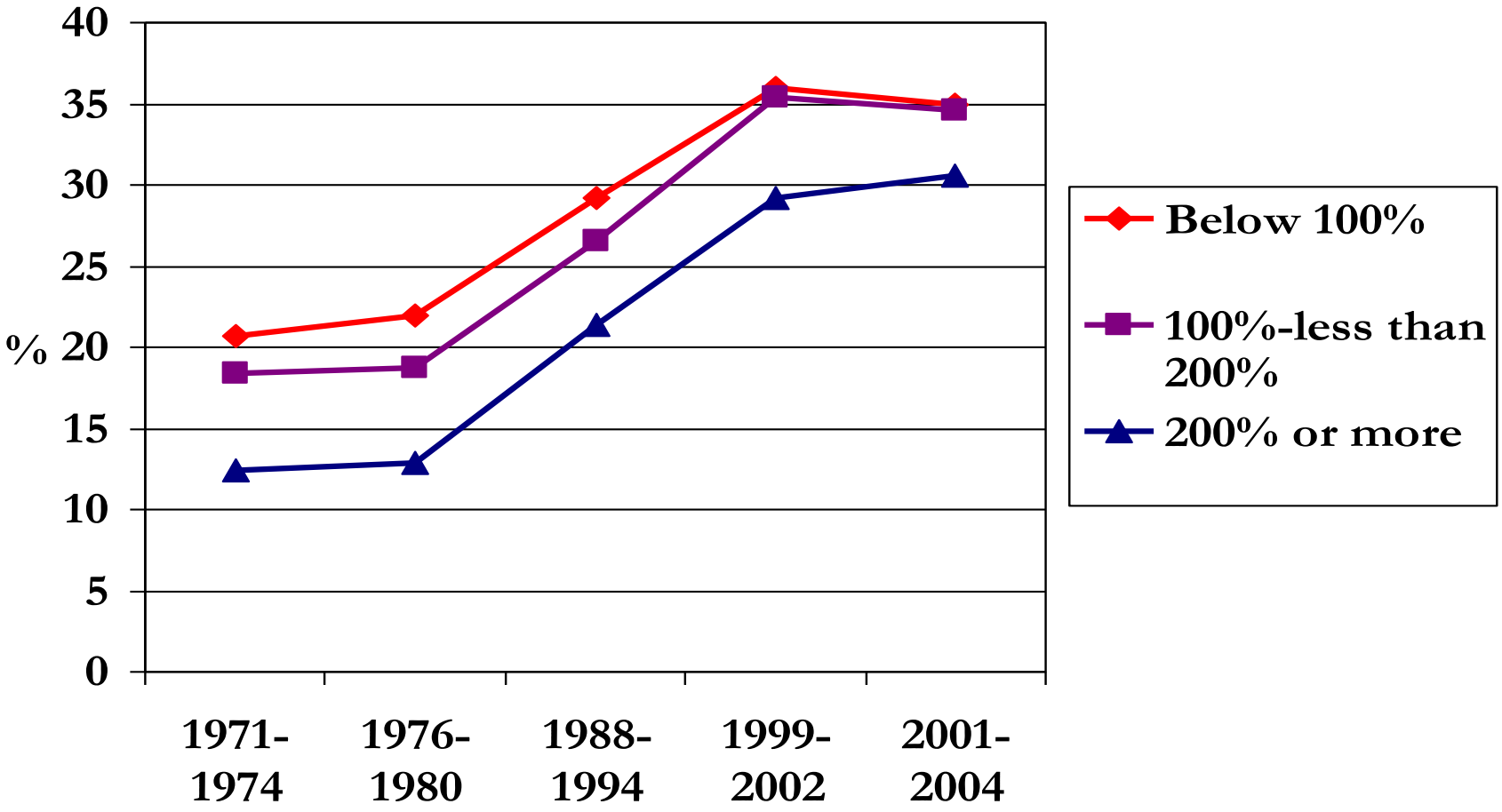


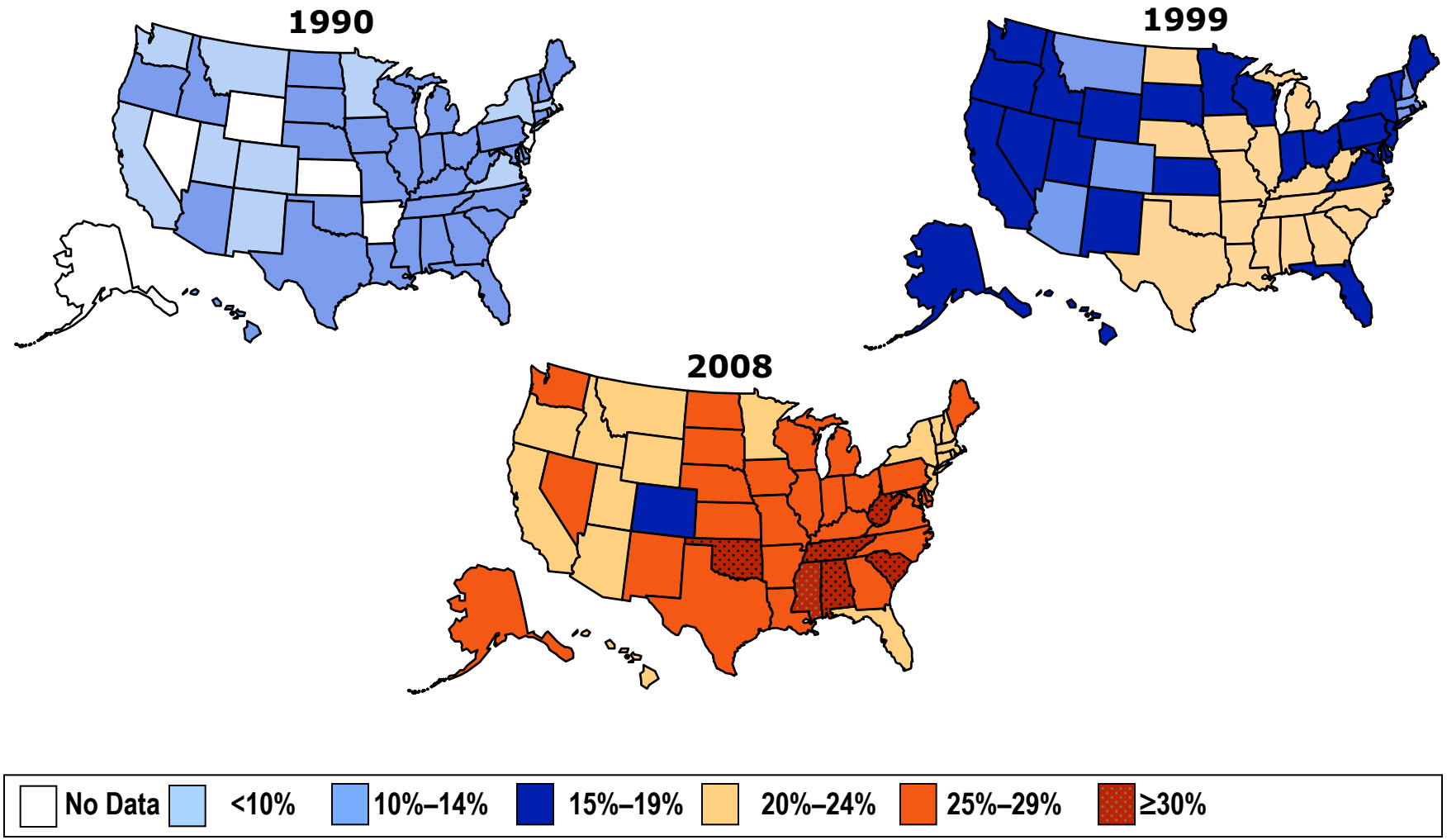
Figure 1 The prevalence of obesity according to body mass index (BMI) in Korean adults, based on the national health and nutrition survey from 1995 to 2001, a secular trend in mean BMI of Korean adults (A), a secular trend in prevalence of obesity (BMI ≥ 25 kg m^{-2}) in Korean adults (B).

Obesity, age 20-74, by income, NHANES, U.S. (BMI ≥30)



National Center for Health Statistics. Health, United States, 2006. Hyattsville, MD: 2006

Obesity* Trends Among US Adults
BRFSS, 1990, 1999, 2008



BRFSS: Behavioral Risk Factor Surveillance System

*BMI ≥30 kg/m2

Obesity Statistics:

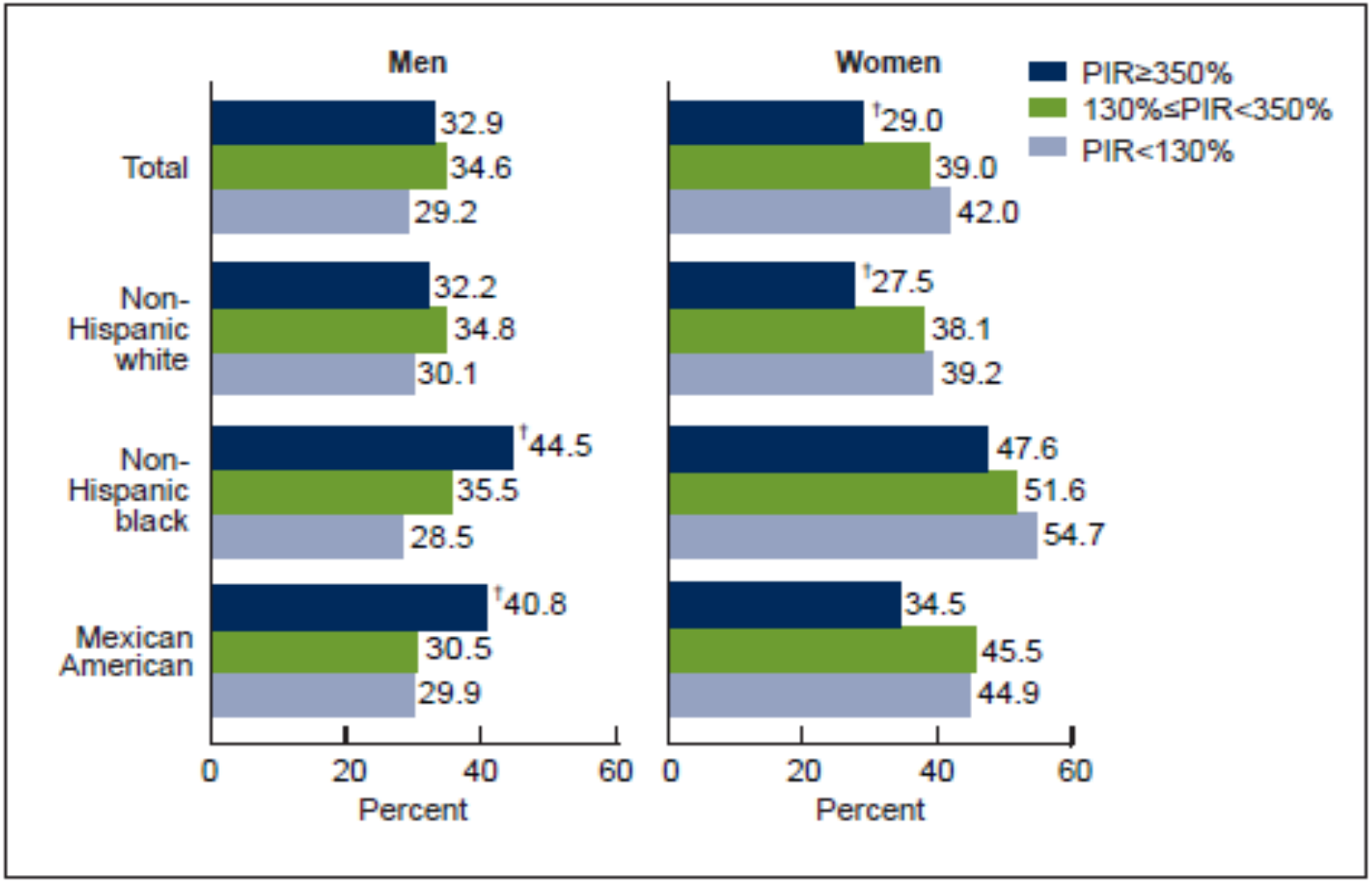
US National Center For Health Statistics (November. 2007)

- **More than one-third of U.S. adults –– over 72 million people -- were obese** in 2005-2006: 33.3 percent of men and 35.3 percent of women.

- **Adults aged 40 - 74** had the highest obesity prevalence compared with other age groups

- Approximately 53 percent of non-Hispanic **black women** and 51 percent of **Mexican-American women** aged 40-59 were obese compared with about 39 percent of non-Hispanic white women of the same age.

Figure 1. Prevalence of obesity among adults aged 20 years and over, by poverty income ratio, sex, and race and ethnicity: United States 2005–2008



†Significant trend.

NOTES: PIR is poverty income ratio. Persons of other race and ethnicity included in total.

SOURCE: CDC/NCHS, National Health and Nutrition Examination Survey, 2005–2008.

National Medical Spending Attributable To Overweight And Obesity: How Much, And Who's Paying?

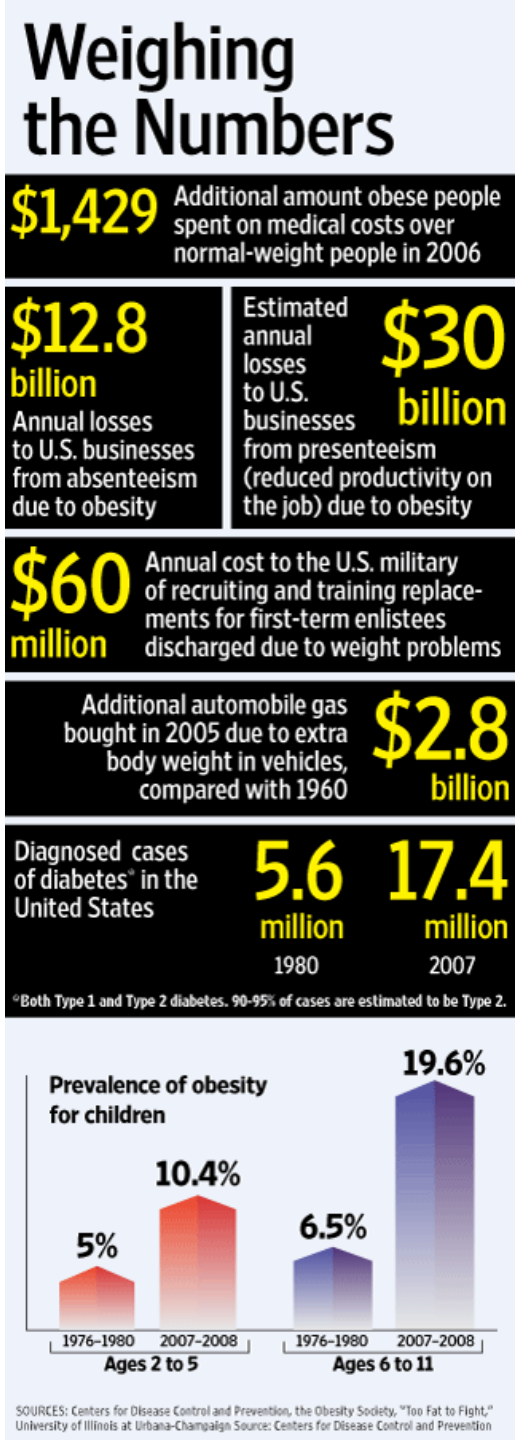
Further evidence that overweight and obesity are contributing to the nation's health care bill at a growing rate.

by Eric A. Finkelstein, Ian C. Fiebelkorn, and Guijing Wang

ABSTRACT: We use a regression framework and nationally representative data to compute aggregate overweight- and obesity-attributable medical spending for the United States and for select payers. Combined, such expenditures accounted for 9.1 percent of total annual U.S. medical expenditures in 1998 and may have been as high as $78.5 billion ($92.6 billion in 2002 dollars). Medicare and Medicaid finance approximately half of these costs.

