The Cardiovascular Effects of Prolonged Sitting or Standing & The Effects of Sit-Stand Workstations

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[I have no financial interests]

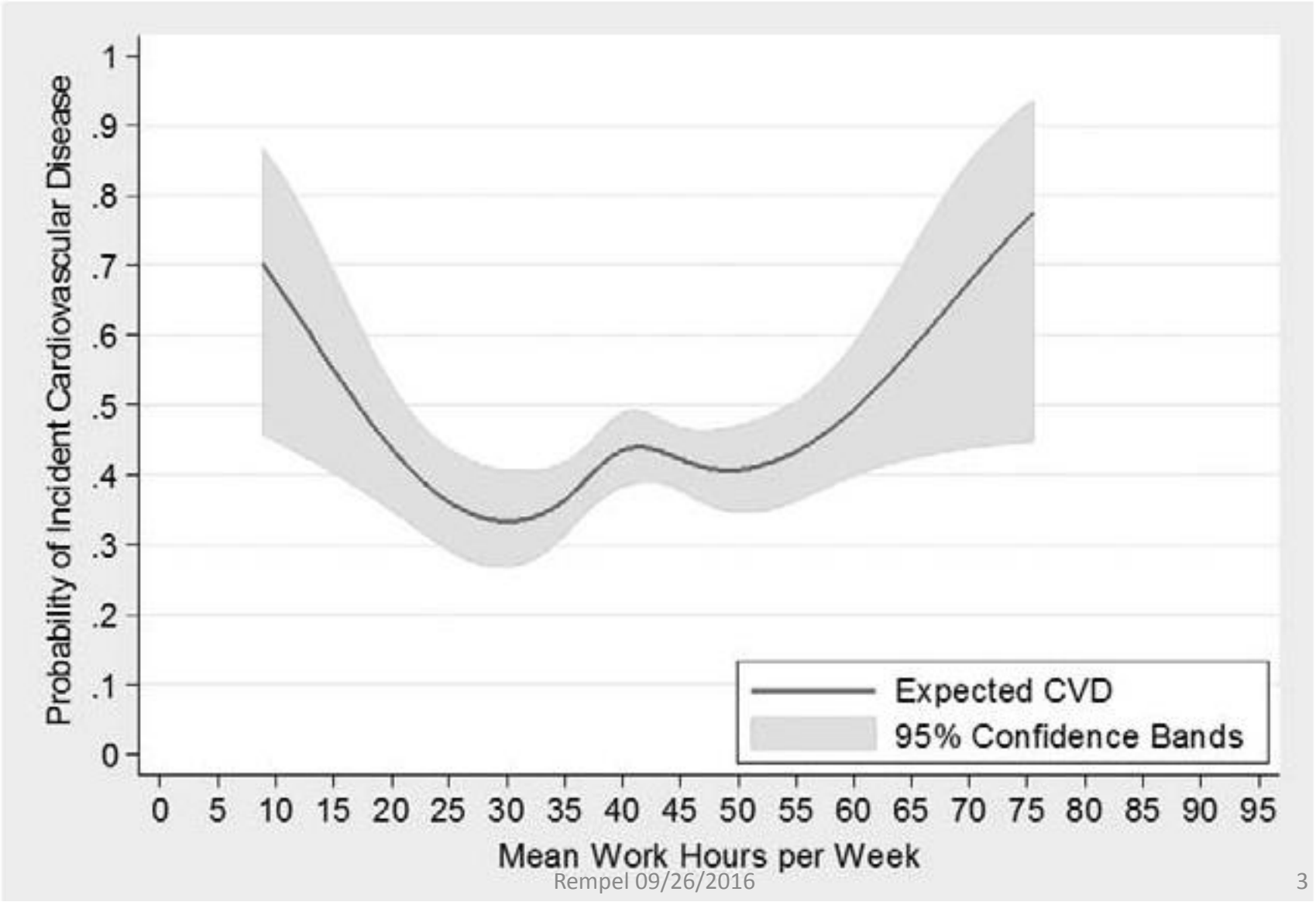
Sit – Stand and Health

- Reduces back-neck pain.
- <u>Reduces cardiovascular risk?</u>

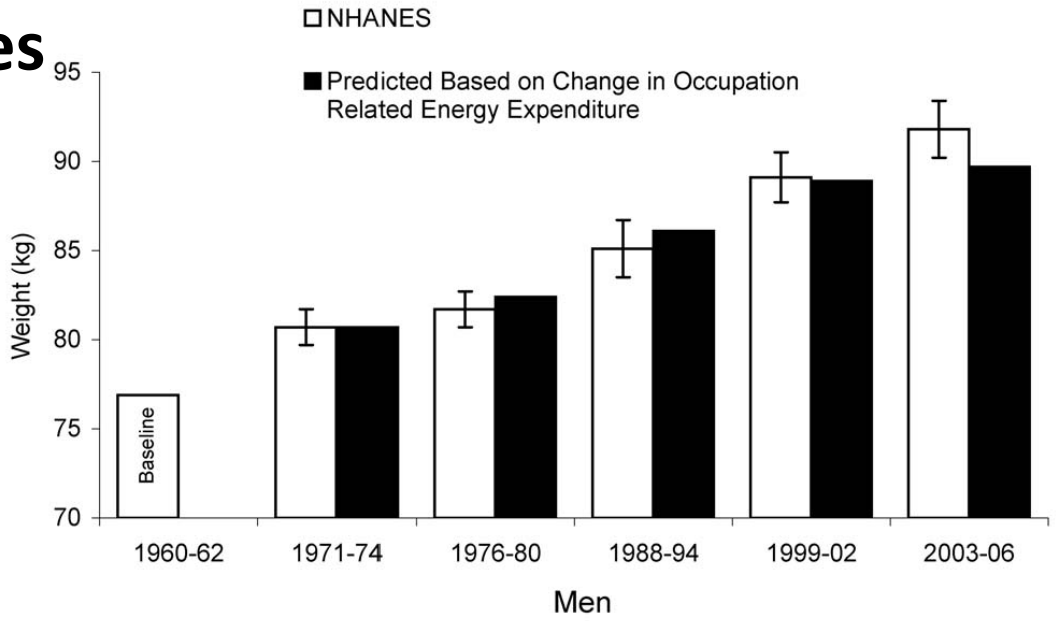
"You were right- I do feel more productive standing up"

