

Fit for Work and The Physical Activity Paradox

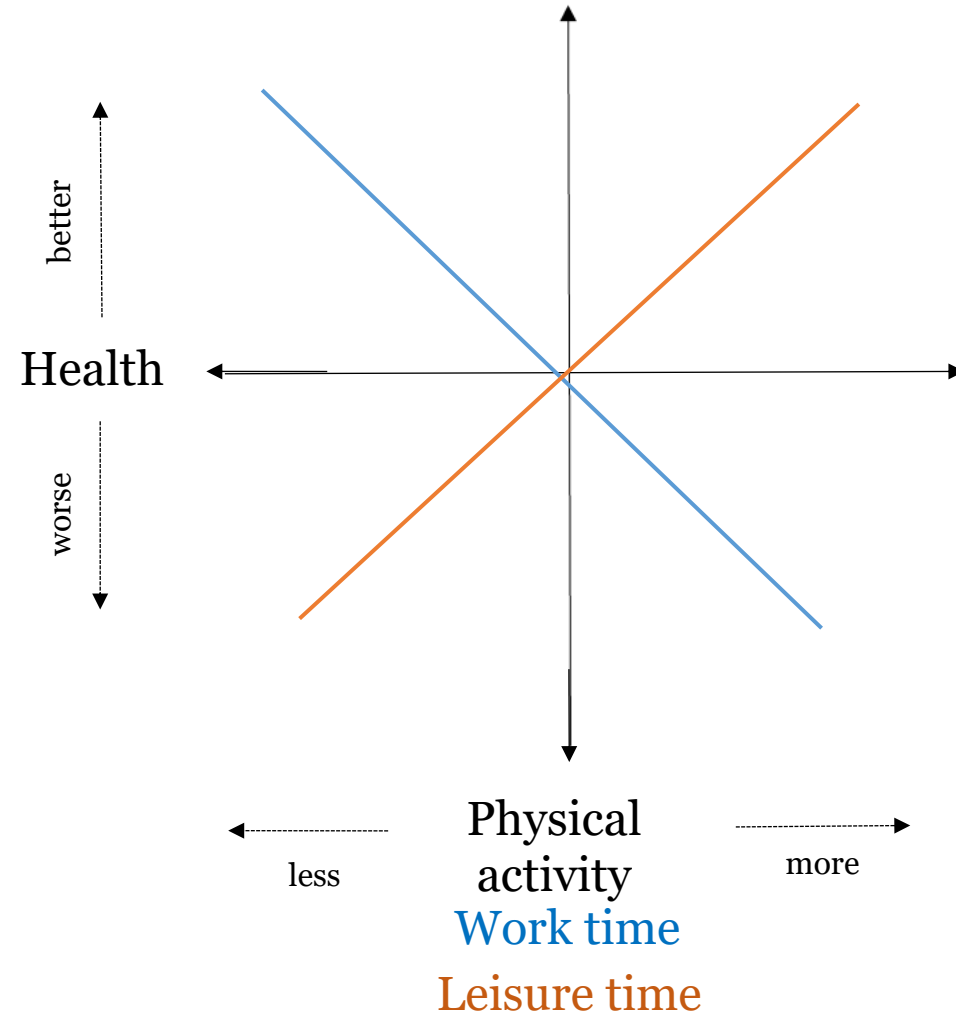


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The Physical Activity Paradox

The physical activity paradox

Different health effects from physical activity in different settings...



Duurnal physical activity and cardiovascular disease

By exposure to:

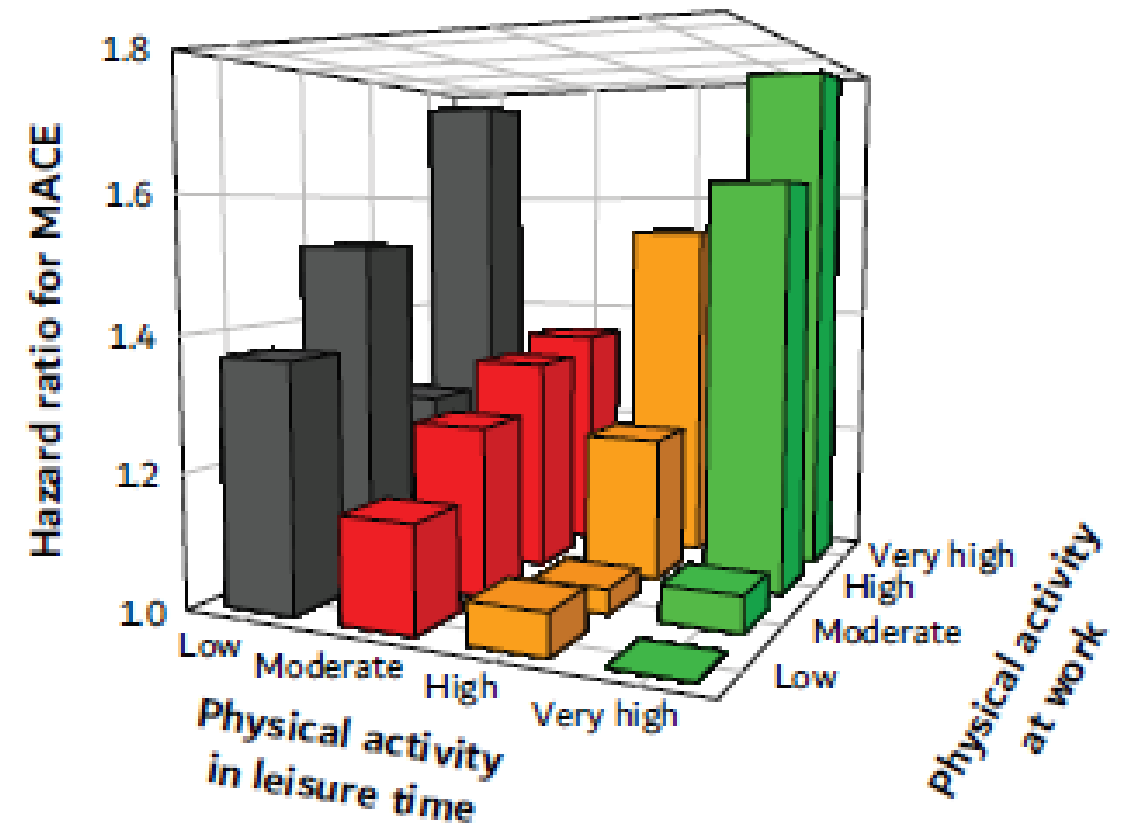
- Repetitive work^{1,2}
- Mainly standing and walking at work^{2,3,4}
- Heavy lifting^{5,6}
- High intensity of occupational physical activity^{7,8}

Increased risk for:

- Hypertension
- Cardiovascular disease
- Ischemic heart disease

1. Astrand et al 1968. *J Appl Physiol*.
2. Allesøe et al 2015. *Eur J Prev Cardiol*.
3. Hu et al 2014. *Asia Pac J Public Health*.
4. Holtermann et al 2010. *SJWEH*.
5. Petersen et al 2012. *BMC Public Health*.
6. Korshøj et al 2019. *SJWEH*.
7. Korshøj et al 2015. *EJAP*.
8. Krause et al 2007. *SJWEH*.