$147 billion in 2008 U.S. dollars

Source – Theodore Dalrymple. Our Big Problem. The Wall Street Journal (May 1, 2010)

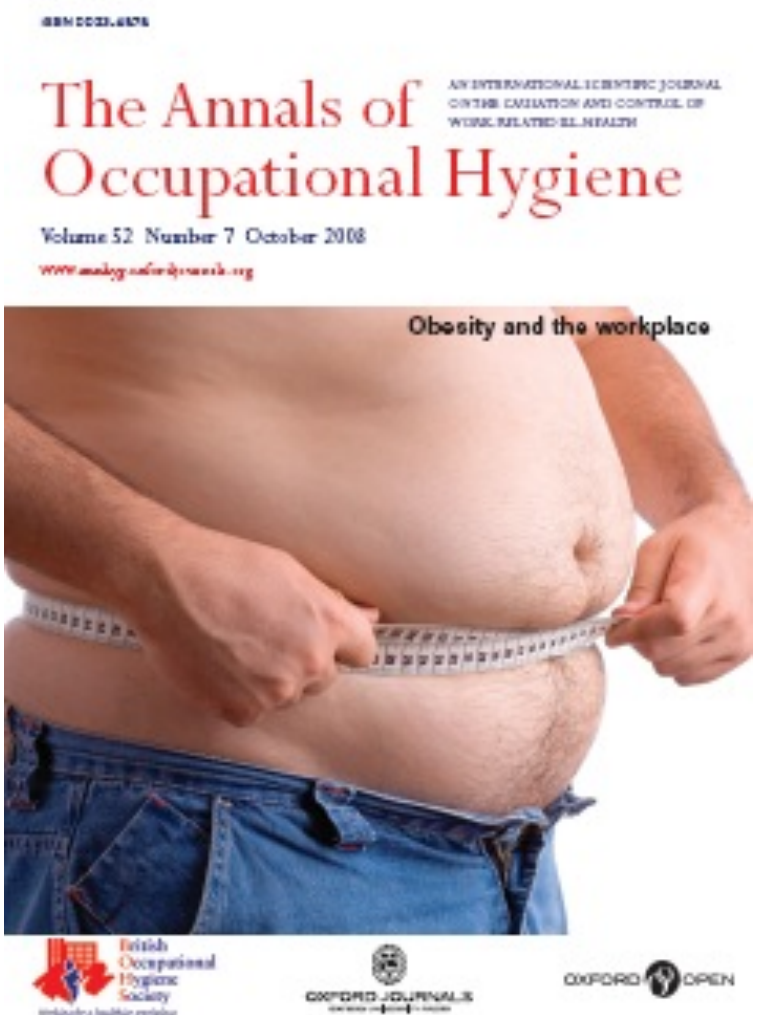


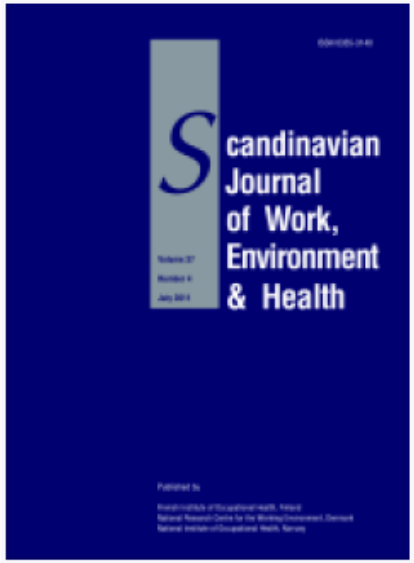
WORK (PSYCHOSOCIAL WORKING CONDITIONS) AND OBESITY: MECHANISMS

Obesity: Contributing Factors
(by the US Centers for Disease Control and Prevention)

- Overweight and obesity result from an **energy imbalance.** This involves eating too many calories and not getting enough physical activity.
- Body weight is the result of **genes, metabolism, behavior, environment, culture, and socioeconomic status.**
- **Behavior and environment** play a large role causing people to be overweight and obese. These are the greatest areas for prevention and treatment actions.

Obesity and the workplace?





Editorial

Scand J Work Environ Health 2013;39(3):217-220
doi:10.5271/sjweh.3362

The obesity epidemic in the occupational health context

by Bonde JPE, Viikari-Juntura E

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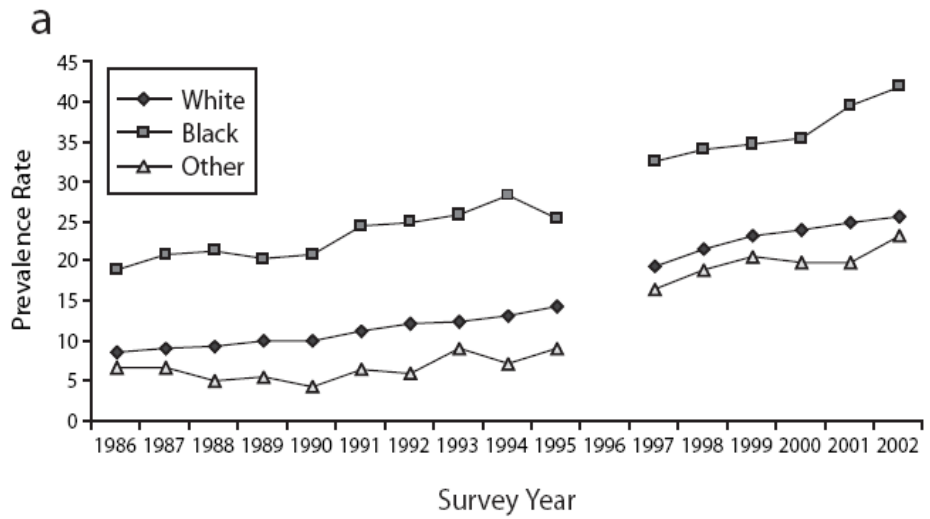
In conclusion, the papers in this thematic issue of the *Scandinavian Journal of Work, Environment & Health* demonstrate how, for several reasons, the obesity epidemic is an important issue in occupational health research and practice. Some occupational risk factors contribute to obesity, and obesity contributes to injuries and preterm exit from the labor market. It is also known that behavioral changes focusing on diet and physical activity are key factors to address. But at present it is not known if and how this knowledge can be utilized for preventive action at the workplace. This gap in knowledge defines a major research area that so far has been given far too little attention.

Trends in obesity prevalence rates among working adults in the US



(*Am J Public Health.* 2005;95:1614–1622. doi:10.2105/AJPH.2004.050112)

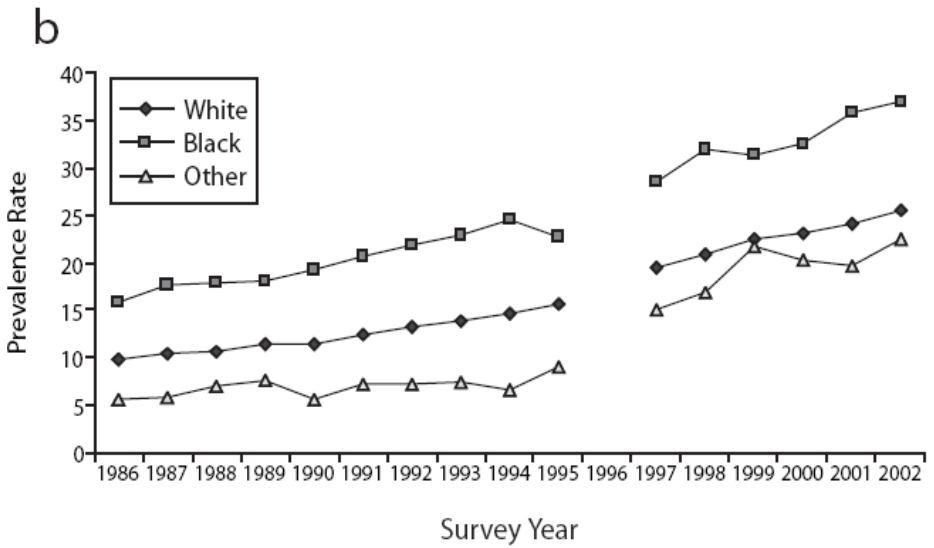


FIGURE 1—Trends in gender- and race-specific prevalence rates of obesity among working adults, (a) men and (b) women: the National Health Interview Survey, 1986 to 2002.

Top 3 and bottom 3 male occupations in obesity prevalence (from Caban et al., 2005)

- **Top 3 occupations:**
  - Motor vehicle operators (31.7%)
  - Private household occupations (31.3%)
  - **Firefighters and police** (29.8%) – the most active group in leisure-time physical activity (Caban et al., 2007)!!!

- **Bottom 3 occupations:**
  - Health-diagnosing occupations (11.2%)
  - Health technologists/technicians (13.7%)
  - Architects and surveyors (14.5%)

Work and Obesity: Mechanisms
(Choi et al., 2009: obesity in firefighters)

- **Working Conditions - Decreased Energy Expenditure**
  - Decreased work-related physical activity
  - Decreased leisure-time physical activity
- **Working Conditions - Increased Energy Consumption**
  - Stress-induced overeating
  - Sweet/chocolates over fruit/fish/vegetables (Oliver and Wardle, 1995)
- **Working Conditions - Chronic strain – Hypothalamus Dysfunction**
  - Alternations of the autonomic nervous system, endocrine systems, and circadian rhythms in relation to lipid metabolisms (Björntorp, 2001)
- **Combinations of the above**

EMPIRICAL STUDIES: WORK-RELATED PHYSICAL ACTIVITY AND OBESITY

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 53:1088–1101 (2010)

Sedentary Work, Low Physical Job Demand, and Obesity in US Workers

BongKyoo Choi, ScD,[1*] Peter L. Schnall, MD,[1] Haiou Yang, PhD,[1] Marnie Dobson, PhD,[1] Paul Landsbergis, PhD,[2] Leslie Israel, DO,[1] Robert Karasek, PhD,[3,4] and Dean Baker, MD[1]

Workplace Changes in the US since the 1980s

- Decrease in routine manual tasks and strenuous jobs
- Increase in sedentary work
- Factors associated with these changes include:
  - Technology (mechanization, automation, or computerization)
  - Work organization (lean production)
  - Industrial structure (service-driven economy)
  - Labor relations (decreased rates of unionization)

Research question

- **Work-related physical activity is associated with general and central obesity in US workers**
  - Well-known fact: Leisure-time sedentary lifestyle is associated with general obesity
  - Few studies look at both low levels of physical activity at work and obesity (general and central) in US workers

Methods: Study Design/population

- **Cross-sectional** and **secondary data analysis** study
- 2,019 **workers** (1,001 male/1,018 female) from the **Midlife Development in the United States II** (MIDUS II) dataset
  - From 1995 to 1996, the MacArthur Midlife Research Network carried out a national survey (MIDUS I study)
    - 7,000 Americans to investigate the role of behavioral, psychological, and social factors in understanding age-related differences in physical and mental health
    - Demographics comparable to the US population
  - The Institute on Aging at the University of Wisconsin, Madison performed a longitudinal follow-up interview/survey (2004-2006)

Methods: Exposure Variables
Work-related physical activity

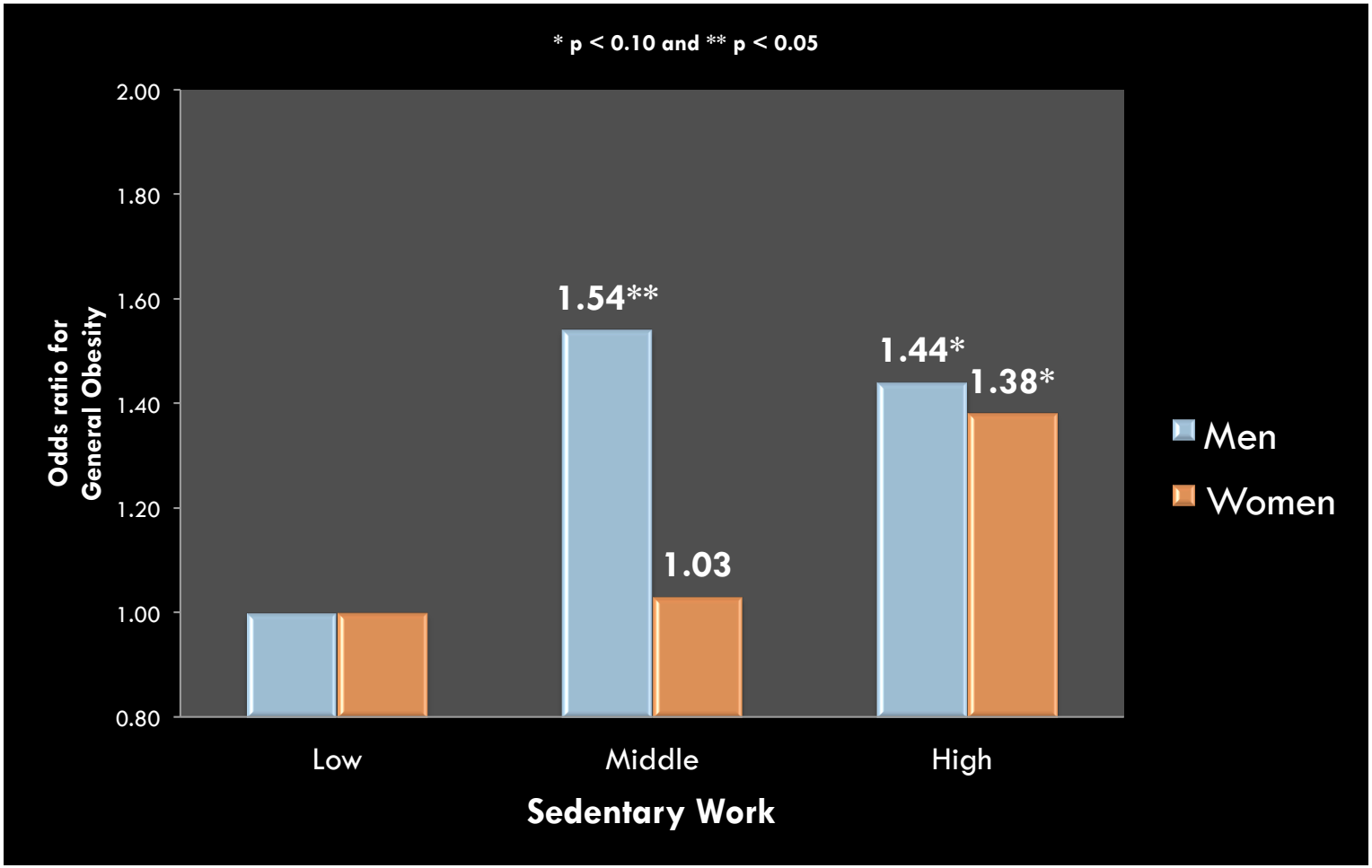
- **Sedentary work (S)** (ie, "*how often does your job require you to sit for long periods of time during your work-shift?*")
- **Physical job demand (P)** (ie, "*how often does your job require a lot of physical effort during your work-shift?*")
  - Response set for exposure variables: Likert scale using **High** (all of the time, most of the time), **Middle** (some of the time), and **Low** (little of the time, and never)