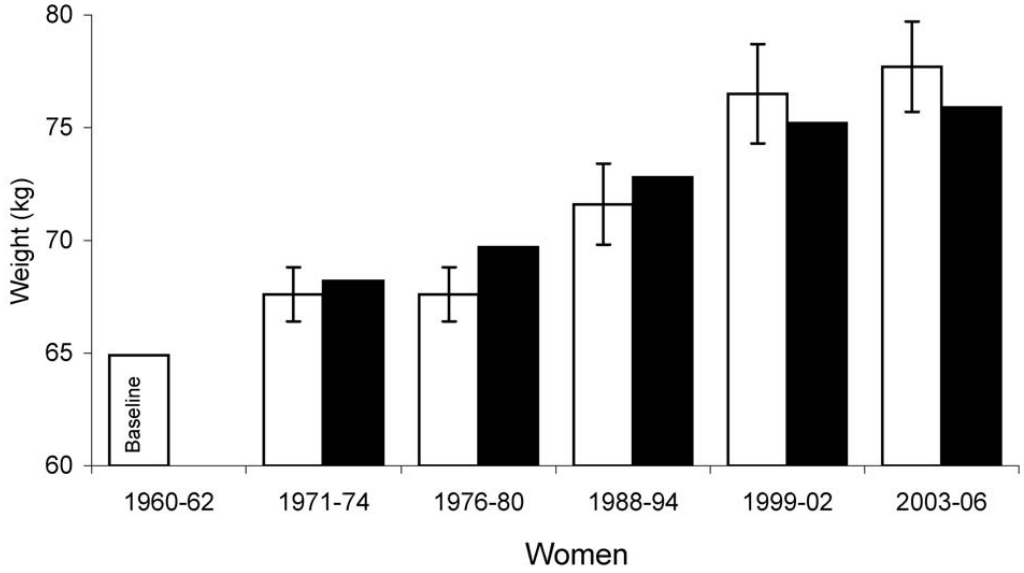
Work hours and CVD

US Prospective PSID Population Survey 1986-2011, N=22,000; adjusted for age, sex, industry, occupation. [Conway et al. JOEM 2016; 58(3):221]



Predicted Weight Changes





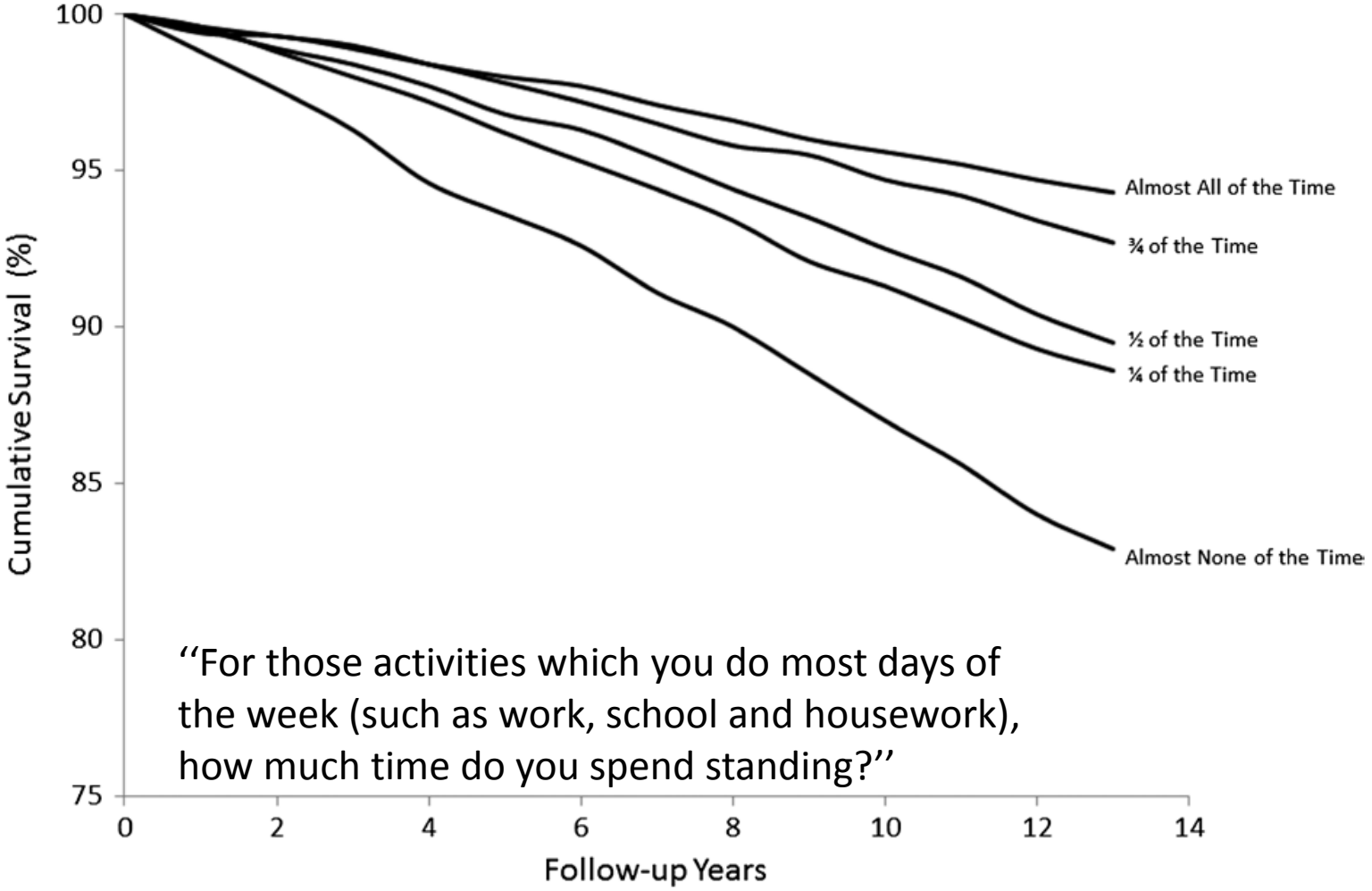
Church, Thomas, Tudor-Locke, et al. PLoS ONE, 2011

Do sit-stand workstations reduce CVD risk?

- Does occupational sitting increase CVD?
- Does occupational physical activity decrease CVD?
- Can sit-stand reduce BMI?
- Can sit-stand reduce blood pressure?