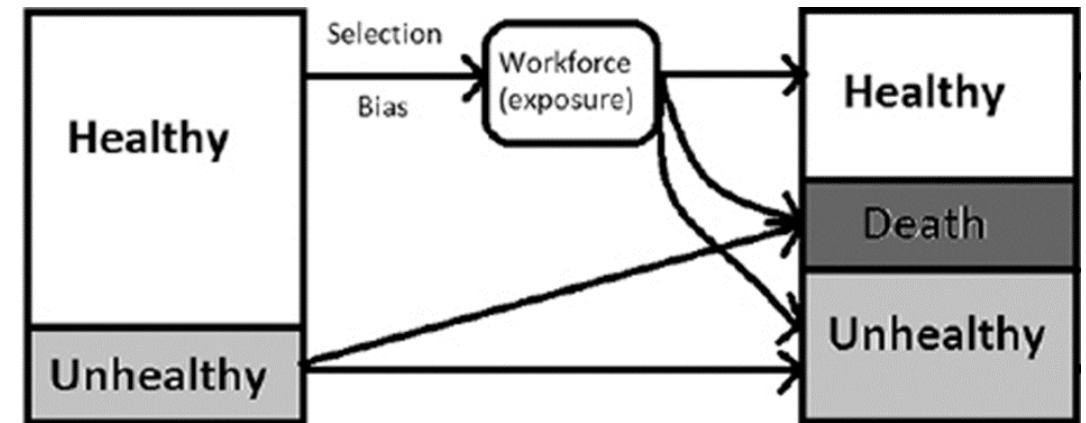
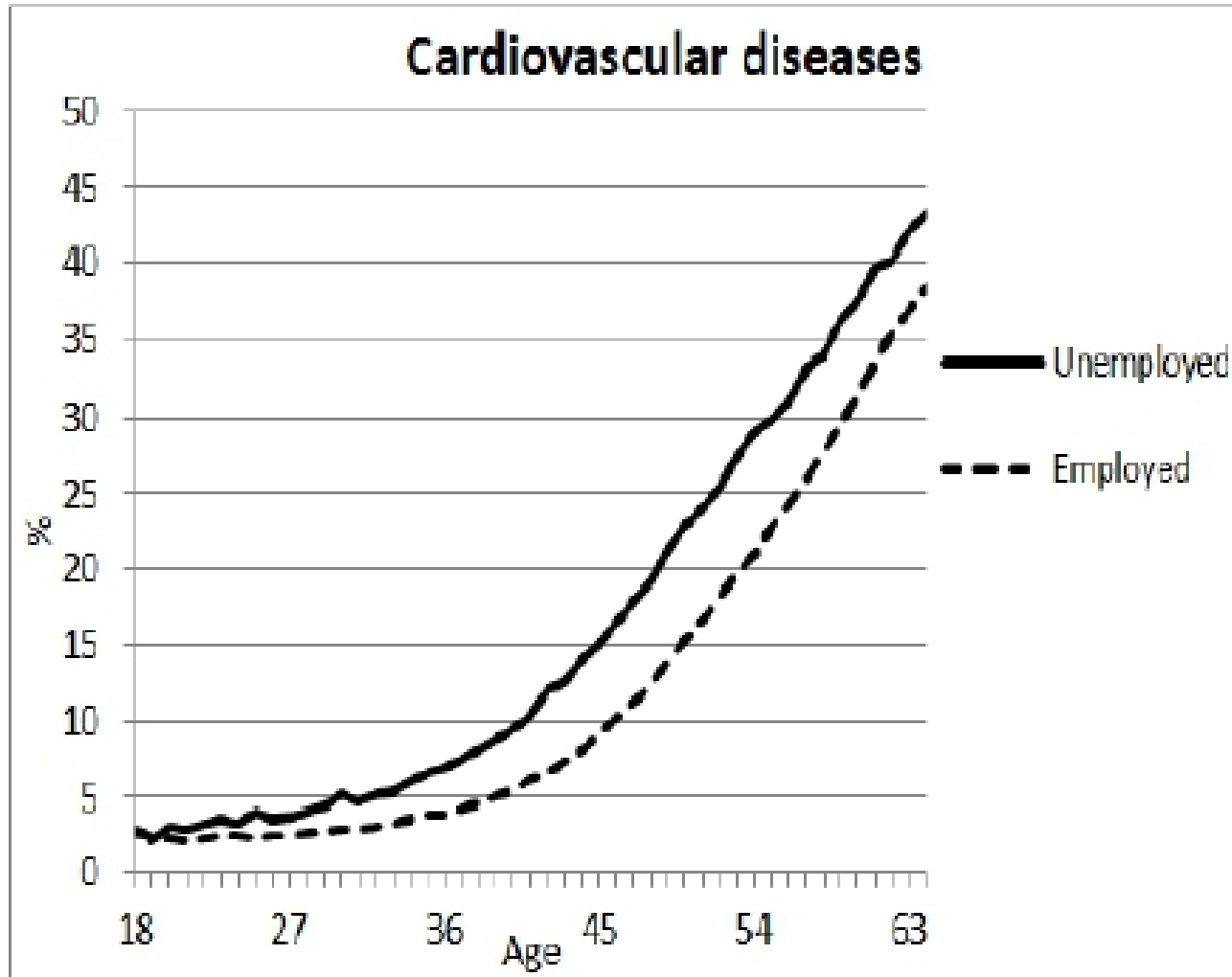
Major adverse cardiovascular events



MACE = Non-fatal myocardial infarction or stroke

(Holtermann et al 2021, European Heart Journal)

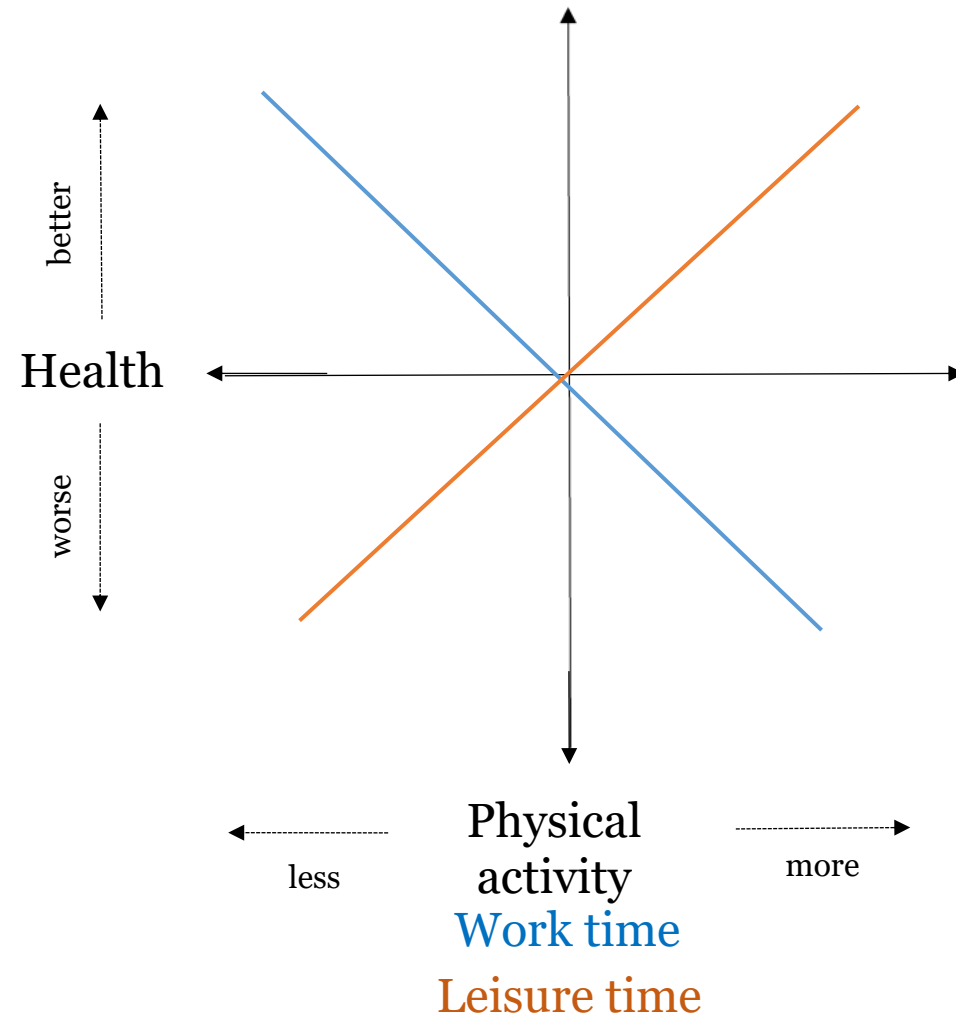
But...work is good for your health!