- **Physical inactivity at work (P+S)**: combination of the above two variables due to a high ($r = 0.50$) inter-correlation
- **Stratification of working hours per week**: (40+ vs. 40 or less)

Methods: Covariates

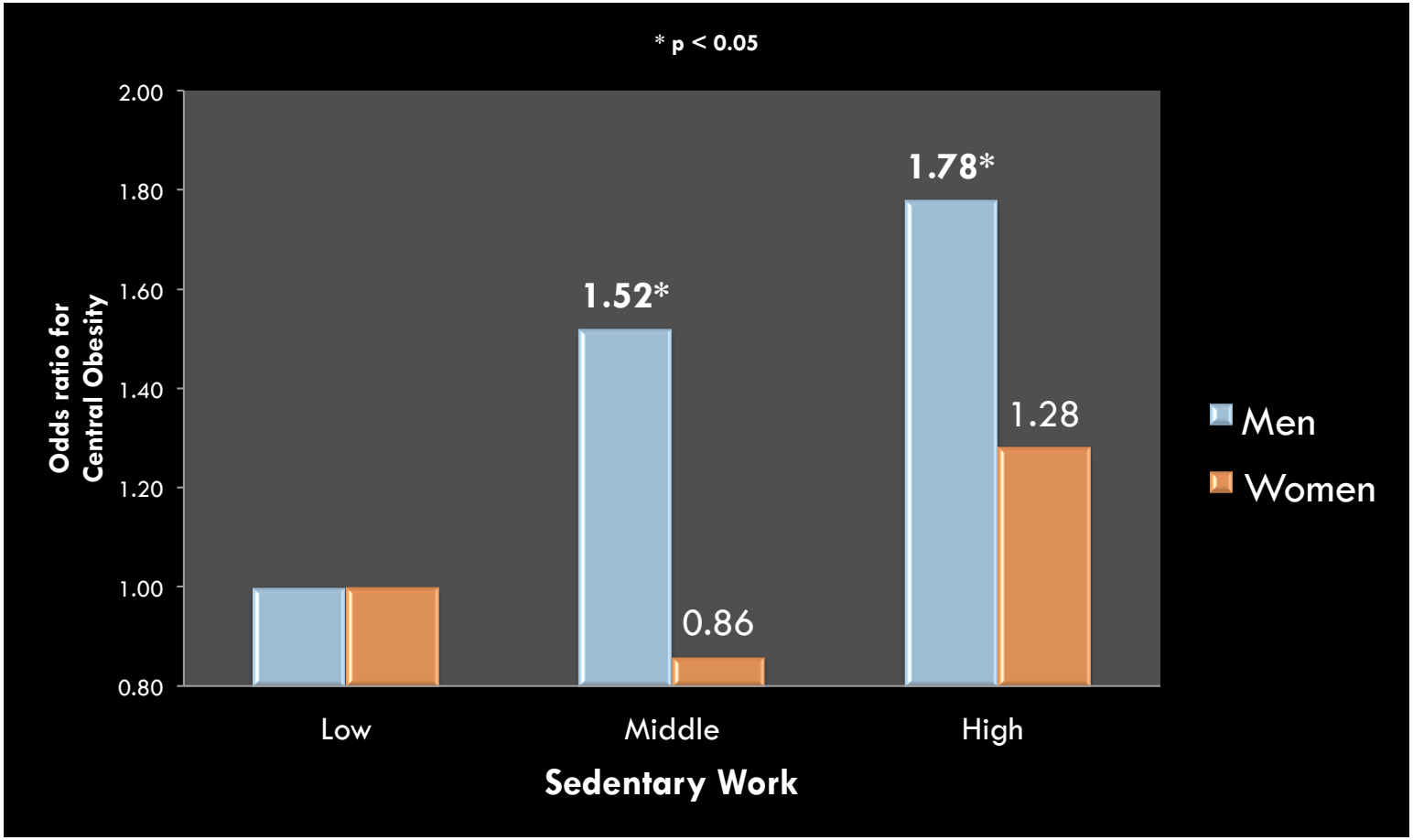
- **Socio-demographic** (i.e., age, household income, education)
- **Psychosocial working conditions** (i.e., job control, quantitative job demands, social support at work, working hrs per week)
- **Health status** (i.e., chronic diseases, major depression)
- **Health behaviors** (i.e., **leisure-time physical activity = LTPA, stress-related overeating,** smoking, alcohol).

Results: Sedentary work and general obesity (BMIs ≥ 30 kg/m^2) – multivariate analysis*



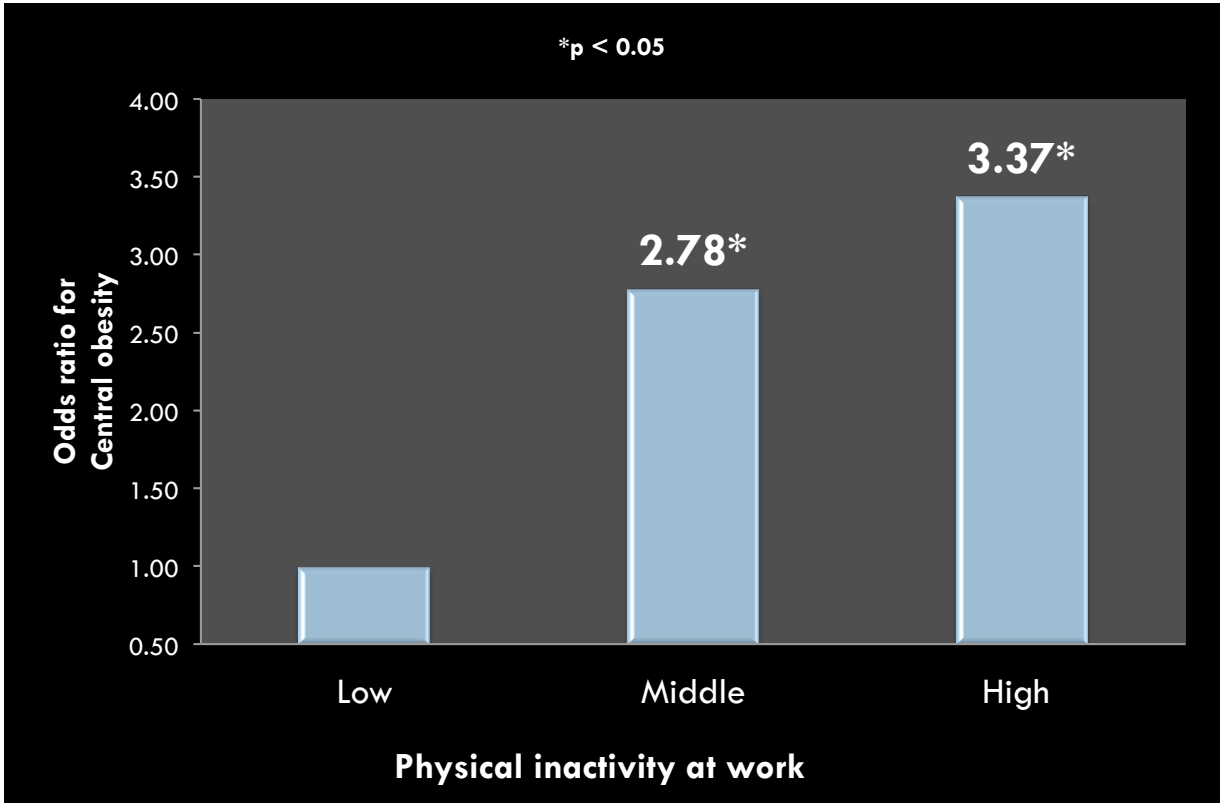
*Controlled for socio-demographic variables, psychosocial working conditions, health status, and health behaviors

Results: Sedentary work and central obesity – multivariate analysis*



*Controlled for socio-demographic variables, psychosocial working conditions, health status, and health behaviors

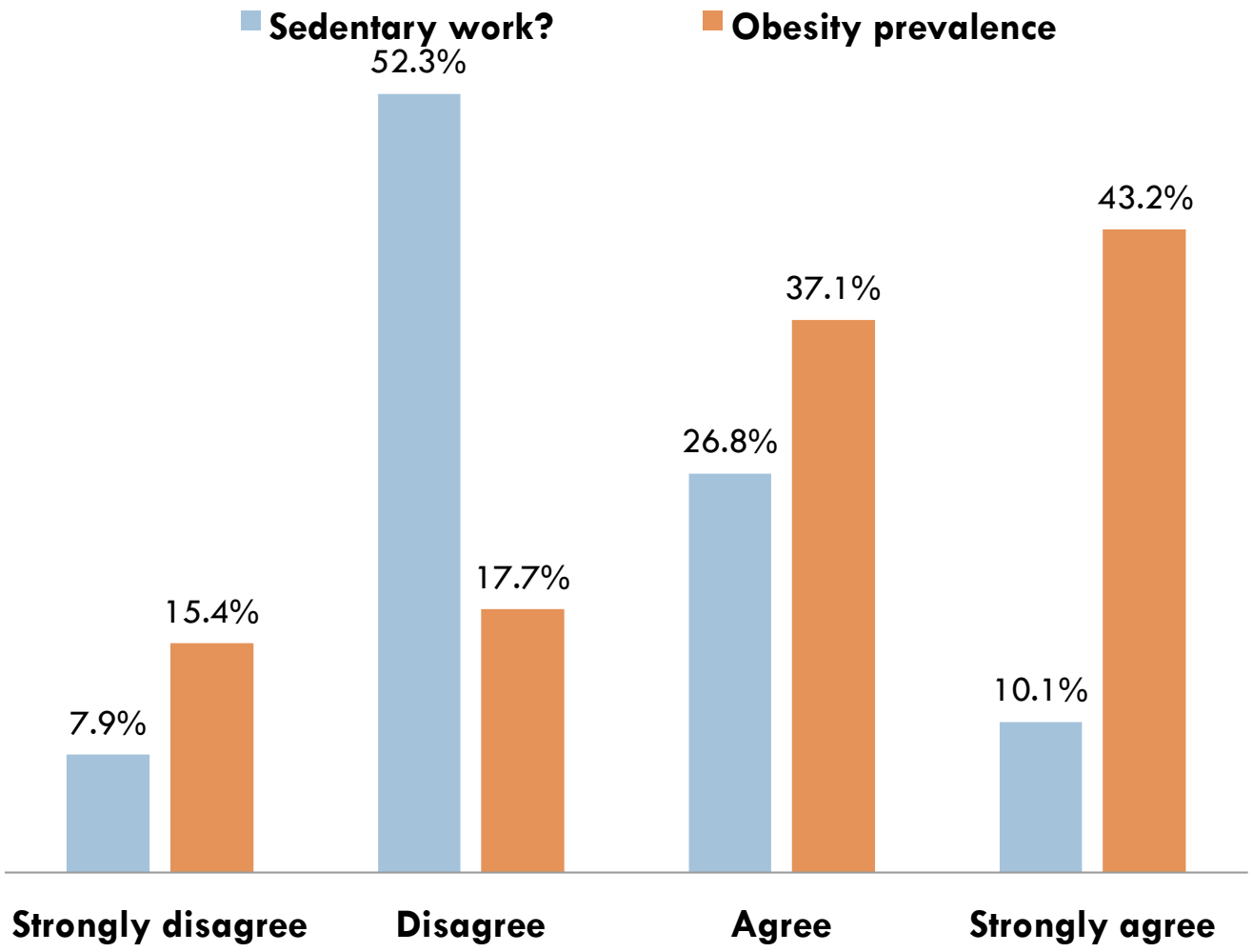
Results: Physical Inactivity at Work (S+P) and Central Obesity in male workers (40+ hrs per week) – multivariate analysis*



Odds ratios for central obesity: Non-active leisure-time physical activity: 1.67 and stress-induced overeating: 3.29

*Controlled for socio-demographic variables, psychosocial working conditions, health status, and health behaviors

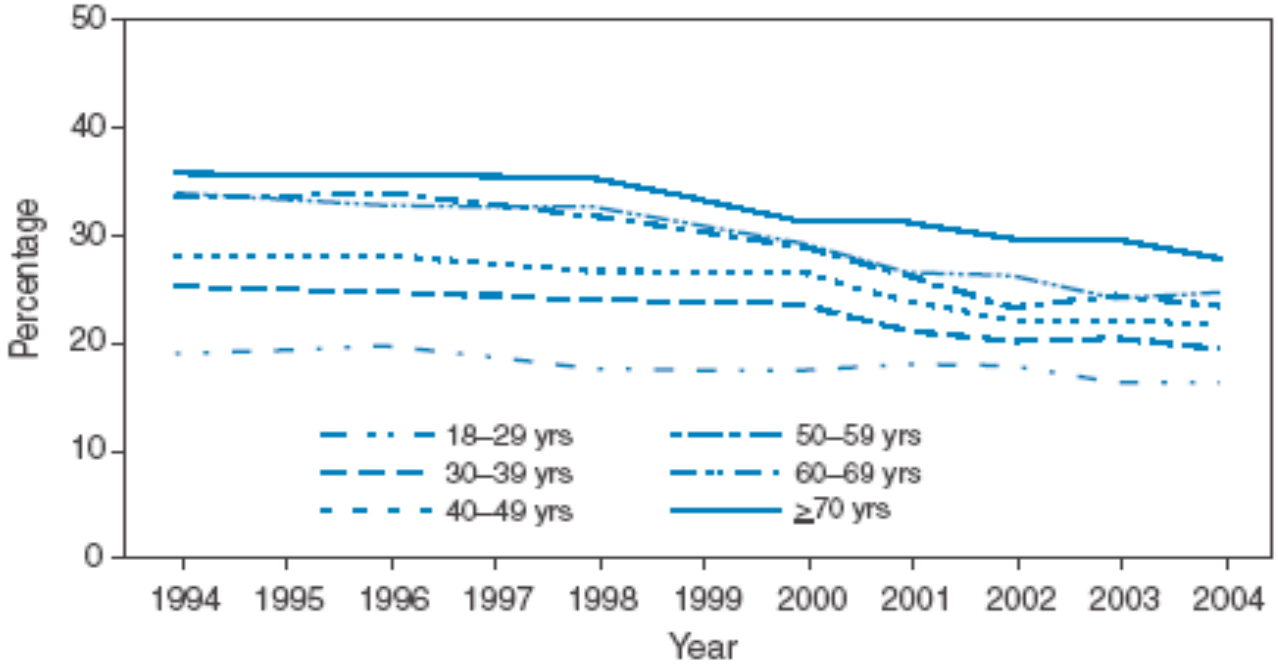
Survey response: "My job often requires sitting for long periods of time." and obesity (based on waist circumference) in 365 FFs



EMPIRICAL STUDIES: WORK AND LEISURE-TIME PHYSICAL ACTIVITY

Trends of leisure-time physical inactivity in US males

FIGURE 1. Prevalence of leisure-time physical inactivity among men, by age group and survey year — Behavioral Risk Factor Surveillance System, United States,* 1994–2004



* The survey question regarding leisure-time physical activity was not asked in Rhode Island in 1994.