Daily Standing Time and All-Cause Mortality

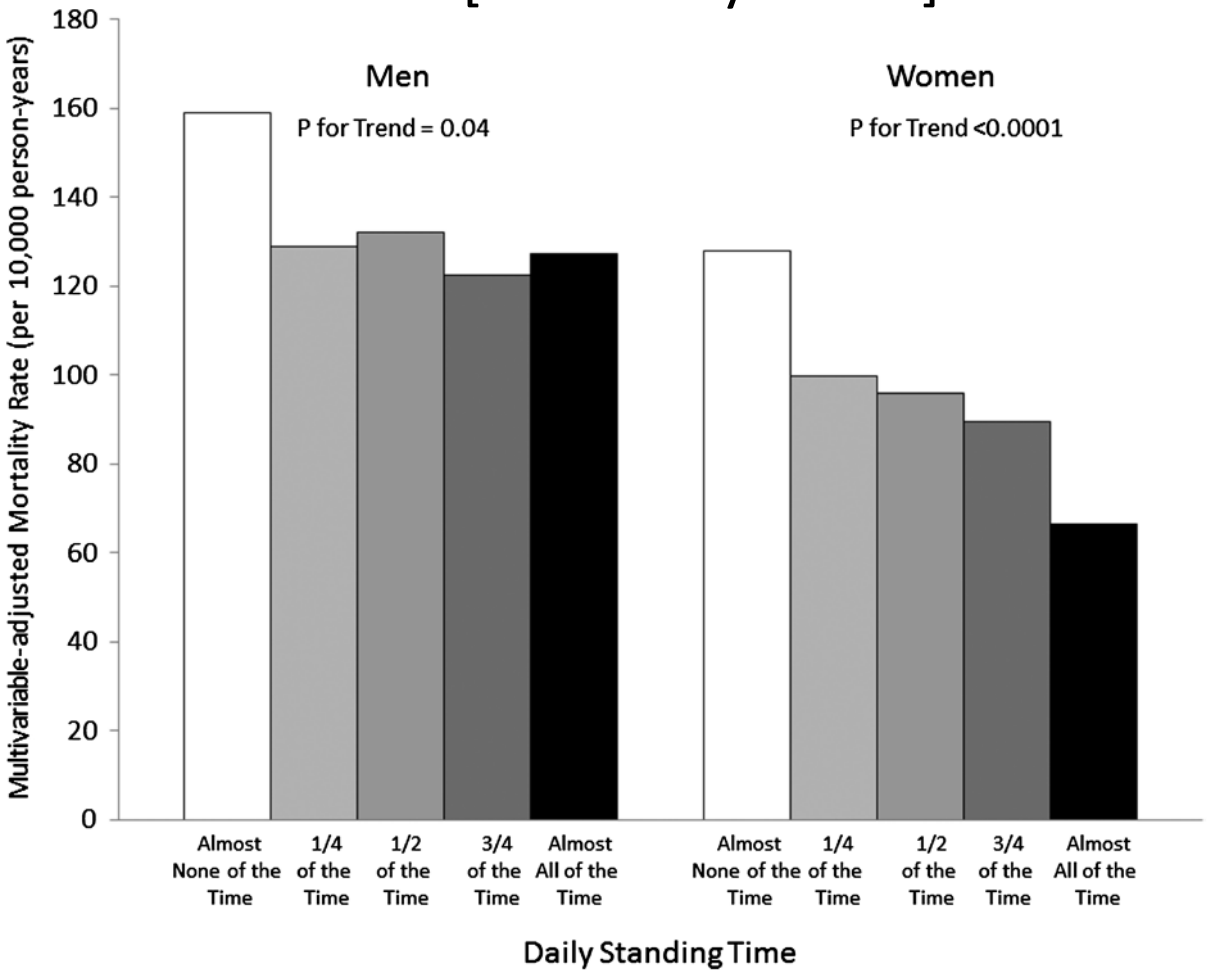
[Katzmarzyk 2009]



17,013 Canadians, ages 18-90, (41% of mortality = CVD), no adjustment for covariates

Daily Standing Time and All-Cause Mortality

[Katzmarzyk 2014]



Adjusted for age, smoking, alcohol, LTPA, physical activity readiness

Total Sitting Time & CVD

- Borodulin 2014: N= 4,516 x 8.6 yrs; 25-74 yo, **HR 1.06** (1.01-1.11) (h/d)
- Matthews 2015: N=154,614 x 6.8 yrs; 59-82 yo
  - Male HR =1.10 (5-7h) =1.18 (7-9h) =1.29 (9-12h) =**1.42** (>12h)
  - Female: HR =1.07 (5-7h) =0.99 (7-9h) =1.36 (9-12h) =**1.47** (>12h)
- Petersen 2014: N= 71,363 x 5.4 yrs; 18-99 yo; HR= 0.97 (6-10h); =**1.27** (>10h)
- Chau 2015: N= 50,817x 3.3 yrs; **HR 2.15** (1.34- 3.44) (>10h vs < 4h)
  - Occupational sitting time does not increase risk

Occupational Sitting Time & CVD

- Stamatakis 2013:N= 11,168x12.9 yrs; >40 yo; **HR=0.94** [sit v stand-walk]
- Moller 2016: N= 11,996x19.0 yrs; 21-69 yo; **HR=0.98** (0.88-1.09)
- Kikuchi 2015 (all cause mortality)

  office M N= 15,863x10.0 yrs; 57 yo; **HR=0.87** (0.75-1.01) [>3h/d)

  F N= 12,005x10.2 yrs; 57 yo; **HR=1.03** (0.77-1.39) [>3h/d]

Adjustment: gender, age, employment, education, smoking, LTPA, BMI, diet, alcohol, serum cholesterol, hypertension

London Bus Drivers Study

Morris J et al., Lancet 1953.

Drivers at increased risk for incident CHD compared to conductors: 2.7 v 1.9/1000.

“Differences due to differences in physical activity”

London Bus Drivers Study

Morris J et al., Lancet 1953.