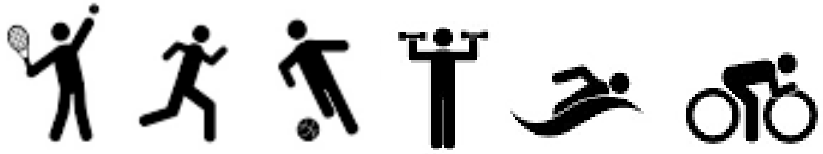
Healthy worker selection bias

The physical activity paradox

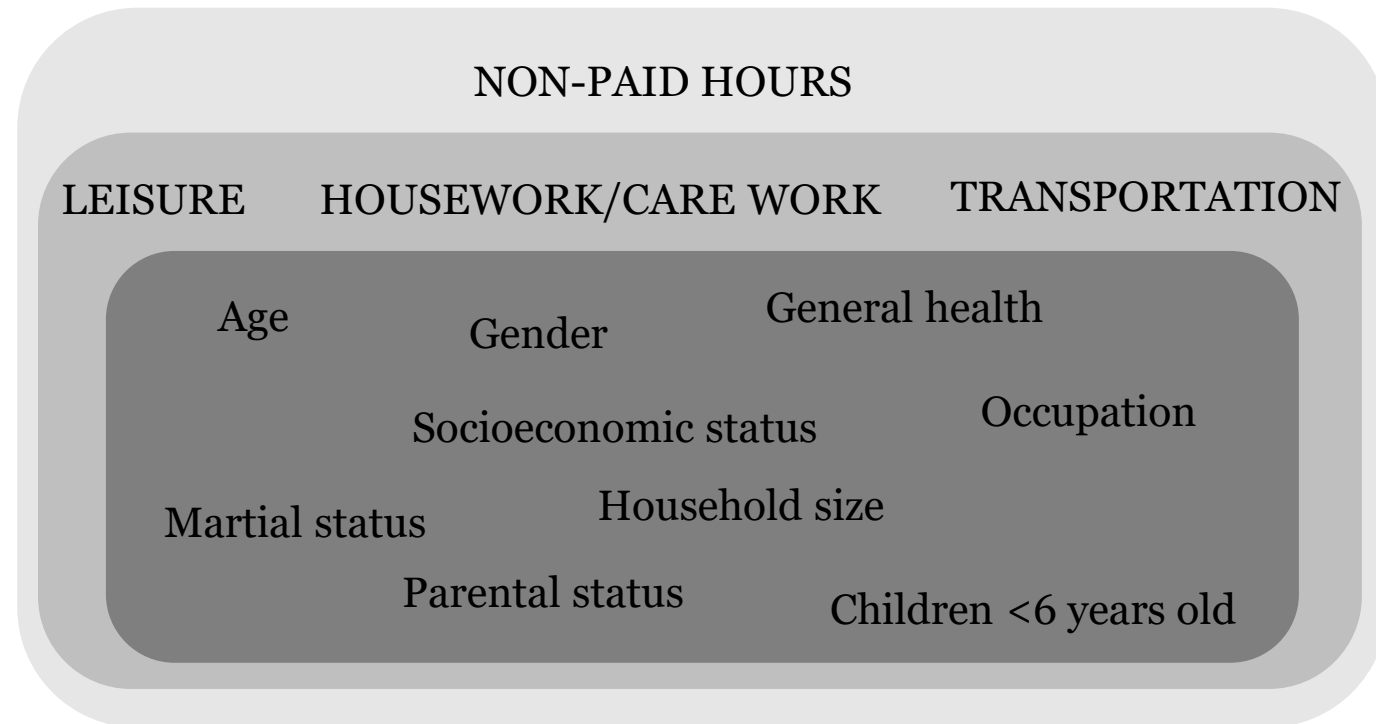
Different health effects from physical activity in different settings...



Leisure time physical activity



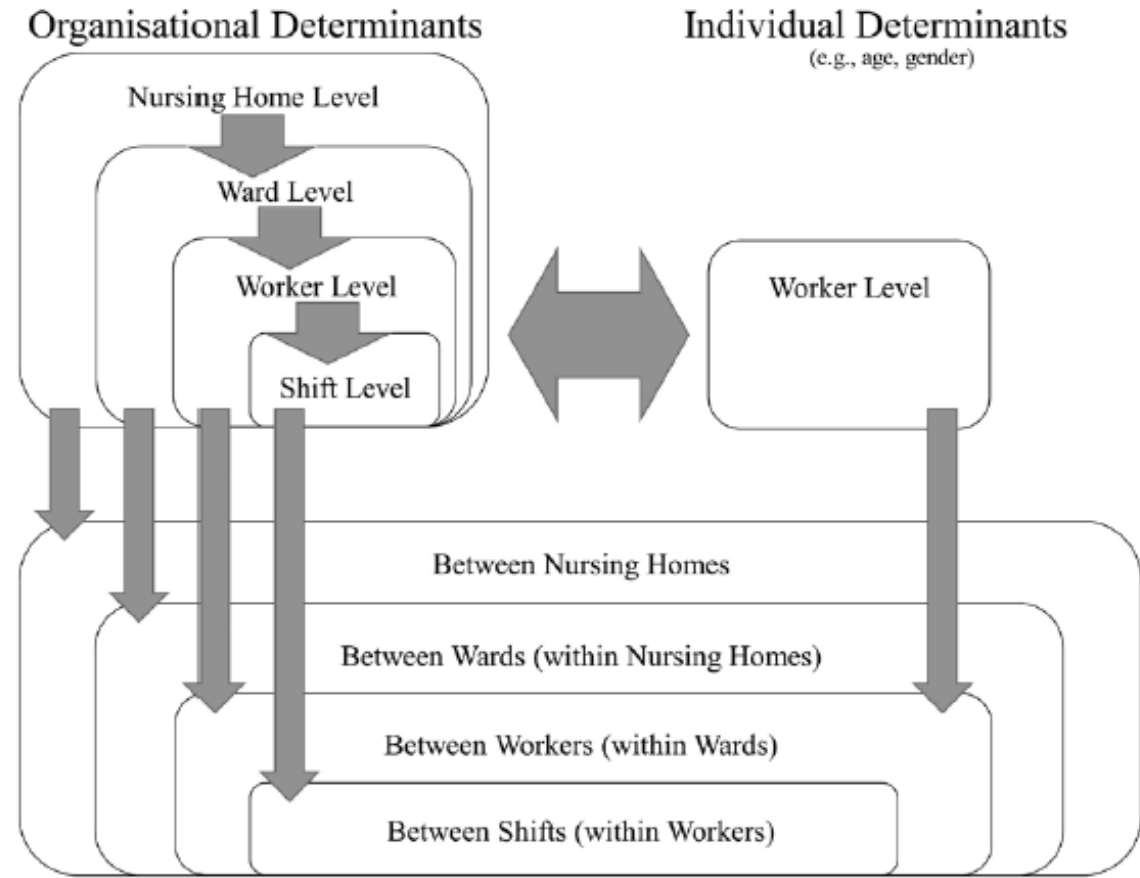
- Short duration
- High intensity
- Dynamic and unconstricted movements and body positions
- Sufficient recovery
- By choice



Occupational physical activity

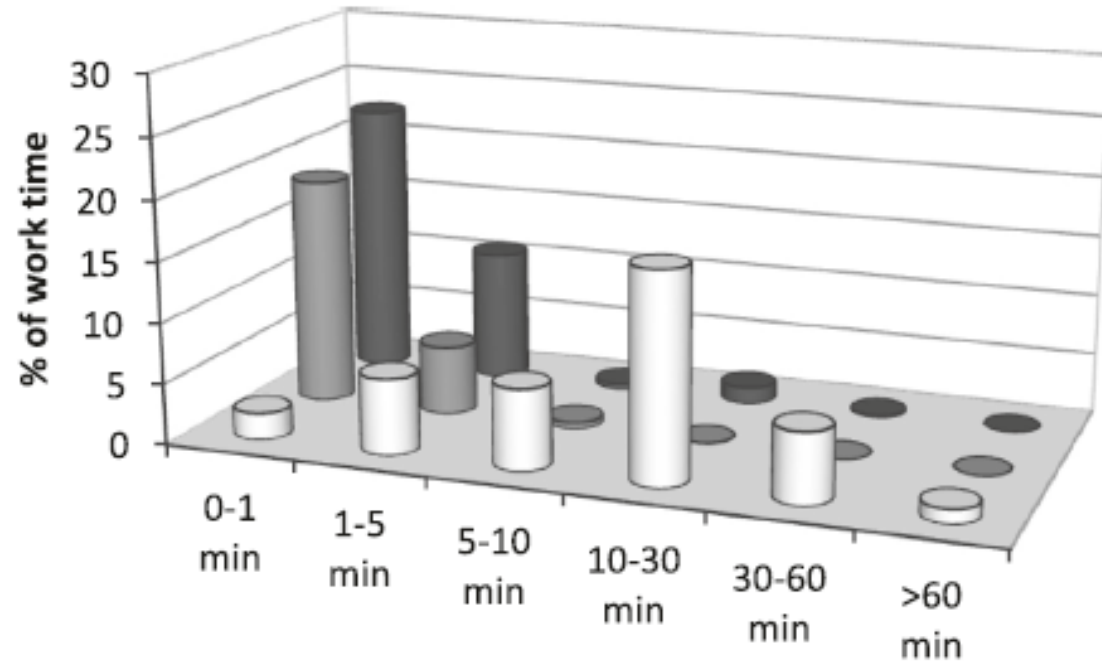


- Low/moderate intensity
- Long duration
- Static and restricted movements and body positions
- Insufficient recovery
- Set by job task