International Journal of Occupational Medicine and Environmental Health 2010;23(3):239–253
DOI 10.2478/v10001-010-0029-0

PSYCHOSOCIAL WORKING CONDITIONS AND ACTIVE LEISURE-TIME PHYSICAL ACTIVITY IN MIDDLE-AGED US WORKERS

BONGKYOO CHOI[1], PETER L. SCHNALL[1], HAIOU YANG[1], MARNIE DOBSON[1], PAUL LANDSBERGIS[2], LESLIE ISRAEL[1], ROBERT KARASEK[3,4], and DEAN BAKER[1]

Spillover vs. compensation: relationship between work and nonwork (Staines, 1980)

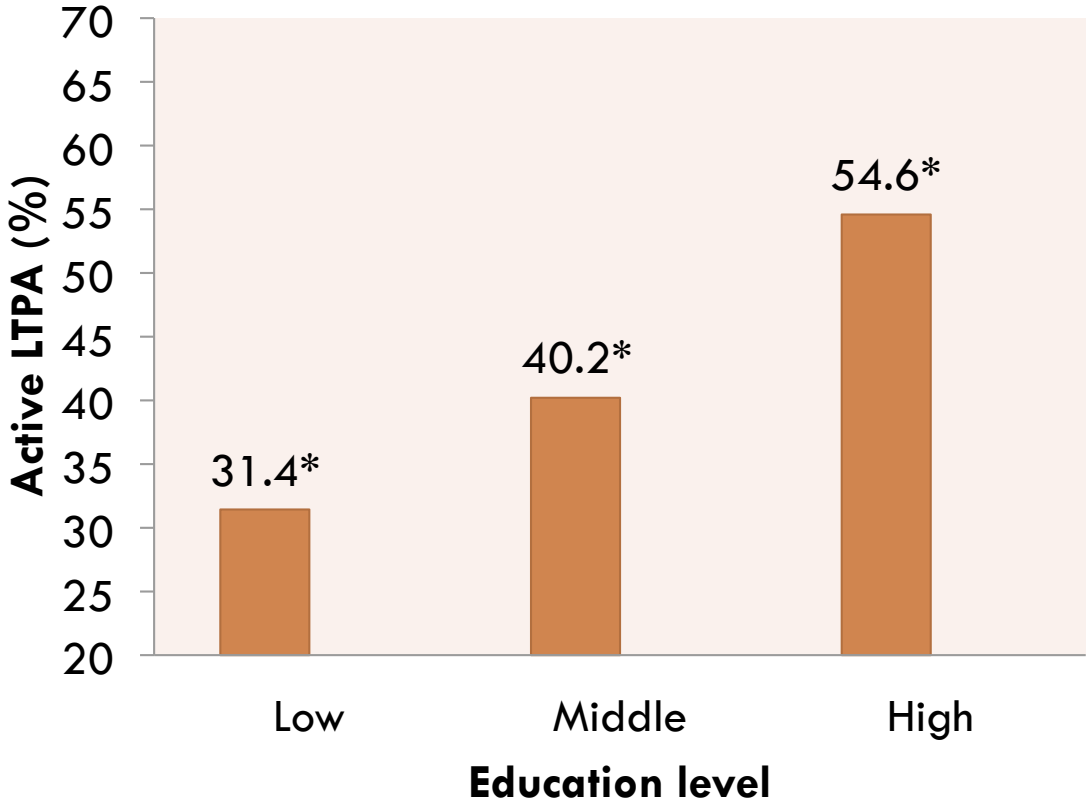
- **Spillover hypothesis:** Workers' experiences on the job carry over into the nonwork area and possibly vice versa (similarity).
  - Meissner (1971) – "the long arm of the job" at a Canadian wood product factory
  - Karasek's Demand-Control Model: active-passive axis

- **Compensation hypothesis:** A negative relationship between work and non-work.
  - High physical effort at work – Low physical activity during the leisure-time

Research question

- **Are psychosocial working conditions associated with active leisure-time physical activity (LTPA) in the US workforce?**

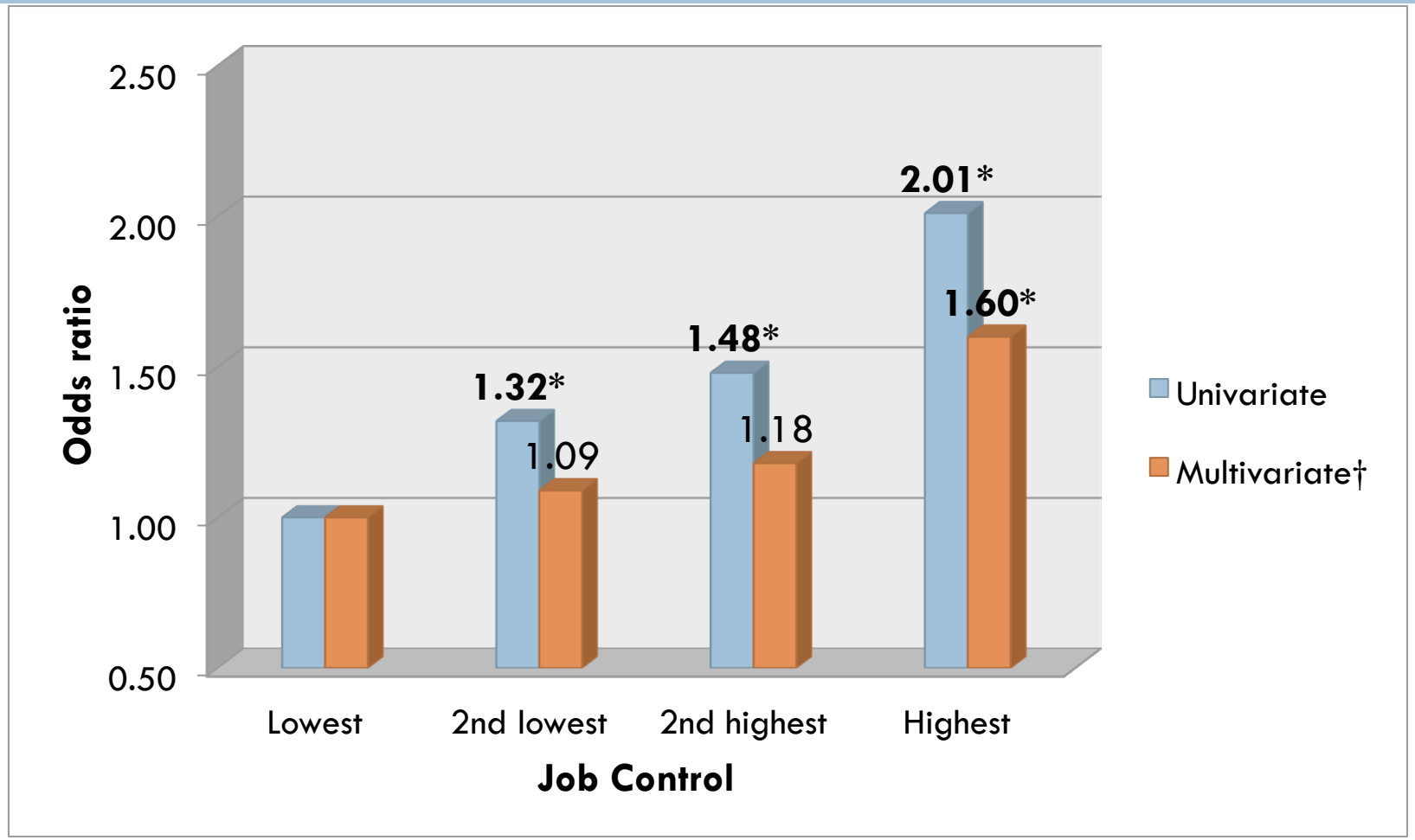
Results: Distribution of active LTPA by education (*p < 0.001)



High = university/graduate school graduate;
Middle = some college education, but unfinished;
Low = high school graduate and lower education

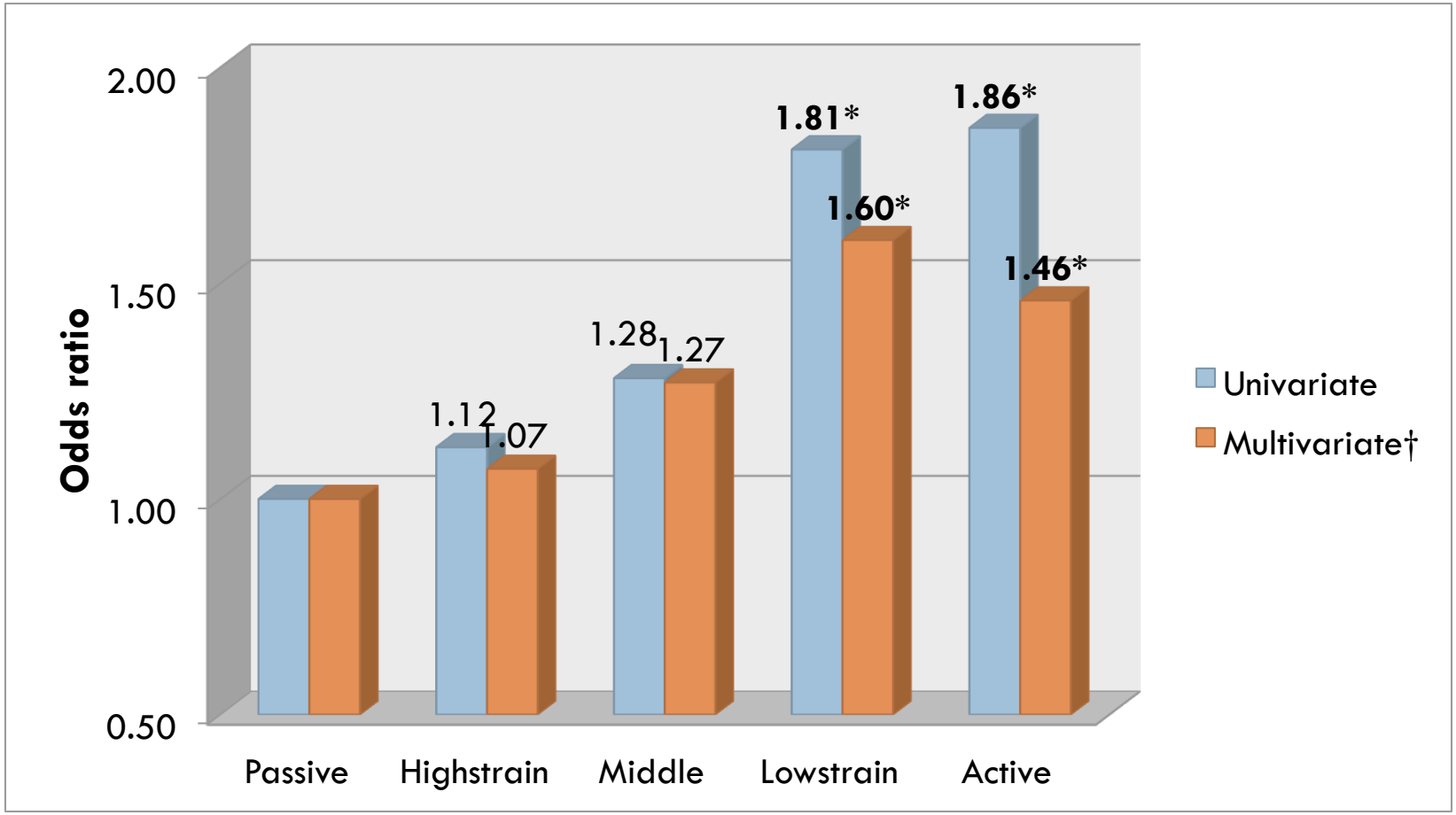
Odds ratios of job control for active LTPA

* p < 0.05



†Socio-demographic, psychosocial working conditions, health status, and health behaviors were controlled for.

Odds ratios of Demand-Control quadrants for active LTPA * p < 0.01 (the reference group: low strain)



†Socio-demographic, psychosocial working conditions, health status, and health behaviors were controlled for.

Education-level stratified multivariate analysis in men for active LTPA

- **High/middle education group** (n=761): very similar to the results of the non-education stratified analysis.

- **Low education group** (n=240): high job control and active job were not associated with active LTPA. Longer work hours (> 40 hours/week) and the low and middle levels of annual household income were associated with less active LTPA: OR (95% CI) = 0.46 (0.23–0.92); 0.20 (0.08–0.54); and 0.38 (0.16–0.89), respectively.

Education-level stratified multivariate analysis in women for active LTPA

- **High/middle education** (n=746): very similar to the results of the non-education stratified analysis. High physical effort at work was marginally ($p = 0.06$) associated with active LTPA: OR (95% CI) = 1.57 (0.98–2.50).

- **Low education** (n=272): very similar to the results of the non-education stratified analysis.

Job Strain as a Risk Factor for Leisure-Time Physical Inactivity: An Individual-Participant Meta-Analysis of Up to 170,000 Men and Women

The IPD-Work Consortium

Am J Epidemiol. 2012;176(12):1078–1089

Table 4. Prospective Associations Between Work Characteristics[a] at Baseline and Leisure-Time Physical Activity or Inactivity at Follow-up Among the IPD-Work Consortium of European Cohort Studies (Baseline Years From 1985–1988 to 2006–2008)[b]

Baseline Population and Exposure at Baseline	No.	Odds Ratio[c]	95% CI	Cases at Follow-up	
				No.	%
Physical activity at baseline ($n = 45,927$)					
Low strain	14,551	1[d]	Referent	1,685	12
Passive	11,973	1.20[d]	1.11, 1.30	1,806	15
Active	12,334	1.07[d]	0.99, 1.15	1,483	12
High strain	7,059	1.21[d]	1.11, 1.32	1,049	15
Physical inactivity at baseline ($n = 10,808$)					
Low strain	2,861	1[e]	Referent	1,416	49
Passive	3,432	1.00[e]	0.90, 1.11	1,634	48
Active	2,545	1.10[e]	0.98, 1.22	1,315	52
High strain	1,970	0.98[e]	0.87, 1.10	946	48

EMPIRICAL STUDIES: WORK, STRESS-RELATED OVEREATING, AND CENTRAL OBESITY

TABLE 2 Mean daily energy intake (in kcal) for the U.S. population, 1971 to 2000[a]

Age/sex (years)	NHANES I 1971–74	NHANES II 1976–80	NHANES III 1988–94	NHANES 1999–2000
Both sexes				
1–2	1350	1287	1289	1511
3–5	1676	1569	1591	1622
6–11	2045	1960	1892	2025
Males				
12–15	2625	2490	2578	2460
16–19	3010	3048	3097	2932
20–39	2784	2753	2965	2828
40–59	2303	2315	2568	2590
60–74	1918	1906	2105	2123
20–74[b]	2450	2439	2666	2618
Females				
12–15	1910	1821	1838	1990
16–19	1735	1687	1958	1996
20–39	1652	1643	1958	2028
40–59	1510	1473	1736	1828
60–74	1325	1322	1522	1596
20–74[b]	1542	1522	1798	1877

[a]One-day intakes.