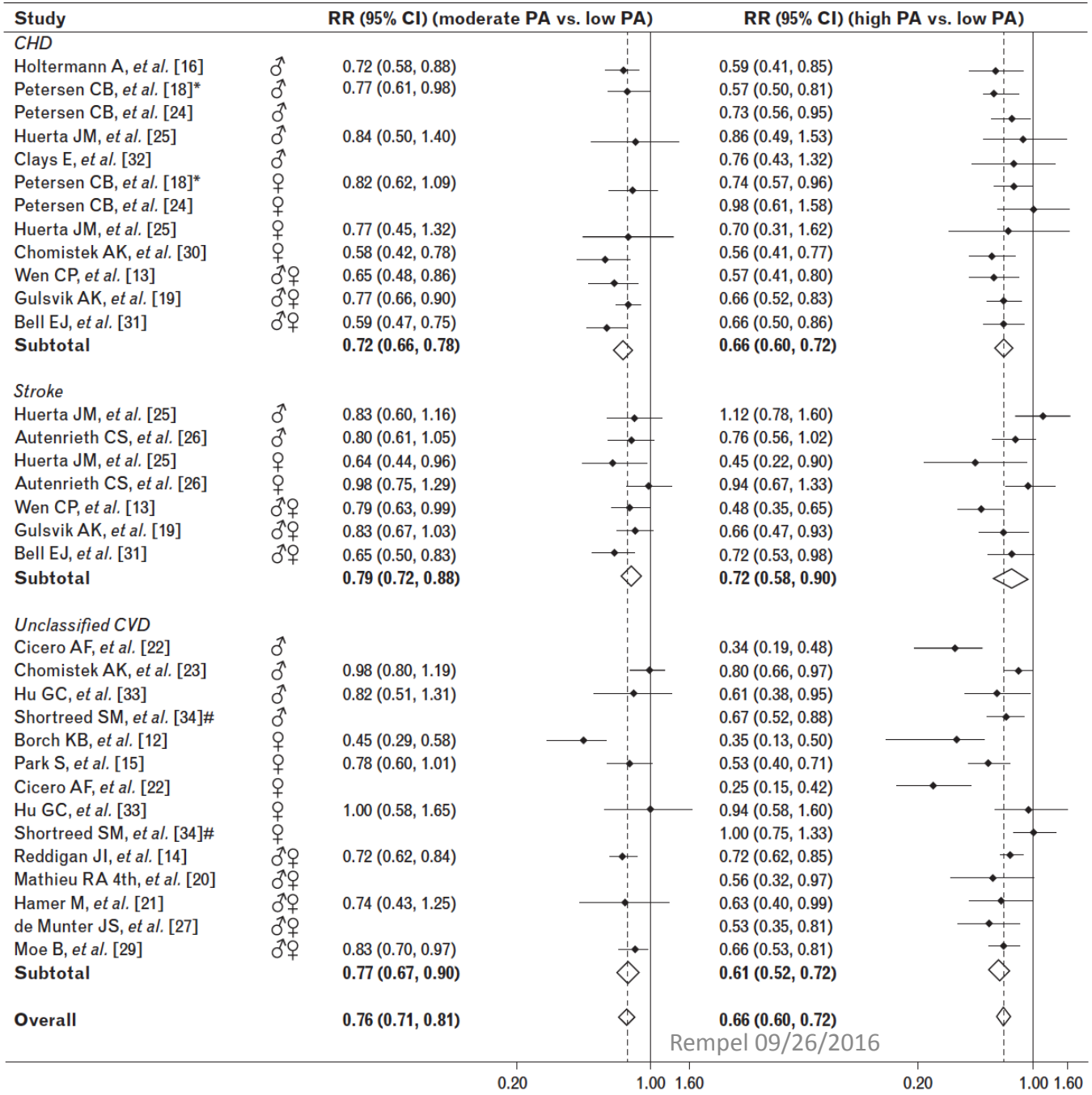
Drivers at increased risk for incident CHD compared to conductors: 2.7/1000 vs 1.9.

“Differences due to differences in physical activity”

No control for stress, BP, smoking, or BMI

<u>Urban bus drivers have elevated BP</u>.

Leisure Time Physical Activity (LTPA) Reduces CVD



LTPA and CVD: Meta-analysis

[Li et al., 2013]

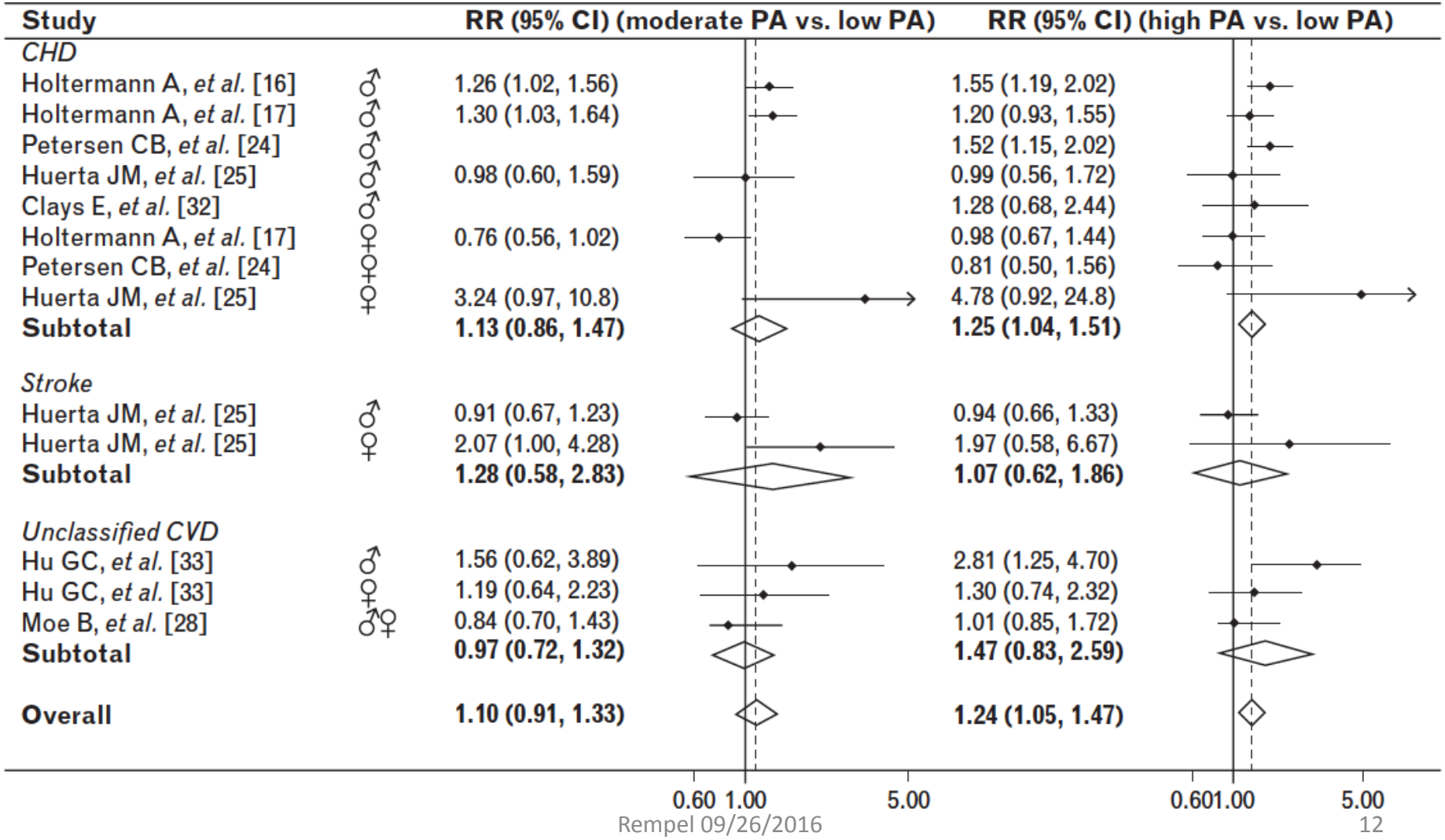
- 23 prospective studies
- 790,000 adults
- 22,000 incidents
- Confounders controlled