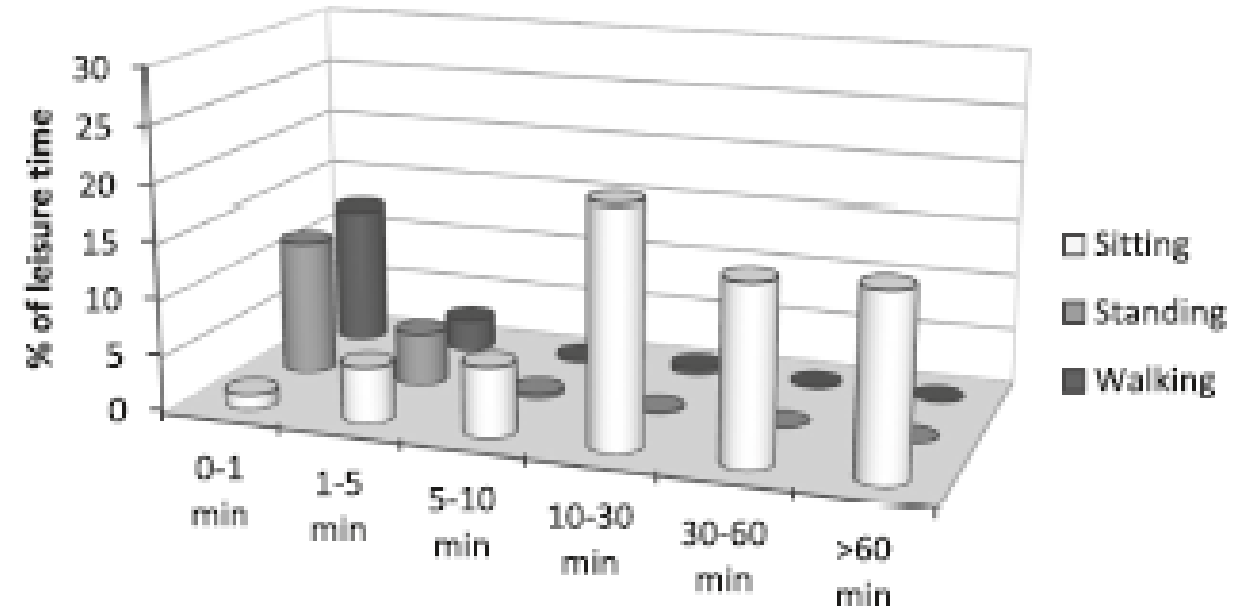


Pattern of physical activity

EVA matrix OPA



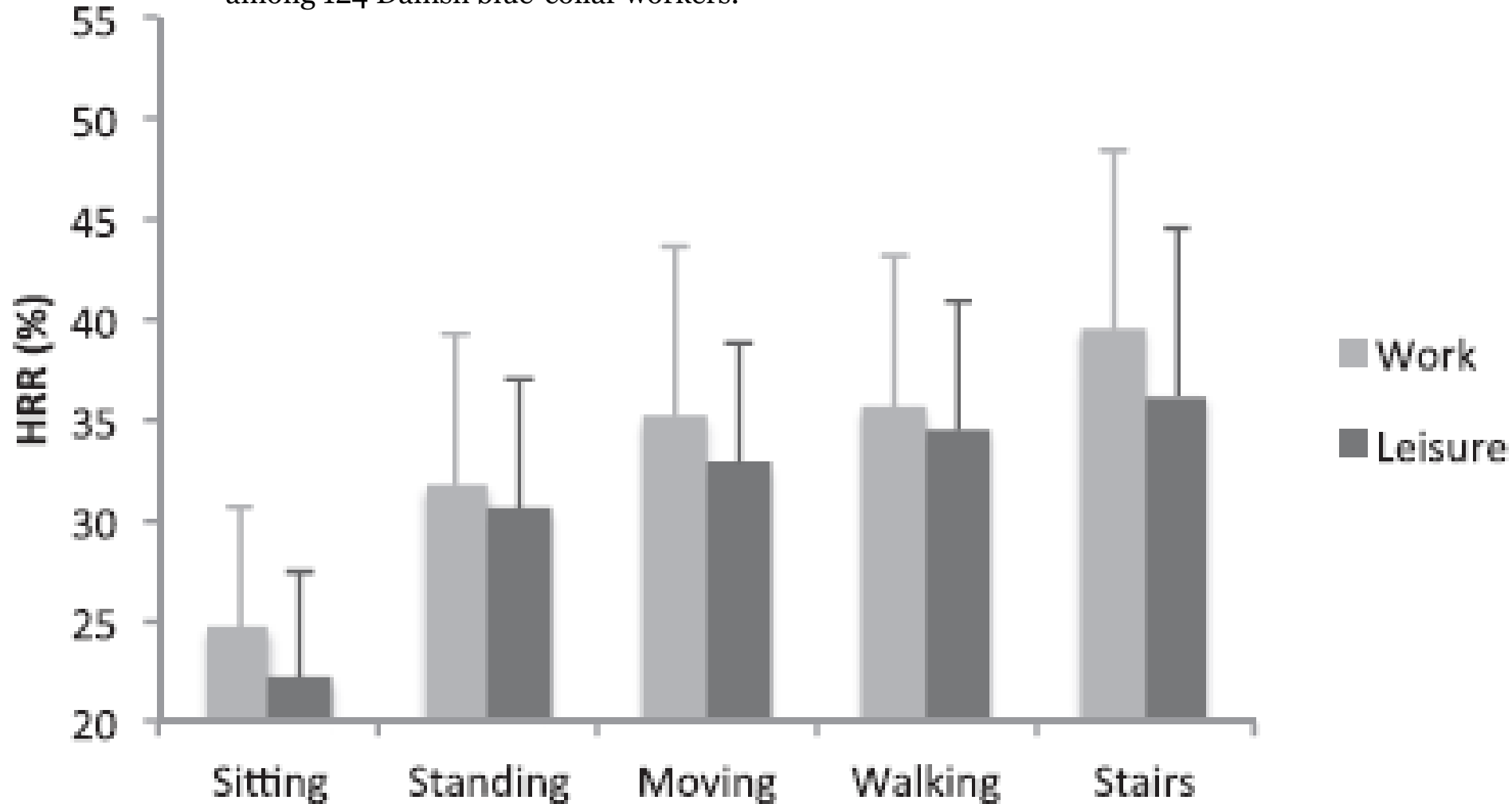
EVA matrix LTPA



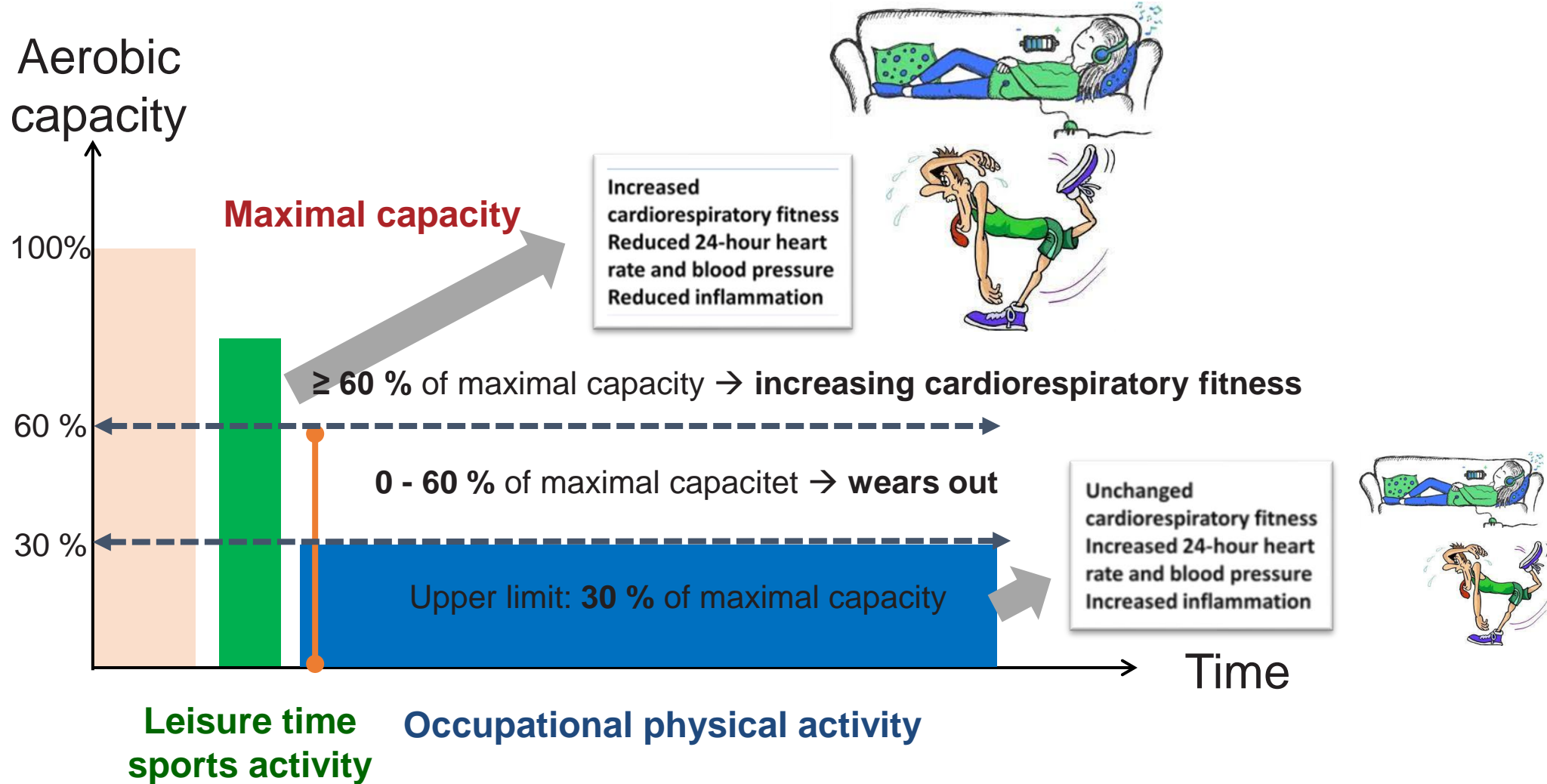
Accelerometry measures of 4 working days among 191 Danish blue-collar workers.