[b]Age-adjusted to 2000 population.

Research questions

- **Whether stress-induced overeating is associated with central obesity**

- **Whether psychosocial working conditions are associated with stress-related overeating in the US workforce.**

Methods: outcomes
stress-induced overeating and central obesity

- **Stress-induced overeating**: those who endorsed either of the following two questionnaire items about "how you respond when you are confronted with difficult or stressful events in your life":
  - "I eat more than I usually do."
  - "I eat more of my favorite foods to make myself feel better."

  - Coping (Folkman & Lazarus, 1985): coping as a process (not coping styles or traits)or

- **Central obesity**: Self-reported waist circumference (> 40 inches for men and > 35 inches for women)

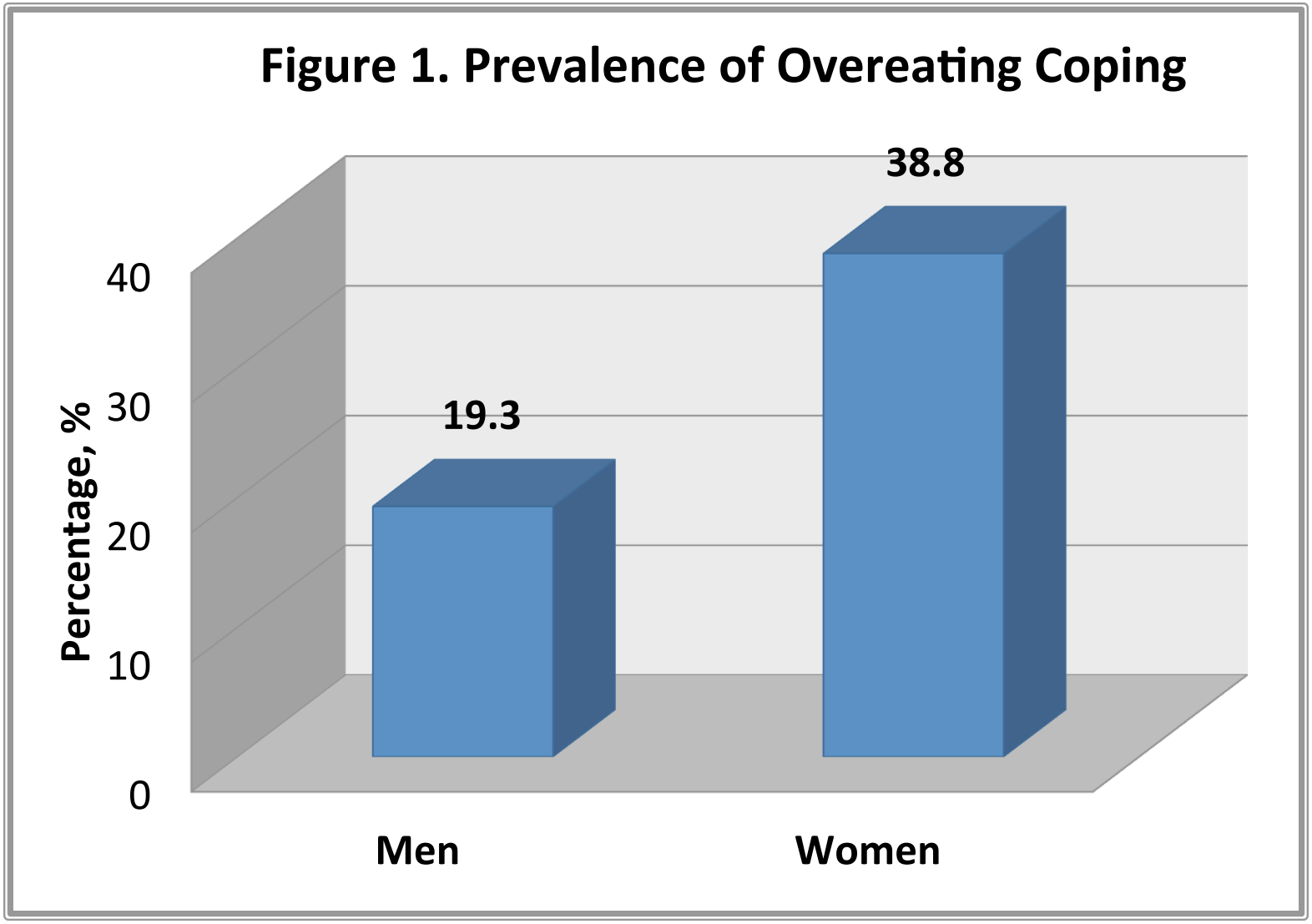
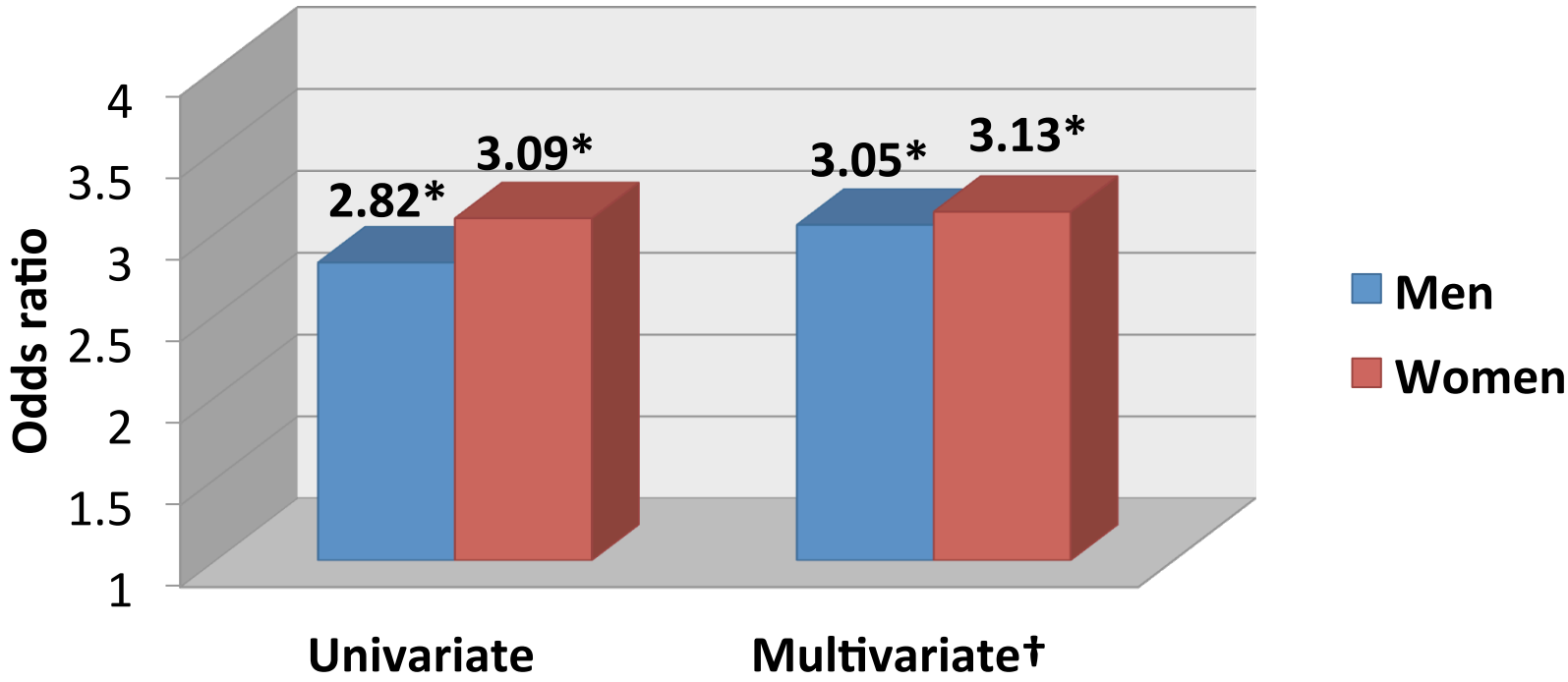


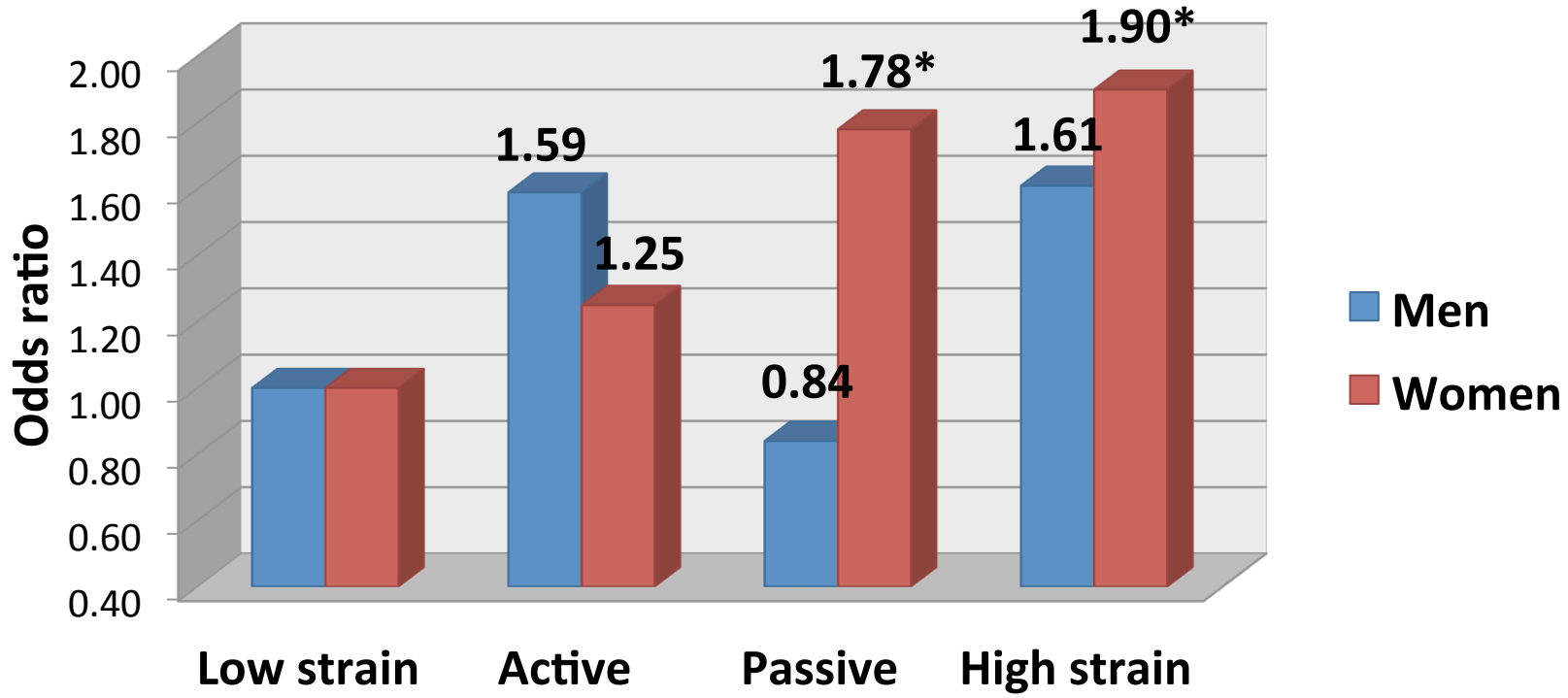
Figure 1. Prevalence of Overeating Coping
Percentage, %
40
30
20
10
0
19.3
38.8
Men
Women

Figure 3. Odds ratios of overeating coping for central obesity (* p < 0.001)



†Socio-demographic, psychosocial working conditions, health status, and health behaviors were controlled for

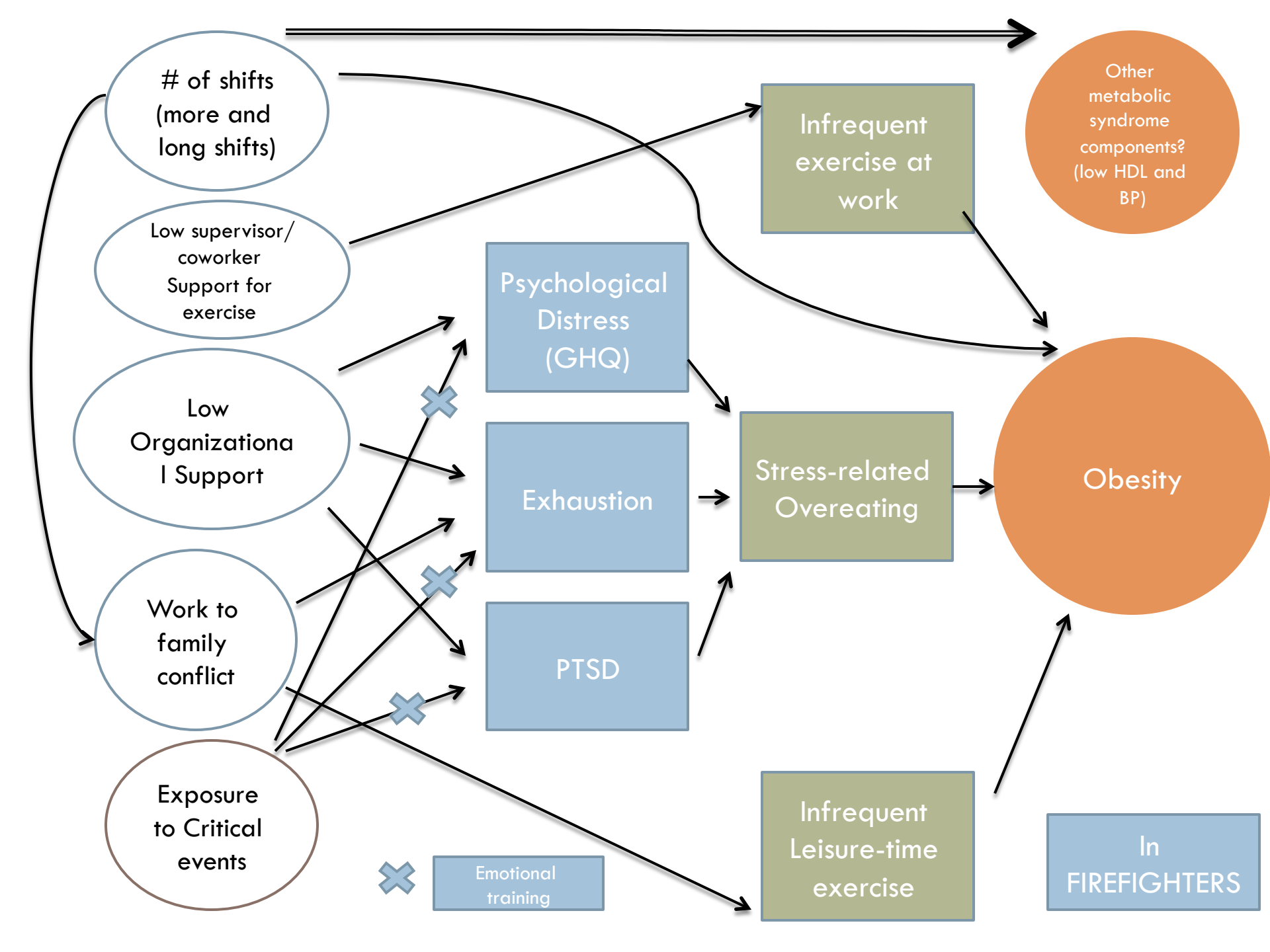
Figure 4. Demand-Control quadrants and stress-related overeating† (* p < 0.01)