- Moderate level LTPA reduced CVD risk 20-30%
- High level LTPH reduced CVD risk 30-40%

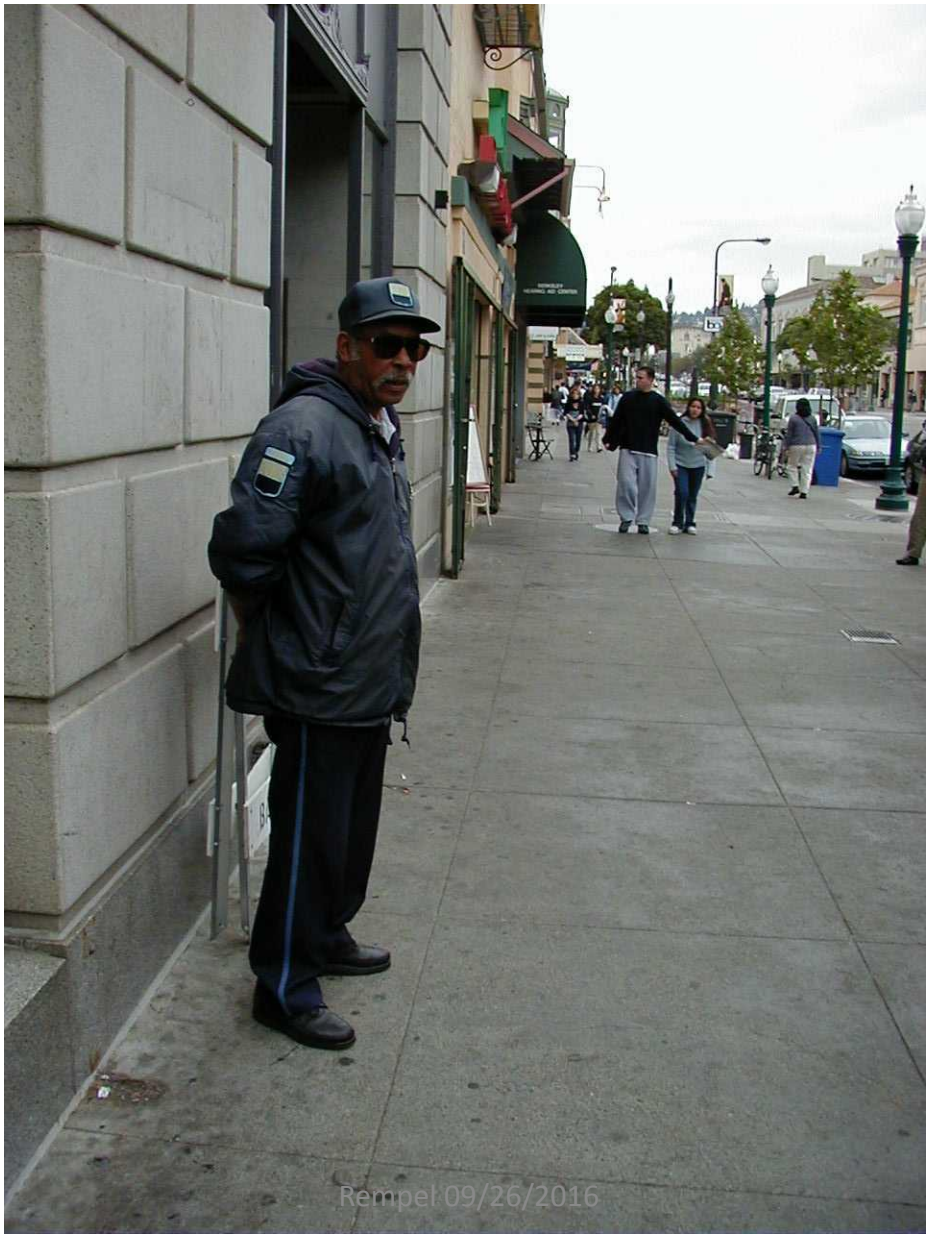
Occupational Physical Activity (OPA) Does Not

[Li et al. Current Opinion in Cardiology. 28(5):575-583, 2013]

- 7 prospective studies with adjustment for covariates
- Moderate OPA increased risk 5-15%
- High OPA increased risk 10-30%