Intensity of physical activity

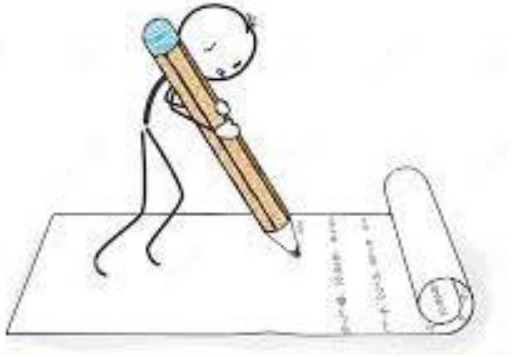
Heart rate measures of 4 working days
among 124 Danish blue-collar workers.



The physical activity health paradox



Take home message



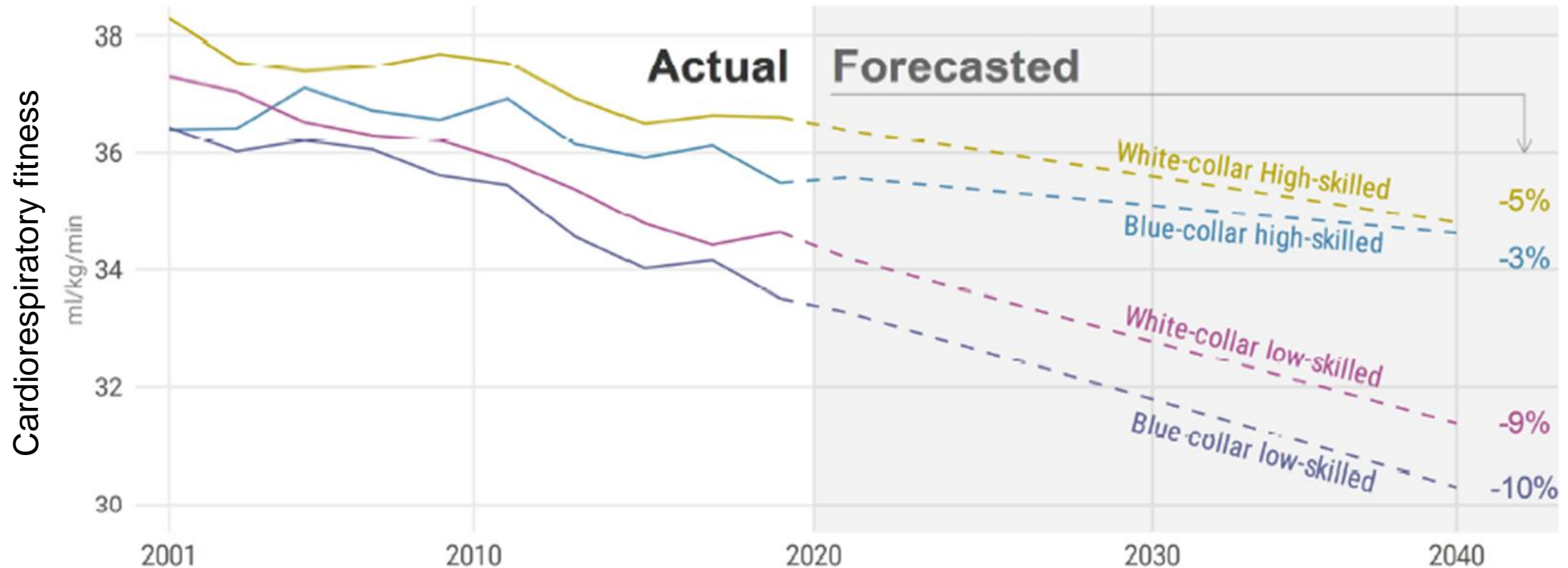
- Different health effects from physical activity in work and leisure
- High levels of occupational physical activity increase risk for (especially among men)
 - cardiovascular disease
 - musculoskeletal disorders
 - type 2 diabetes
- Split physical activity in work and leisure



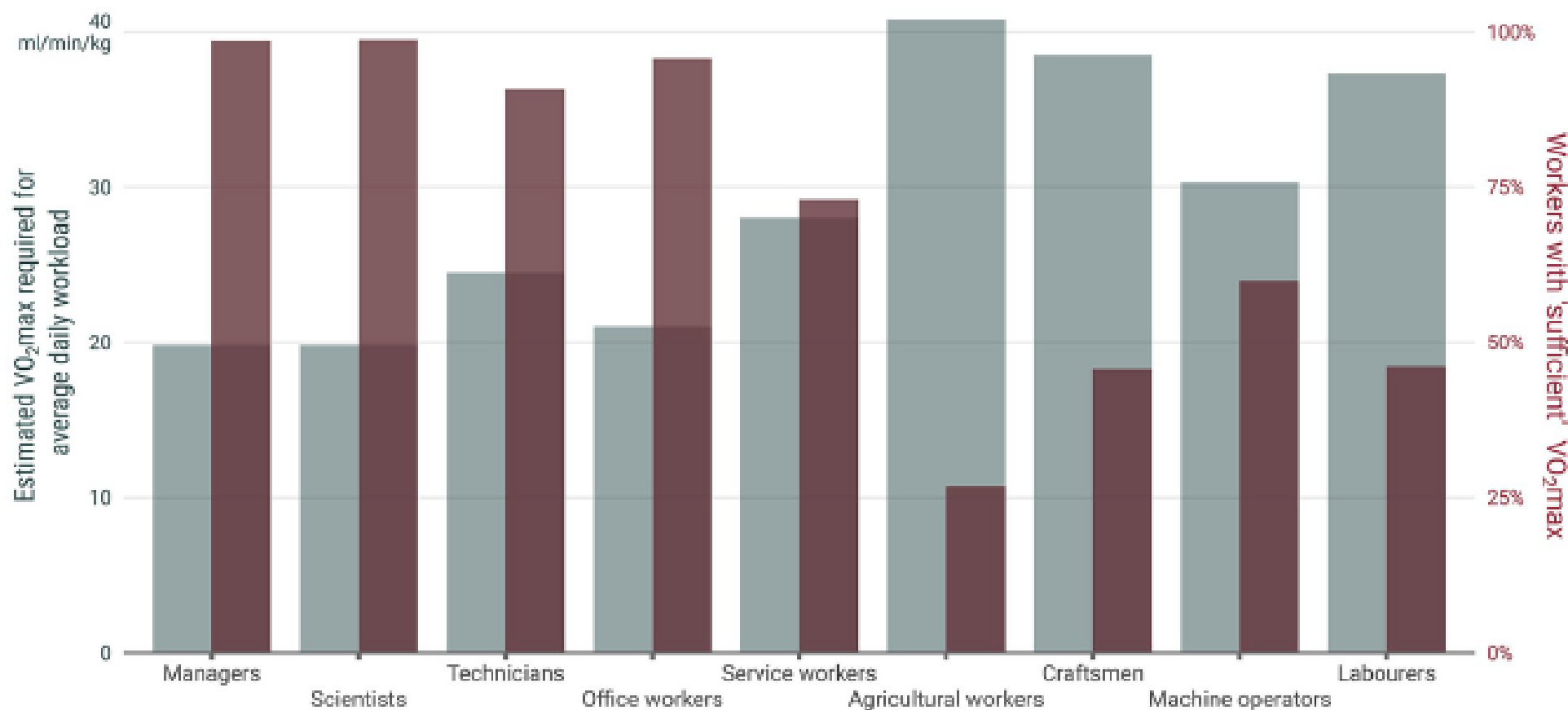
Fit for work

Fitting the task to man or the man to the task
– the key is to find the balance!