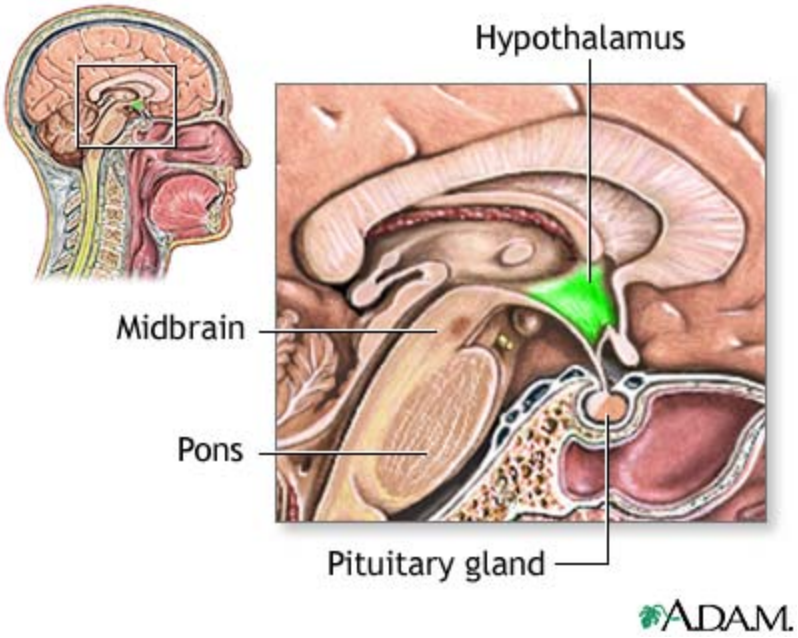
†Socio-demographic, psychosocial working conditions, health status, and health behaviors were controlled for

Odd ratios (95% confidence intervals) of psychosocial working conditions in multivariate logistic regression models

- **Men**
  - High job demands: 1.66 (1.16, 2.37)
  - Low supervisor support: 1.47 (0.99, 2.18), p = 0.06
- **Women**
  - Low job control: 1.63 (1.23-2.15)
  - Low coworker support: 1.35 (1.01-1.80)


# of shifts (more and long shifts)
Low supervisor/ coworker Support for exercise
Low Organizational Support
Work to family conflict
Exposure to Critical events
Infrequent exercise at work
Other metabolic syndrome components? (low HDL and BP)
Psychological Distress (GHQ)
Exhaustion
PTSD
Stress-related Overeating
Obesity
Infrequent Leisure-time exercise
Emotional training
In FIREFIGHTERS

EMPIRICAL STUDIES: WORK STRESS AND CENTRAL OBESITY



Work Stress – Dysfunction of Hypothalamus?

The physiological roles of hypothalamus

- Linked to limbic system, midbrain, lower CNS, & pituitary
- Involved in hunger, satiety, and feeding behavior
- Autonomic nerve systems
- Endocrine systems (- pituitary-adrenals): cortisol and GH/sex hormones
- Interactions with leptin (from Greek word, "*thin*"), synthesized and secreted from adipose tissue; a long-term fat metabolism
- Control of body temperature
- Sleep (circadian rhythm) – *suprachiasmatic nucleus*

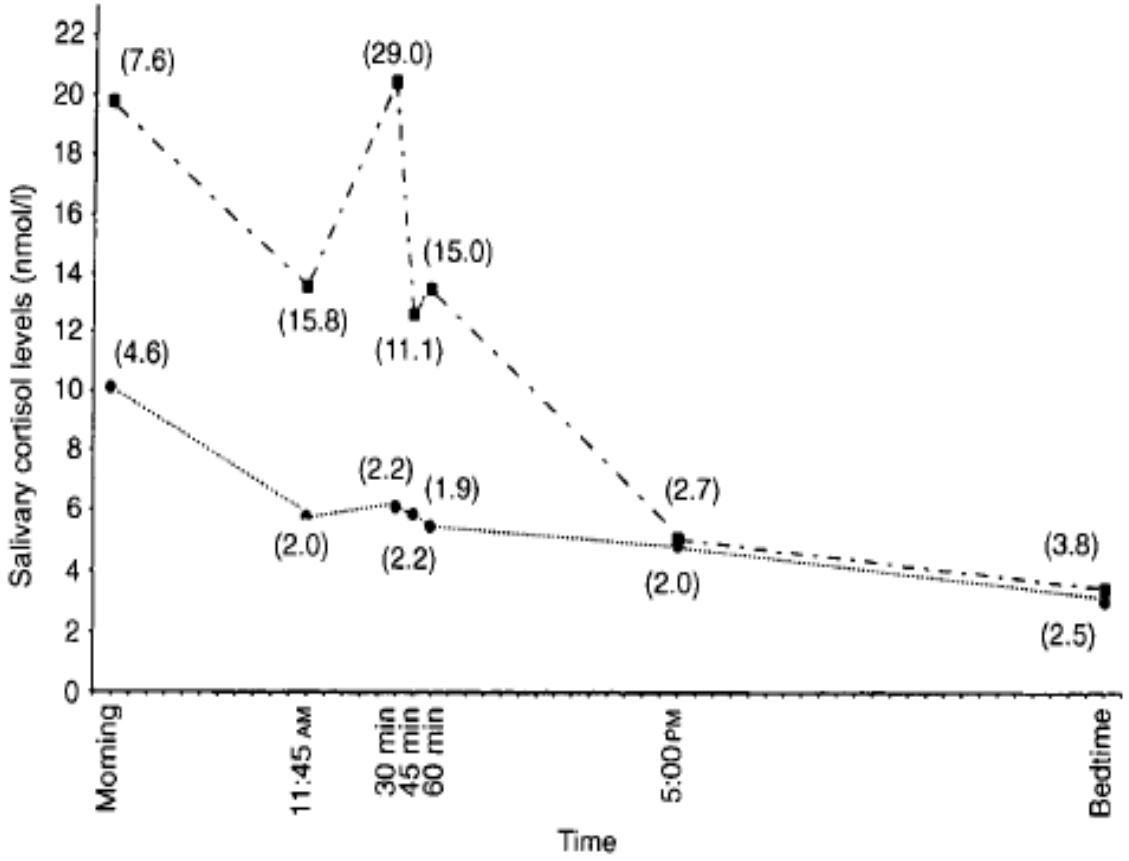


Figure 1 Salivary cortisol levels (nmol/l) over a day. Lunch at 12:00 AM. Results are given as means and standard deviations (numbers in parentheses). The upper curve illustrates diurnal cortisol secretion with high plasticity of the HPA axis, and the lower curve illustrates diurnal cortisol secretion with low plasticity of the HPA axis (modified from 14 and 15).

Table 1 The association between the status of the hypothalamic–pituitary–adrenal (HPA) axis and health in middle-aged men ($n = 284$). Results are given as Spearman's rank-correlation coefficient (modified from references 14 and 15)

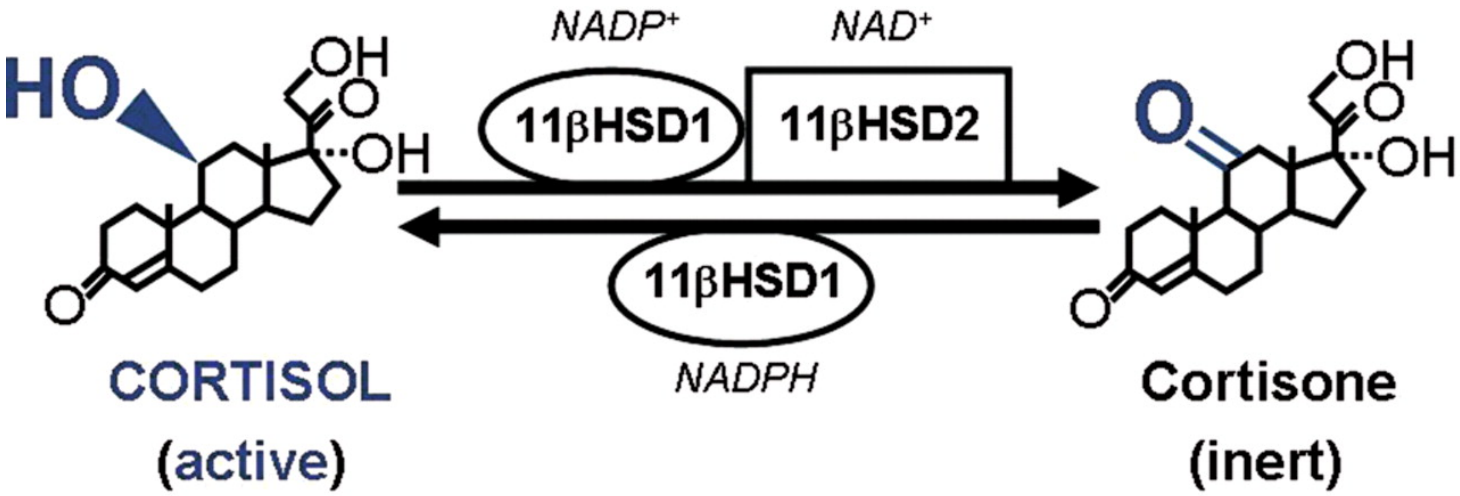
Health indicators	Diurnal cortisol secretion with high plasticity of the HPA axis	Stress-related cortisol secretion with low plasticity of the HPA axis
Body mass index (kg/m^2)	−0.13*	0.34***
Waist–hip circumference ratio	−0.16**	0.45***
Abdominal sagittal diameter (cm)	−0.11	0.47***
Testosterone (nmol/l)	−0.02	−0.18***
Insulin-like growth factor I (µg/l)	0.21**	−0.33***
Fasting insulin (mU/l)	0.02	0.39***
Fasting glucose (mmol/l)	−0.09	0.43***
Triglycerides (mmol/l)	−0.04	0.18***
Total cholesterol (mmol/l)	−0.21***	0.35***
LDL-cholesterol (mmol/l)	−0.17**	0.37***
HDL-cholesterol (nmol/l)	−0.11	−0.24***
Systolic blood pressure (mmHg)	−0.29***	0.31***
Diastolic blood pressure (mmHg)	−0.28***	0.39***
Heart rate (beats/min)	0.04	0.31***

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Does central obesity reflect "Cushing's disease of the omentum"?

Interpretation Adipose stromal cells from omental fat, but not subcutaneous fat, can generate active cortisol from inactive cortisone through the expression of 11β-HSD1. The expression of this enzyme is increased further after exposure to cortisol and insulin. In vivo, such a mechanism would ensure a constant exposure of glucocorticoid specifically to omental adipose tissue, suggesting that central obesity may reflect "Cushing's disease of the omentum".

Lancet 1997; **349:** 1210–13



Job control and job demands as risk factors for central obesity in US workers: a 9-year follow-up study

BongKyoo Choi[1], Peter Schnall[1], Marnie Dobson[1],
Haiou Yang[1], Paul Landsbergis[2], Dean Baker[1]

Awarded as BEST ABSTRACT at the ICOH-WOPS 2010 Amsterdam conference, June 14-17, 2010

Research question

- **To investigate whether job control and job demands are associated with central obesity in US workers.**
  - Few studies have examined longitudinally the relationship between psychosocial work characteristics and central obesity

- Data from the National Survey of Midlife Development in the United States [**MIDUS I, 1995-1996 (T1) and II, 2004-2006 (T2)**]: an approximately representative sample of the US population: under-representing those who were black, young, or had less education (Ryff et al., 2007).
- **Inclusion criteria**:
  - Age range: 25-59 yrs old (T1)
  - Completed both the interview and questionnaire at baseline and follow-up (T2)
  - **Working at T1 and T2**
  - Valid exposure and outcome information at T1 and T2
- **Exclusion criteria**:
  - **Obese at baseline (T1)**
  - Cancer ever (T1) or cancer treatment (T2)
  - Weight loss (> 10 pounds) due to illness over past 10 yrs at T1 and T2

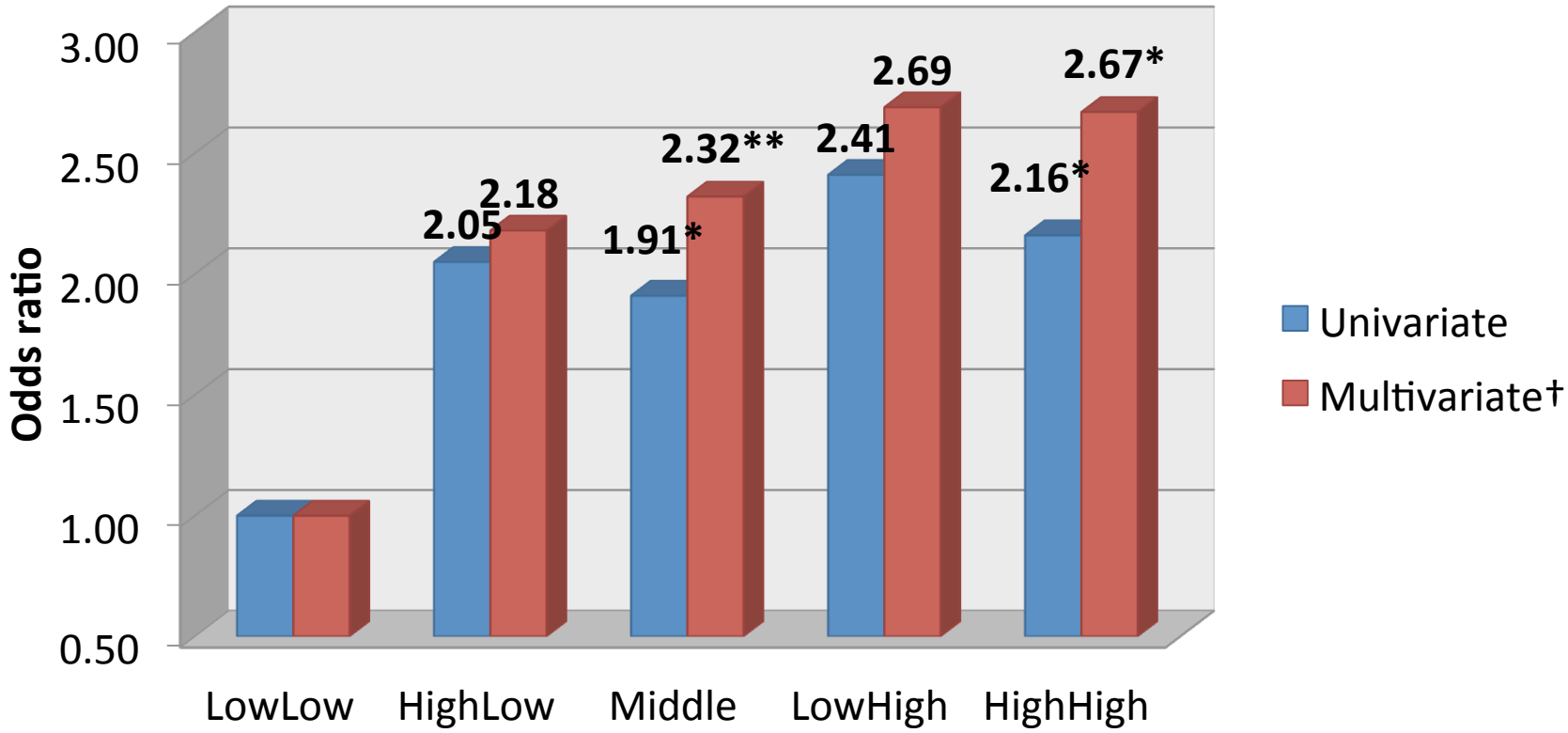
Socio-demographic characteristics of the study subjects