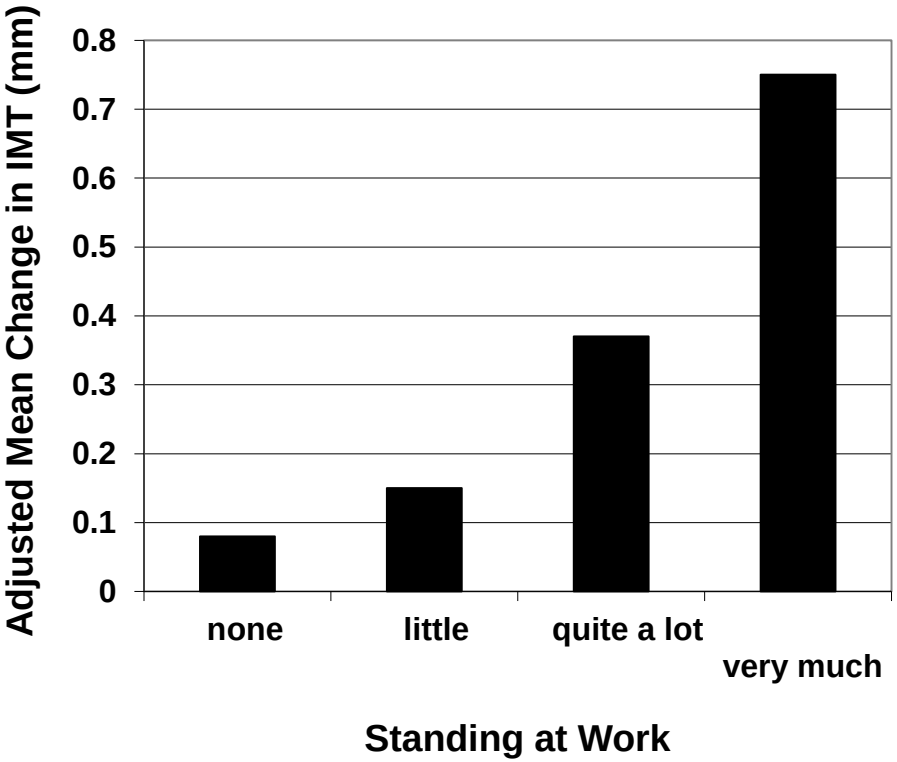


Standing at Work Increases CVD



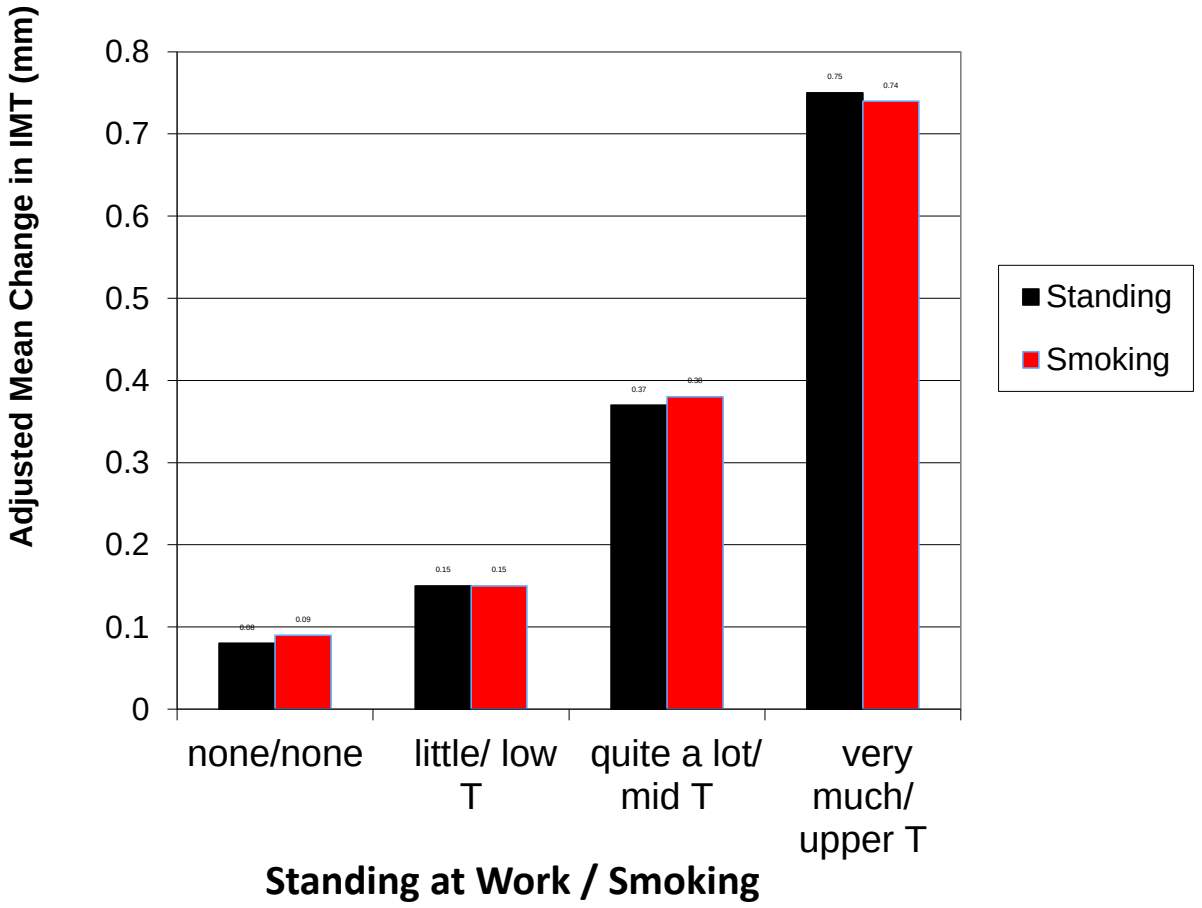
Standing Increases Carotid Atherosclerosis

4-year Change of Carotid Intima Media Thickness (IMT), adjusted for Age, Technical, Physical and Psychosocial Job Factors, Income, Biological and Behavioral Factors: Men with IHD