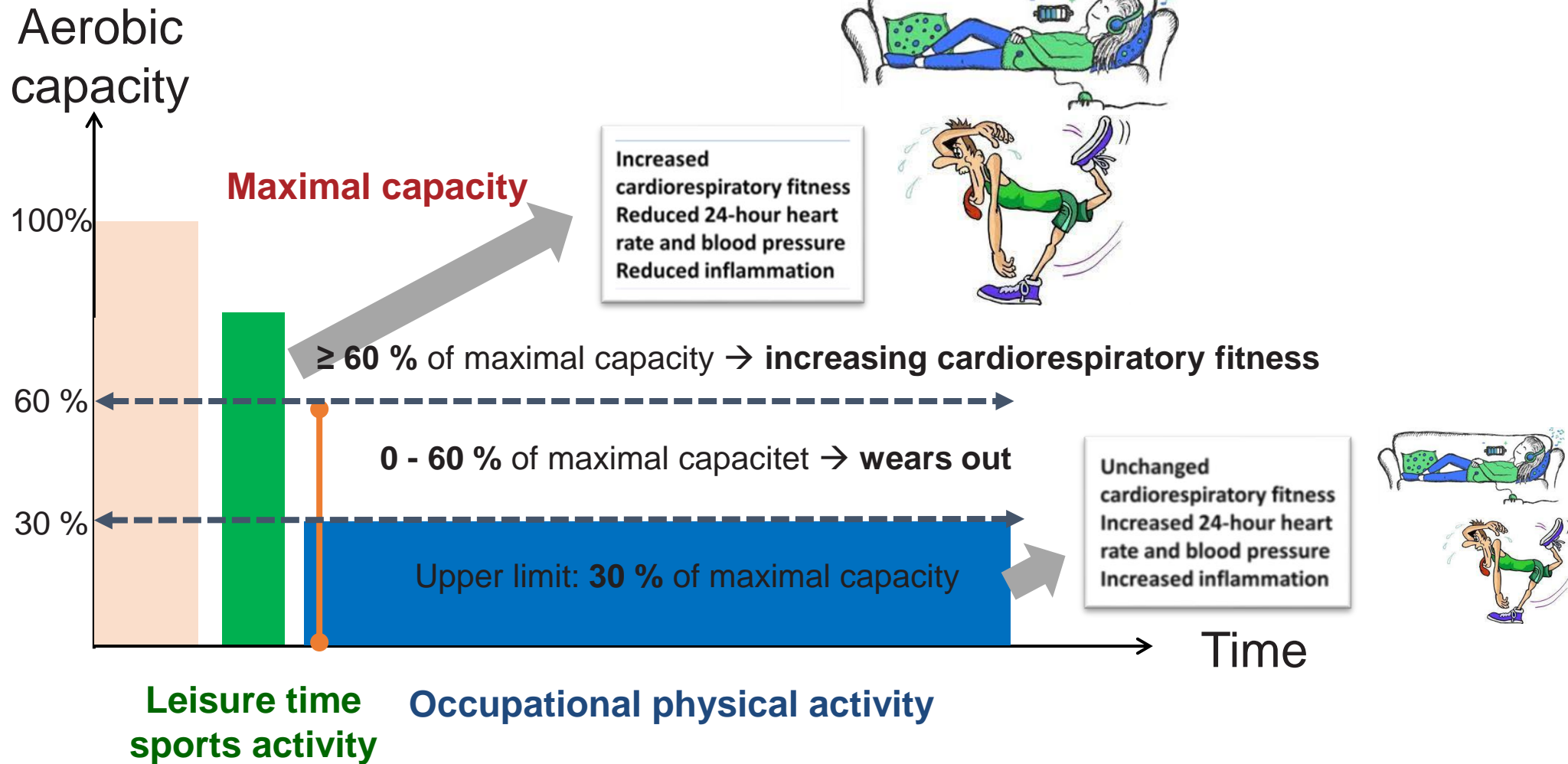
Maintenance of cardiorespiratory fitness



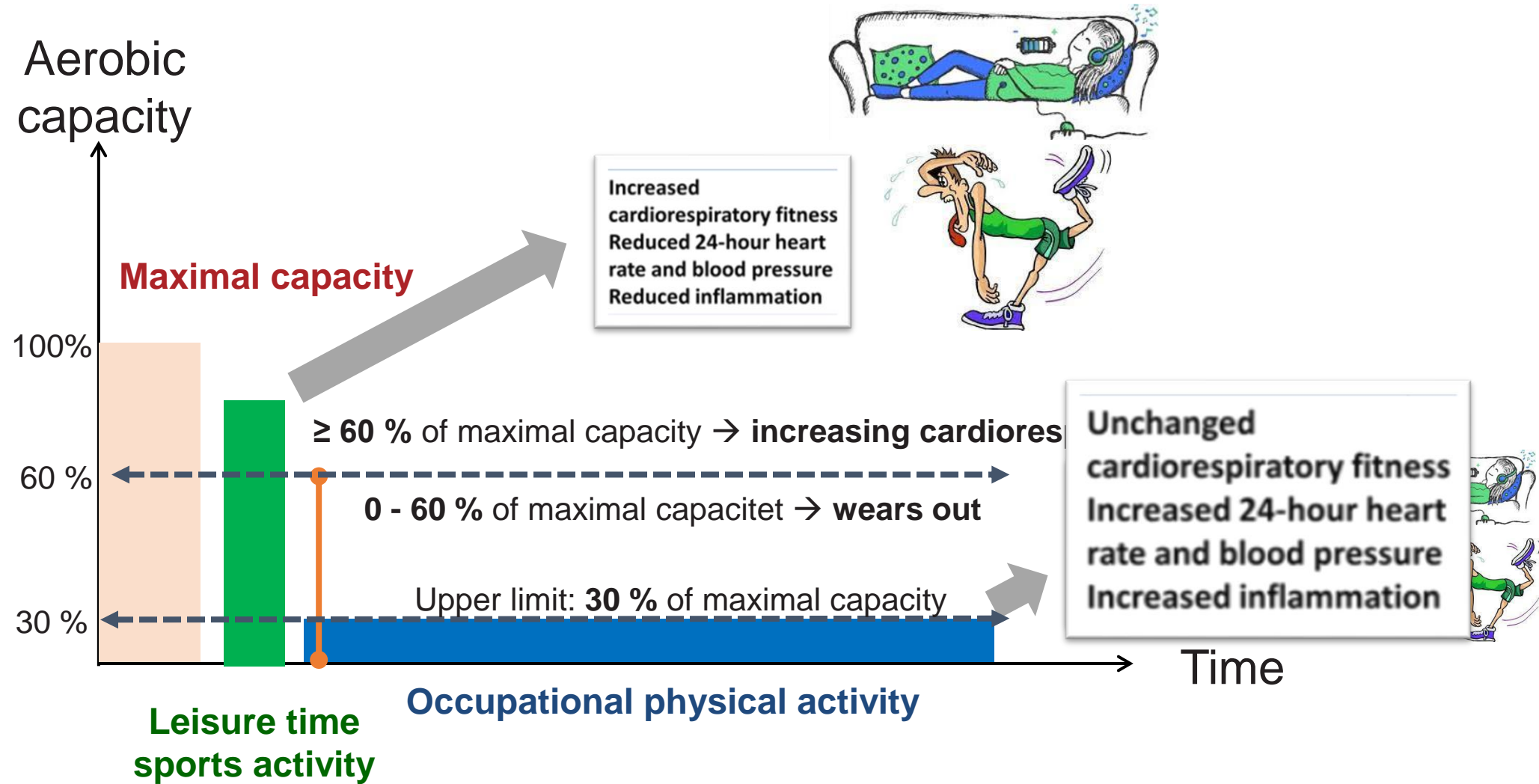
Match between worker capacity and task requirements



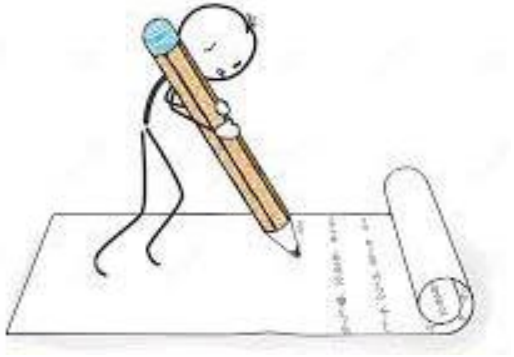
The physical activity health paradox



The physical activity health paradox



Take home message



- Blue collar workers, especially those with higher age or having a cardiovascular disease, are vulnerable for overstrain due to imbalance between capacity and requirement



- Maintain cardiorespiratory fitness, especially among blue collar workers

Intervention effect Cardiorespiratory fitness

Table 2. Summary results of changes for each study group after 12 weeks intervention. Changes in post/pre-intervention values are absolute and not adjusted. Differences are estimated as the difference between means with 95% confidence intervals (95% CI), based on the 1-factor analysis of covariance (ANCOVA) with the level at baseline applied as a covariate. [BP=blood pressure; HDL=high-density lipoprotein; LDL=low-density lipoprotein; SD=standard deviation; SE=standard error.]