		Men (n = 648)	Women (n = 535)
Age (at T1), years		M = 41.0 (SD = 8.5)	M = 40.5 (SD = 8.5)
Race (at T1)	Whites	96.6%	95.5%
	Non-whites	3.4%	4.5%
Education (at T1)	High school or less	23.1%	25.8%
	Some college	26.4%	32.0%
	University or more	50.5%	42.2%

Changes in central obesity and waist circumference over 9 years

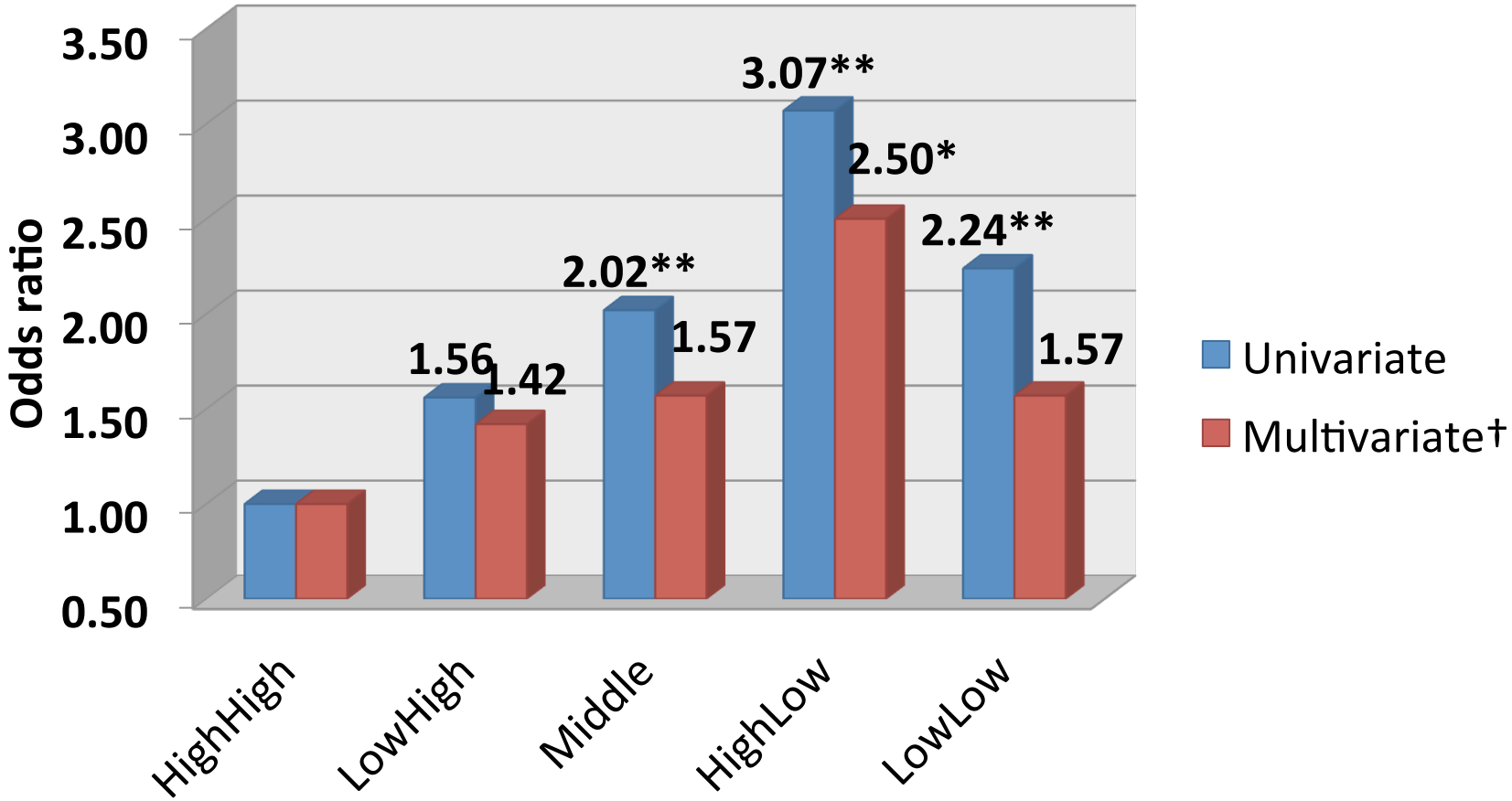
	Men (n = 648)	Women (n = 535)
Central obesity (at T2)	19.3 %	25.4%
Waist Circumference Difference (T2 – T1)	Mean = + 4.9 cm SD = 6.5	Mean = + 8.0 cm SD = 9.3

Figure 1. Odds ratios of job demands for central obesity in men: * p < 0.05 and ** p < 0.01



†Socio-demographic variables, physical activity at work, and health behaviors were controlled for.

Figure 2. Odds ratios of job control for central obesity in <u>women</u>: * p < 0.10, ** p < 0.05



†Socio-demographic variables, physical activity at work, and health behaviors were controlled for.

A summary of multivariate* analyses

	Men	Women
Job control	-	+
Job demands	+	-
Job strain	-	+

+ significant ($p < 0.05$); + no longer significant after controlling for health behaviors (possible mediation by health behaviors such as overeating coping and leisure-time physical activity); and - non-significant

*Controlled for socio-demographic variables, physical activity at work, and health behaviors

EMPIRICAL STUDIES: SHIFT WORK

Survey response: Total # of 24-hr shifts in the past month and central obesity (based on waist circumference) in 317 male FFs

# of shifts	Prevalence (among 317 FFs)	Obesity prevalence
8-11 shifts (the reference)	9.4%	**11.9%**
11.5-14 shifts	60.2%	**27.9%**
14.5-16 shifts	23.6%	**25.6%**
16.5-21 shifts	**6.8%**	**34.7%**

- After considering age, education, race, rank, number of daily calls, exercise, and eating behaviors. Frequent shifts – disturbance in circadian rhythms – lipid metabolism.
- However, it was also **correlated with eating behaviors**: stress-related overeating and frequent consumption of soft or energy drinks and with **work and family interference** (associated with leisure time exercise).

CDC/NIOSH PROGRAMS FOR PREVENTING OBESITY AT WORKPLACES

Healthier Worksite Initiative (HWI):

http://www.cdc.gov/nccdphp/dnpao/hwi/aboutus/index.htm

- HWI first came about in October 2002 when CDC Director Julie Gerberding asked the National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP) to develop a workforce health promotion (WHP) initiative focused on the four pillars of the President's HealthierUS Executive Order — physical activity, nutritious eating, preventive health screenings, and making healthy choices.

- The Web site was developed as a comprehensive one-stop shop for planners of Workforce Health Promotion (WHP) programs.

LEAN *Works!* – A Workplace Obesity Prevention Program

http://www.cdc.gov/leanworks/

- **"CDC's LEAN *Works!* Leading Employees to Activity and Nutrition" is a FREE web-based resource** that offers interactive tools and evidence-based resources to design effective worksite obesity prevention and control programs, including an obesity cost calculator to estimate how much obesity is costing your company and how much savings your company could reap with different workplace interventions.

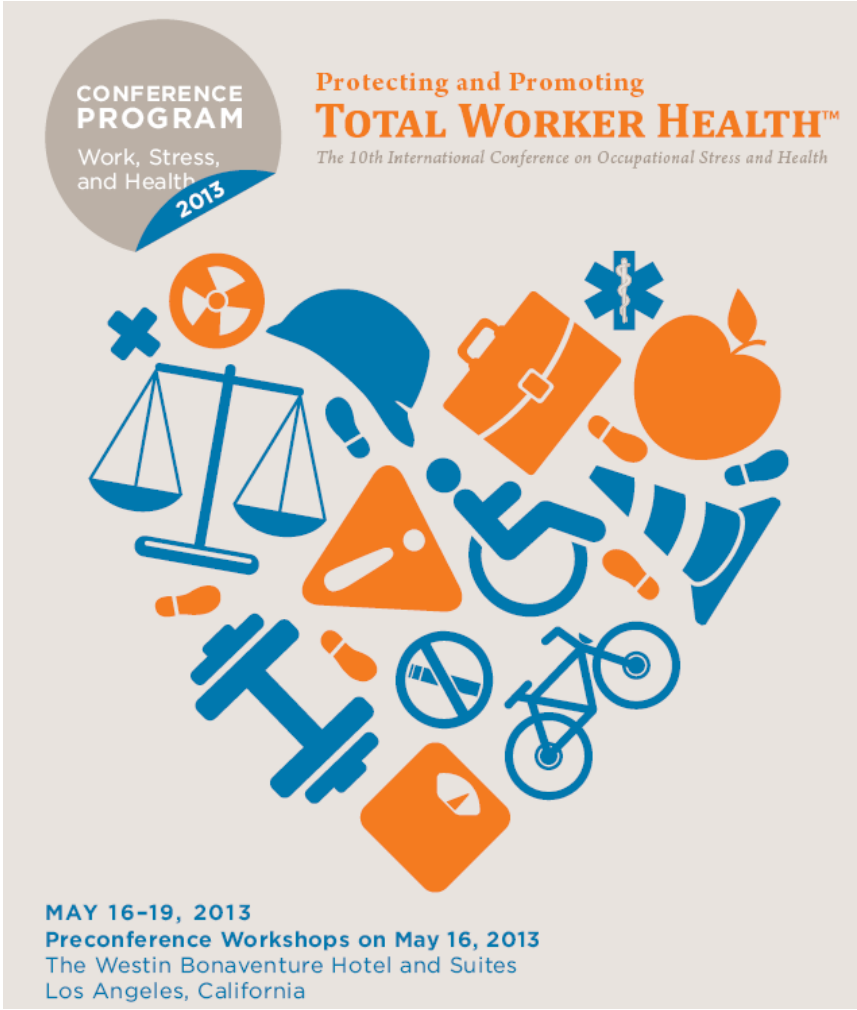
LEAN *Works!*

LEADING EMPLOYEES TO ACTIVITY AND NUTRITION

NIOSH Total Worker Health

http://www.cdc.gov/niosh/TWH/

- Total Worker Health is intended to identify and support **comprehensive approaches to reduce workplace hazards and promote worker health and well being.** The premise of Total Worker Health is that comprehensive practices and policies that take into account the work environment--both physical and organizational-- while also addressing the personal health risks of individuals, are more effective in preventing disease and promoting health and safety than each approach taken separately.



FORWARD study: htt

forward/

FORWARD
Firefighter Obesity Research:
Workplace Assessment to Reduce Disease

- A 2-year project of the UCI-COEH, funded by the CDC/ NIOSH (PI: Dr. BongKyoo Choi, Award #: R21 OH009911).

SH@W Safety and Health at Work www.e-shaw.org

Saf Health Work 2011;2:301-12 | http://dx.doi.org/10.5491/SHAW.2011.2.4.301

pISSN : 2093-7911
eISSN : 2093-7997

Review

Exploring Occupational and Behavioral Risk Factors for Obesity in Firefighters: A Theoretical Framework and Study Design

BongKyoo CHOI[1], Peter SCHNALL[1,2], Marnie DOBSON[1], Leslie ISRAEL[1], Paul LANDSBERGIS[3], Pietro GALASSETTI[4], Andria PONTELLO[5], Stacey KOJAKU[1] and Dean BAKER[1]

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[3]Department of Environmental and Occupational Health Sciences, State University of New York Downstate School of Public Health, New York, NY
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WORKSITE OBESITY INTERVENTION STUDIES

Meta-analyses of workplace physical activity and dietary behaviour interventions on weight outcomes

L. M. Verweij, J. Coffeng, W. van Mechelen and K. I. Proper

obesity reviews (2011) **12**, 406–429

Summary

This meta-analytic review critically examines the effectiveness of workplace interventions targeting physical activity, dietary behaviour or both on weight outcomes. Data could be extracted from 22 studies published between 1980 and November 2009 for meta-analyses. The GRADE approach was used to determine the level of evidence for each pooled outcome measure. Results show moderate quality of evidence that workplace physical activity and dietary behaviour interventions significantly reduce body weight (nine studies; mean difference [MD] −1.19 kg [95% CI −1.64 to −0.74]), body mass index (BMI) (11 studies; MD −0.34 kg m^{-2} [95% CI −0.46 to −0.22]) and body fat percentage calculated from sum of skin-folds (three studies; MD −1.12% [95% CI −1.86 to −0.38]). There is low quality of evidence that workplace physical activity interventions significantly reduce body weight and BMI. Effects on percentage body fat calculated from bioelectrical impedance or hydrostatic weighing, waist circumference, sum of skin-folds and waist–hip ratio could not be investigated properly because of a lack of studies. Subgroup analyses showed a greater reduction in body weight of physical activity and diet interventions containing an environmental component. As the clinical relevance of the pooled effects may be substantial on a population level, we recommend workplace physical activity and dietary behaviour interventions, in cluding an environment component, in order to prevent weight gain.

The Effectiveness of Worksite Nutrition and Physical Activity Interventions for Controlling Employee Overweight and Obesity

A Systematic Review

This review found that worksite nutrition and physical activity programs achieve modest improvements in employee weight status at the 6–12-month follow-up. A pooled effect estimate of −2.8 pounds (95% CI=−4.6, −1.0) was found based on nine RCTs, and a decrease in BMI of −0.5 (95% CI=−0.8, −0.2) was found based on six RCTs. The findings appear to be applicable to both male and female employees, across a range of worksite settings.

Most of the studies combined informational and behavioral strategies to influence diet and physical activity; fewer studies modified the work environment (e.g., cafeteria, exercise facilities) to promote healthy choices. Information about other effects, barriers to implementation, cost and cost effectiveness of interventions, and research gaps are also presented in this article. The findings of this systematic review can help inform decisions of employers, planners, researchers, and other public health decision makers.