Krause et al., Scand J Work Environ Health, 2000

Standing compared to Smoking



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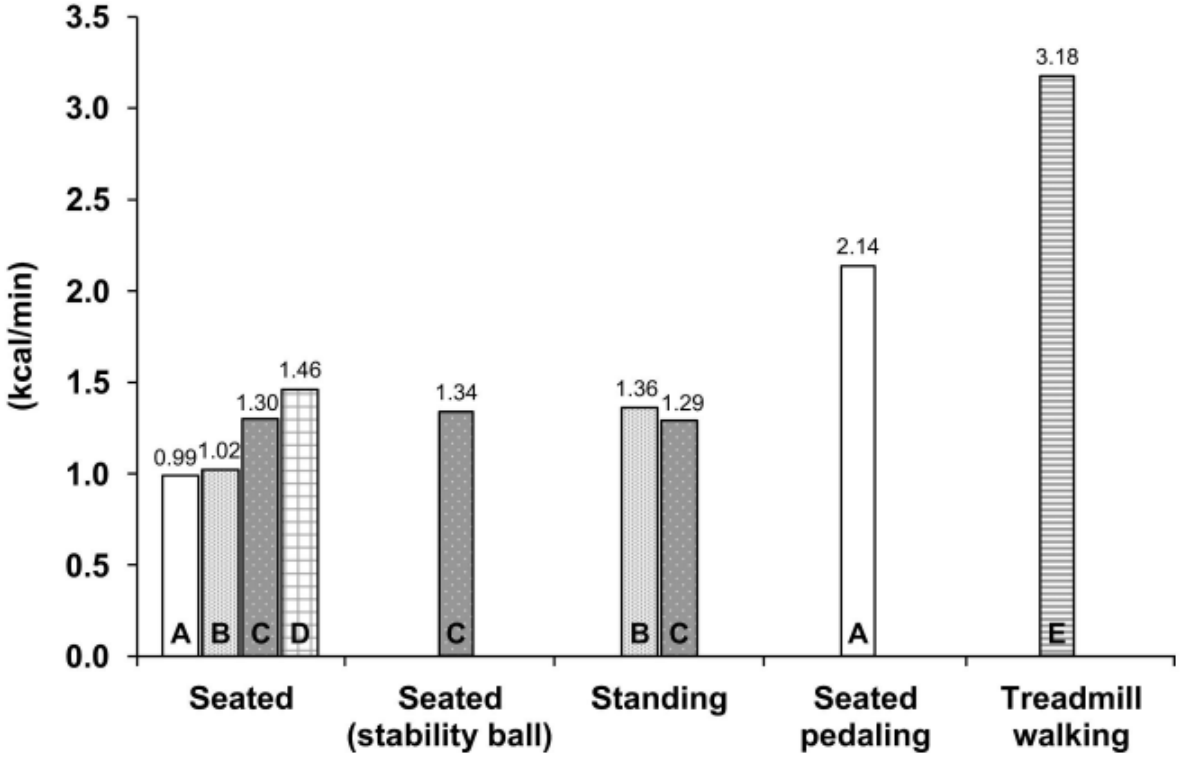
NEPA: Non-exercise physical activity

Tudor-Locke C et al, Int J Obesity 2014



Standing v Sitting	Treadmill Walk v Sitting	Seated Pedaling v Sitting
20 kcal/h (B: Reiff 2012)	120 kcal/h	56 kcal/h
-1 kcal/h (C: Speck 2011)		
4 kcal/h (Beers 2008)		

Use of Sit-Stand Workstations

- Increases standing 50-70 minutes per day.

Does Work NEPA reduce Blood Pressure? 8 week RCT [Graves et al, 2015]

Control (N=21)	
Sitting	402 min/d
Standing	44 min/d
Walking	34 min/d

Sit-Stand Desk (N=23)	
Δ Sitting	-87.6 min/d
Δ Standing	72.9 min/d
Δ Walking	7.1 min/d
Δ Glucose	-0.09 mmol/L
Δ Triglycerides	0.11 mmol/L
Δ Cholesterol	-0.40 mmol/L
Δ SBP	-1.6 mmHg
Δ DBP	-2.5 mmHg

[All differences NS]

Sitting and Lipid Profiles
[Saidj 2013]

- Danish working adults; N=2544; 18-69 yr
- Leisure time sitting (3.1h) assoc with increased TGs, cholesterol, body fat, BMI, waist circumference. (no assoc with Hgb A1c, Plasma glucose)

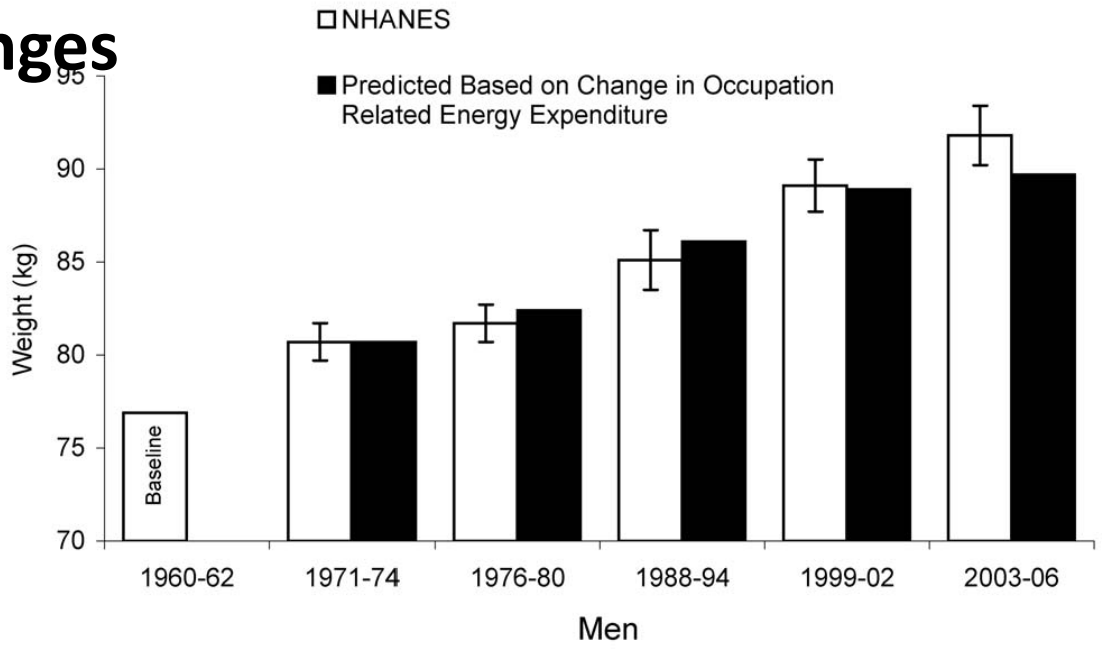
- Occupational time sitting (4.1h) no associations