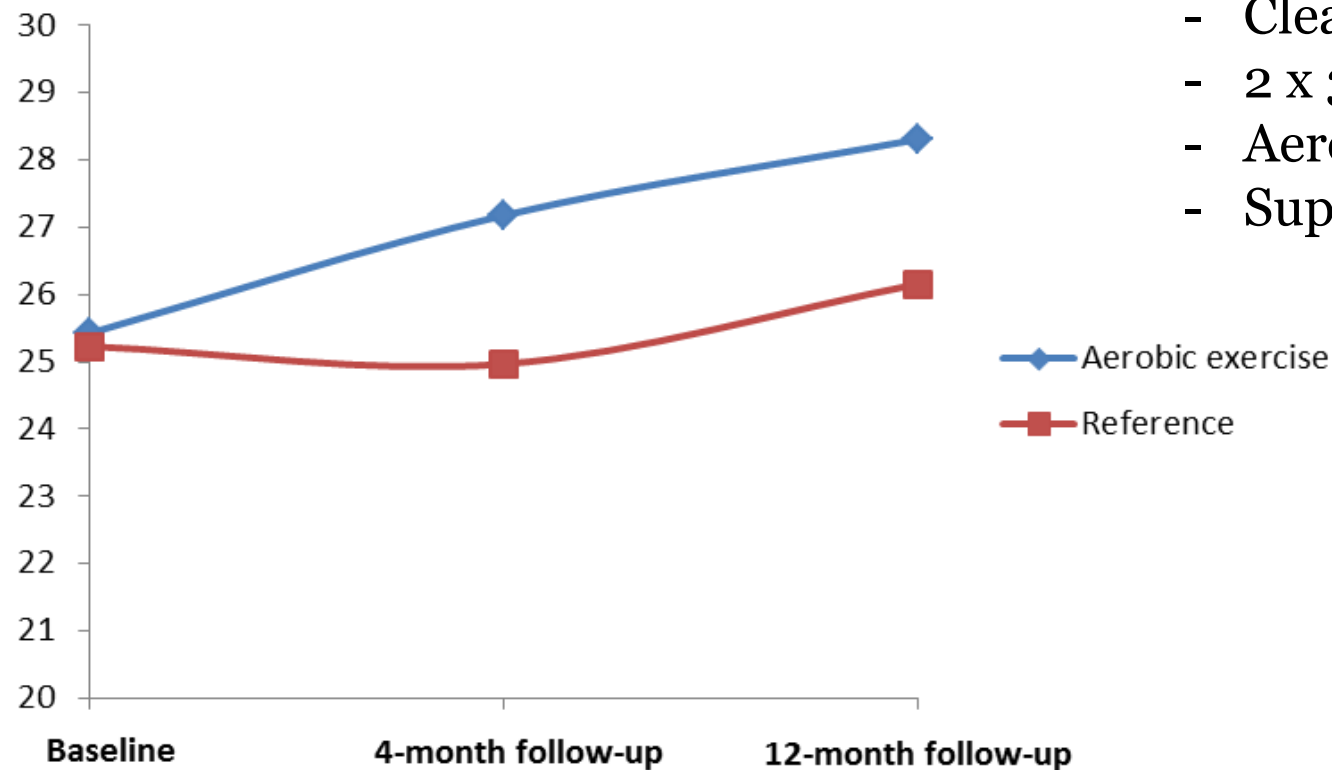
Characteristics	Exercise (N=35) Post/pre intervention		Control (N=32) Post/pre intervention		Difference (N=67) Exercise versus control group			P-value
	Mean	SD	Mean	SD	Mean	SE	95% CI	
Weight (kg)	-0.6	2.1	-0.8	2.9	0.3	0.6	-1.0-1.5	0.68
Body mass index (kg/m ²)	-0.3	0.7	-0.4	1.1	0.1	0.2	-0.3-0.6	0.55
Fat (%)	9.3	15.2	5.9	11.7	2.9	3.3	-3.6-9.4	0.37
VO _{2max} (L/min)	0.3	0.4	-0.0	0.4	0.4	0.1	0.2-0.5	0.000 ^a
HR at steady state (bpm)	-10	11	0	10	-10	3	-15.2- -4.6	0.000 ^a
Relative VO _{2max} (ml/min/kg)	3.9	4.4	0.3	4.5	3.7	1.1	1.5-5.9	0.001 ^a
Isometric muscle strength (nm)								
Shoulder (dominant)	3.9	2.7	7.1	34.9	-3.5	7.6	-18.6-11.6	0.65
Arms (dominant)	0.7	14.8	-1.0	16.1	2.1	3.6	-5.1-9.4	0.56
Abdomen	-7.1	29.0	-7.7	30.2	0.7	7.0	-13.3-14.7	0.92
Back	-17.7	49.1	-16.2	32.7	1.7	8.3	-14.9-18.4	0.84
Leg (right)	-2.0	54.0	-5.7	37.8	2.7	9.7	-16.6-22.1	0.77
Leg (left)	-4.1	20.2	-7.4	28.6	0.7	4.7	-8.6-10.1	0.88
Hand grip (dominant)	-0.4	5.5	-0.5	5.5	-0.1	1.2	-2.6-2.3	0.90
Systolic BP (mm Hg)	-1.8	13.4	-2.0	11.3	0.8	2.9	-4.9-6.6	0.77
Diastolic BP (mm Hg)	-1.9	10.4	-2.9	11.2	1.6	2.4	-3.2-6.4	0.51
Total cholesterol (mmol/l)	-0.2	0.7	0.1	0.6	0.2	0.7	-0.1-0.4	0.56
HDL cholesterol (mmol/l)	0.0	0.1	0.0	0.2	0.0	0.0	-0.1-0.1	0.78
LDL cholesterol (mmol/l)	0.0	0.4	0.0	0.5	0.0	0.1	-0.2-0.3	0.77
Triglyceride (mmol/l)	0.0	0.7	0.0	0.6	-0.0	0.1	-0.3-0.3	0.80

^a Significant change.

- Construction workers
- 3 x 20 min/week
- Aerobic exercise, $\geq 60\%$ HRR and strenght training
- Supervised sessions

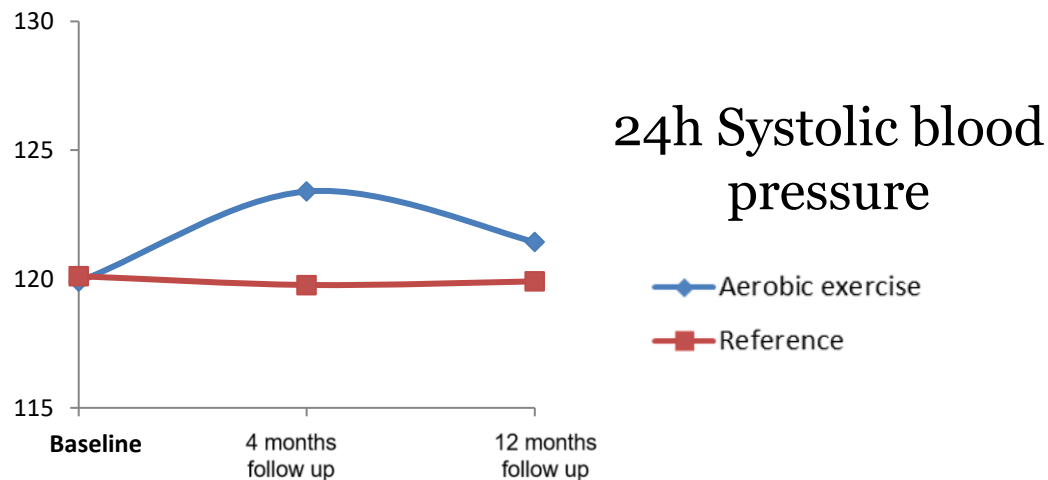
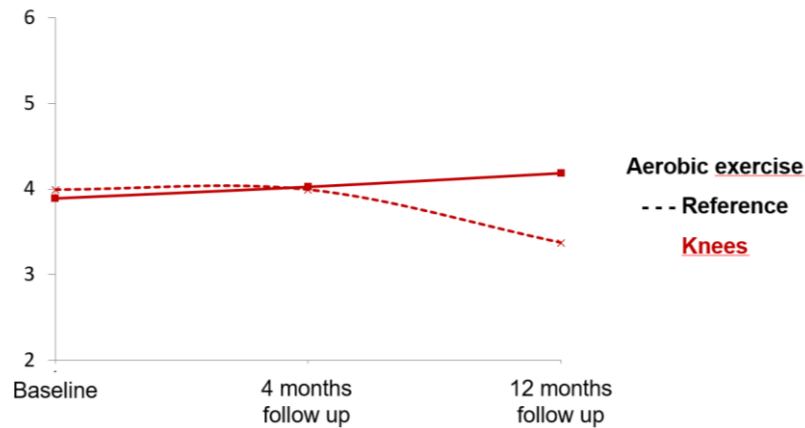
Intervention effect