(Am J Prev Med 2009;37(4):340–357) Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine

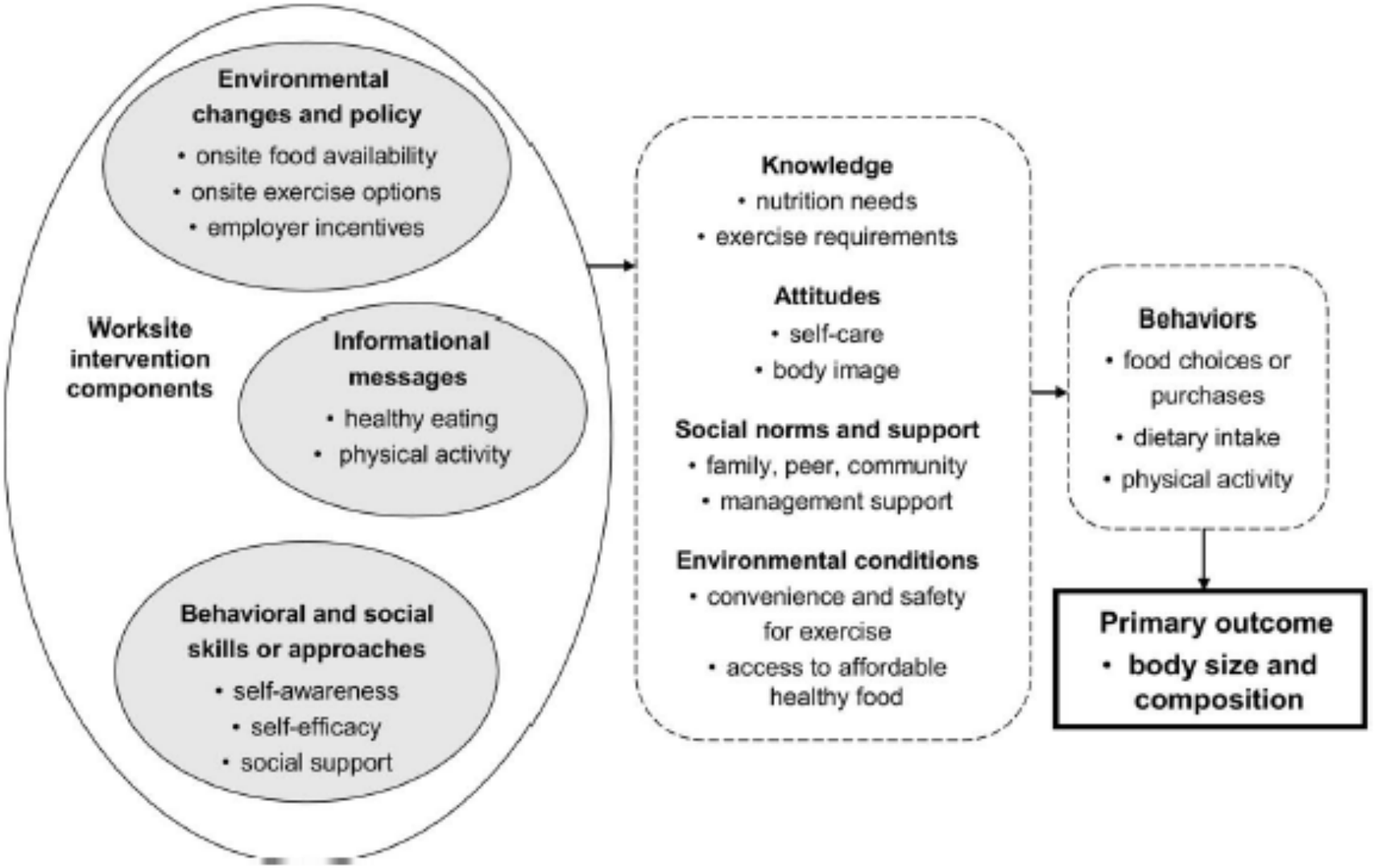
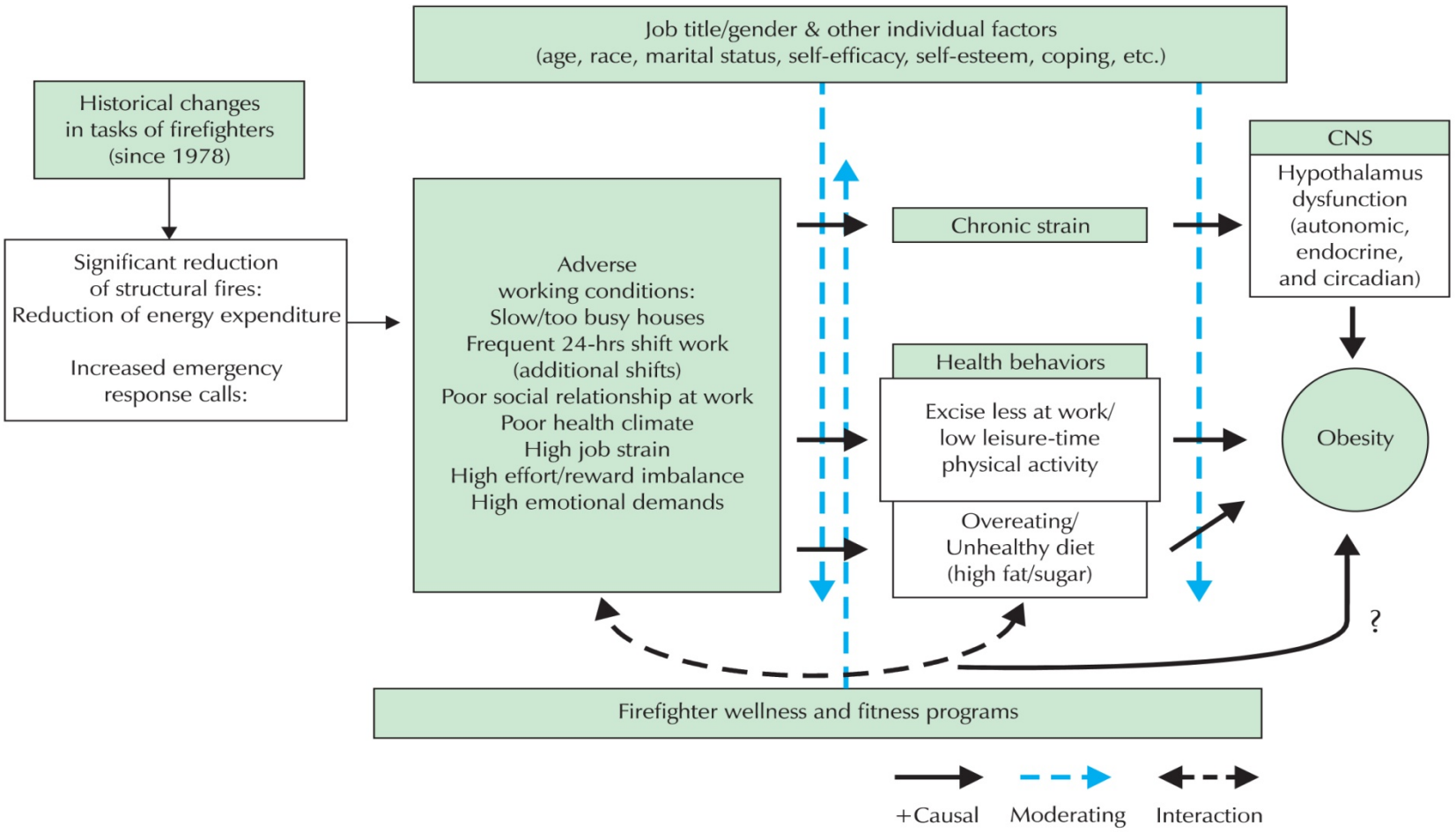


Figure 1. Analytic framework for worksite nutrition and physical activity interventions to improve weight status

(Am J Prev Med 2009;37(4):340–357)



A theoretical framework on working conditions, health behaviors, and obesity in firefighters. CNS: central nerve system. From Choi et al., *Safety and Health at Work* 2011;2:301-12

Two previous studies to prevent obesity among FFs

- The Firefighter Food Intervention Research, and Evaluation (the FFire Study)

- The Promoting Healthy Lifestyles: Alternative Models' Effects (the PHLAME study)

FFire study (Goheer et al., JNEB 2013)

- A 6-month **nutrition intervention** study with 115 firefighters in Maryland (most of them were **volunteer FFs**)
- 6 monthly 90 min education sessions at fire stations (2 control stations and 6 intervention stations)

Table. FFIRE Study Education Session Topics and Cooking Demonstrations

Session	Topics	Cooking Demonstration
1	Energy balance; macronutrients; discretionary calories; nutrient density; plate proportions	Not applicable
2	Fruits and vegetables; healthy fats; microwave cooking	Spaghetti squash (prepared in microwave)
3	Hunger; setting goals; handling slips; mindless eating	Frozen vegetable medley and fruit salad (served with chipotle burrito halves)
4	Whole grains; added sugars; healthy beverages	Meat sauce with ground turkey and spinach; whole-grain pasta
5	Lean protein; sodium; healthier prepared foods (in grocery stores and fast food and sit-down restaurants)	Turkey burgers (using indoor contact grill) with healthy fixings; low-fat coleslaw
6	Portion sizes (using salad components); nutrition facts label and nutrient claims	Salad bar with healthy carbohydrates, fats, proteins, and dressing

FFire study – preliminary results

Summary of Impact on Clinical Outcomes (bolded numbers are statistically significant)

Outcome	Control Stations			Intervention Stations		
	Month 0 - Month 6	Month 6 - Month 12	Month 0 - Month 12	Month 0 - Month 6	Month 6 - Month 12	Month 0 - Month 12
Weight (lbs)	-3	-2	**-5**	**-6**	+ 1	**-5**
Body Mass Index (kg/m^2)	-0.4	-0.4	**-0.8**	**-0.8**	+ 0.1	**-0.7**
Body Fat (%)	-1	-1	**-2**	**-1**	+ 0	**-1**
Waist Circumference (in)	**-1.2**	+0.2	**-1.1**	**-0.5**	+ 0.3	**-0.3**
Diastolic Blood Pressure	**-5.5**	-0.7	**-6.3**	**-5.2**	+2.2	**-3.0**
Systolic Blood Pressure	**-10.5**	-1.0	**-11.5**	**-10.5**	**+5.0**	**-5.4**
Total Cholesterol*	**-26**			**-17**		

* Total cholesterol was only collected at 0 and 6 months

PHLAME I study (Elliot et al., JOEM, 2007)

- A **1-year physical activity and diet intervention** study with 599 firefighters from the 5 fire departments (each having < 500 FFs and no WEFIT program before the study) in Oregon and Washington.
- 11 45 min education sessions based on a team-based health education curriculum on physical activity, nutrition, and other selective topics (e.g., stress management) at fire stations (control stations and intervention stations)
- **"Marginal" program effects** on weight (a loss of 2.5 lbs) and body mass index (a decrease of 0.4 kg/m2, p = 0.06). **But no other obesity and CVD risk measures such as body fat %, waist circumference, and blood pressure. No long-term program effect.**

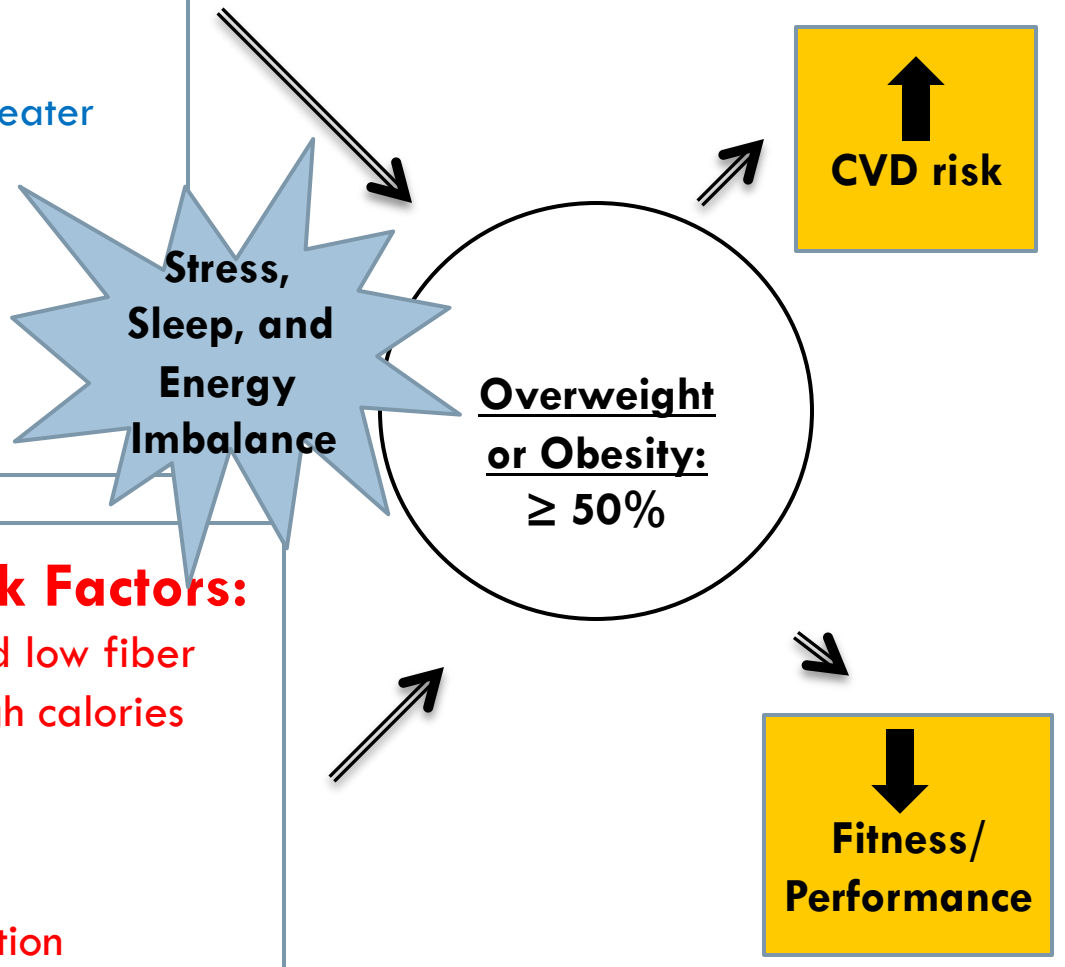
Occupational and Behavioral Risk Factors for Obesity among FFs (2010-2013)

Occupational Risk Factors:

More than 16 24-hr shifts/month:
(an increase of 0.3 inches per shift)
Unbalanced work demands (fewer and greater calls/shift than 4.5-7.5 calls/shift)
Sedentary work/Higher ranks
Supervisor/coworkers support for exercise (protective)
Emotional training in emergency situations (protective)

Health-related Behavioral Risk Factors:

High fat, high salt, high added sugar, and low fiber
Eating cultures at station (portion size, high calories choices, snacking, etc)
Overeating under stress
Overeating since childhood
Frequent soft and energy drinks consumption
Moderate alcohol consumption (protective)
Infrequent exercise esp. during leisure-time



HEROES means

- **H**ealthy
- **E**ating
- **R**educing Stress/Shifts
- **O**rganizational Social (and Family and Community) Support
- **E**xercise and Standing
- **S**leep

→ **To improve the Cardiovascular Health of FFs by achieving and maintaining a healthy body weight**

Goals of the HEROES project

Improving the cardiovascular health of firefighters:
by developing and pilot-testing a firefighter-driven, nutrition-centred health promotion program and using this information for designing an effective obesity intervention study for firefighters in the future

More Questions?

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