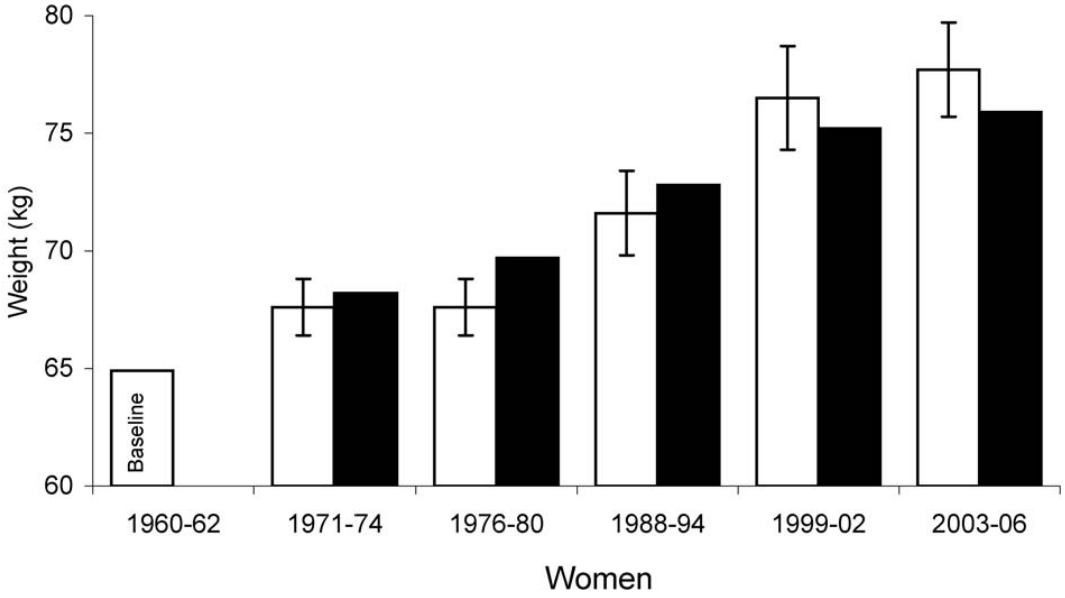
- Adjusted: sex, age, ed, smoking, alcohol, diet, PA

Does Work NEPA reduce Blood Pressure? 4 month RCT [Mainsbridge, JOEM 2014]

- Every hour software prompt to stand up and move
- NEPA of 8 minutes/day reduced resting mean arterial pressure (MAP) by 10 mmHg after 4 months.
- *Strength:* RCT
- *Limitations:*
  - small samples (N=11+18)
  - randomization not successful (controls 5.5 years older)
  - no blinding
  - no age-adjustment
  - no between group-effects analyzed, only pre-post

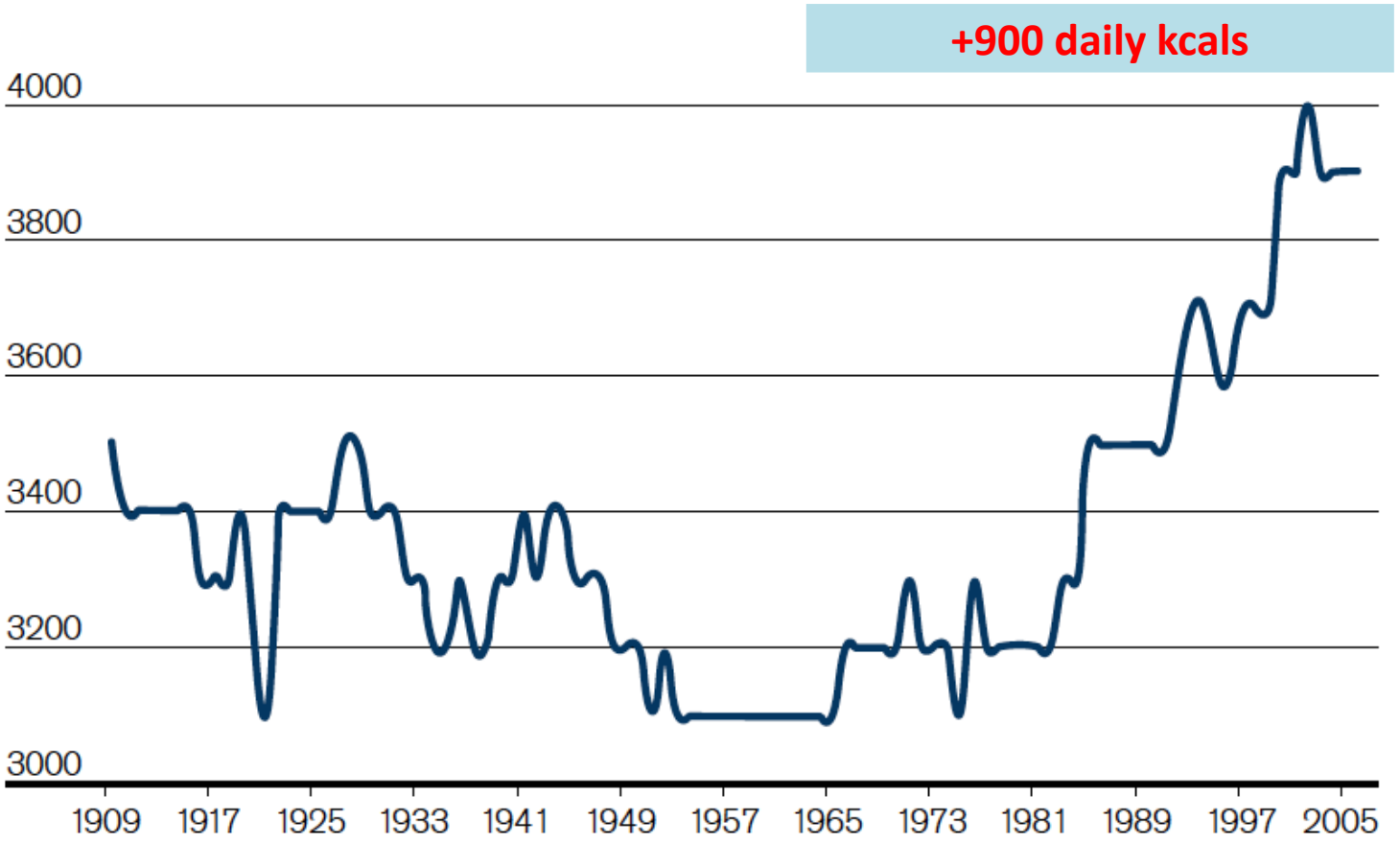
Predicted Weight Changes





Church, Thomas, Tudor-Locke, et al. PLoS ONE, 2011

US Caloric Consumption per Day



USDA, Credit Suisse

Conclusions

- No convincing epidemiologic evidence that sitting at work increases CVD.
- Standing at work increases CVD.
- Occupational physical activity does not decrease CVD.
- No epidemiologic evidence that sit-stand workstations decrease CVD.
- Sit-stand used standing only 50-70 minutes per day ….. inadequate to decrease BMI.
- Standing NEPA effects on BP uncertain.

References: Sit-Stand

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