Cardiorespiratory fitness



- Cleaners
- 2 x 30 min/week
- Aerobic exercise, $\geq 60\%$ HRR
- Supervised sessions

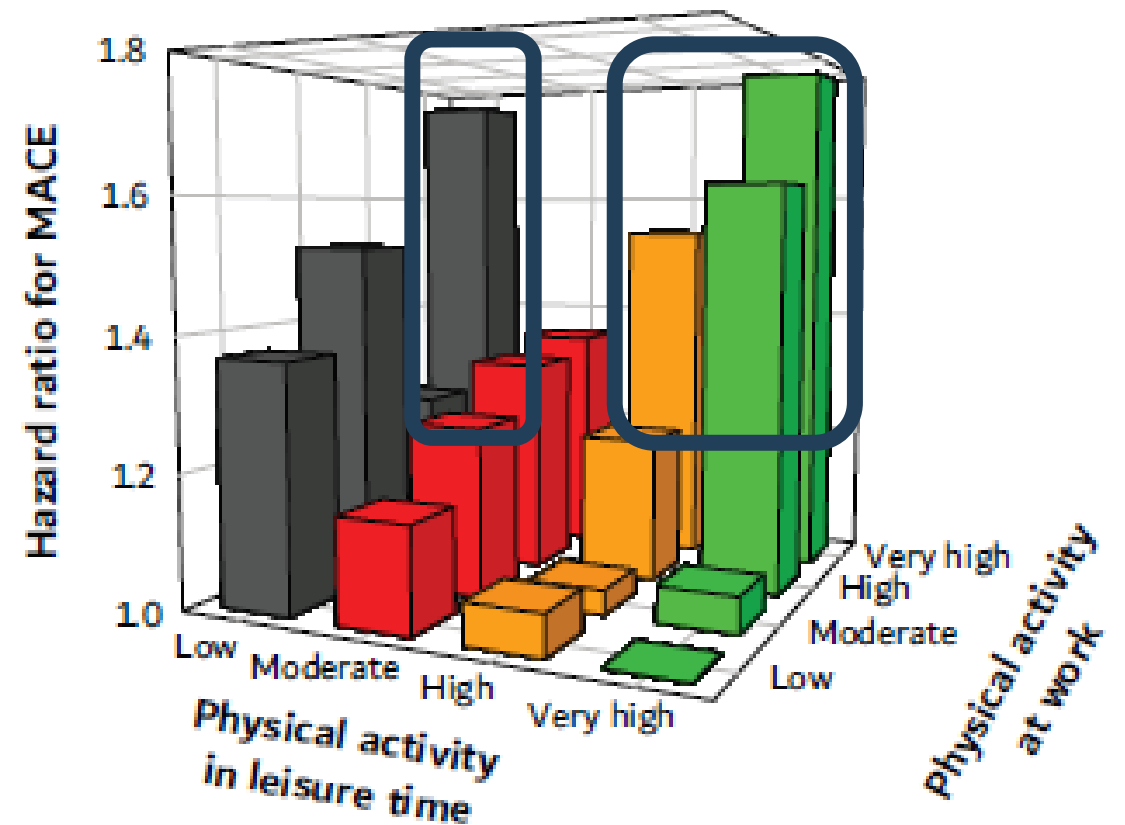
Are physical activity intervention beneficial for all workers?



(Korshøj et al 2016, Plos One; Korshøj et al 2017, Am J Hypertension)

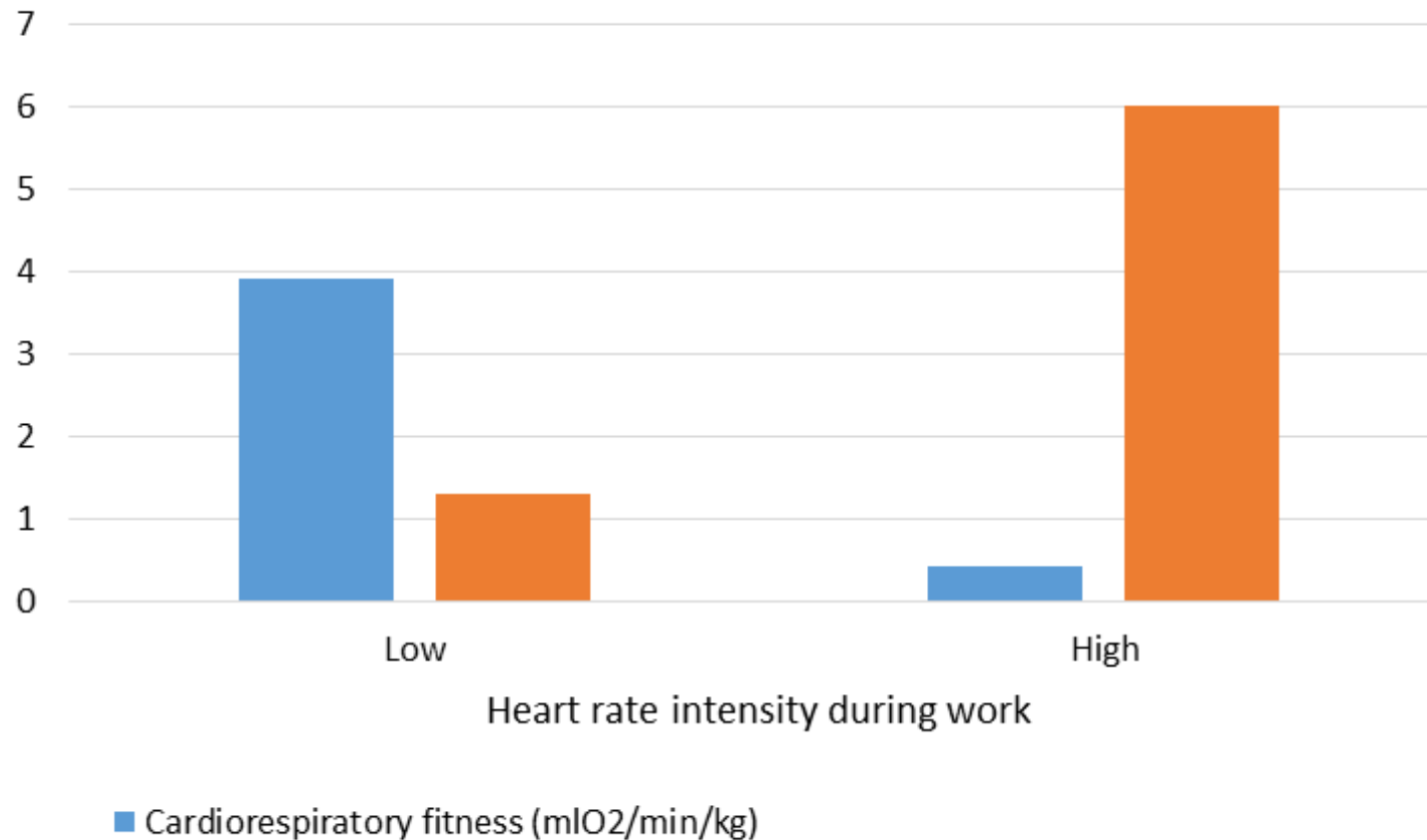
(Korshøj et al 2017, SJPH)

Major adverse cardiovascular events

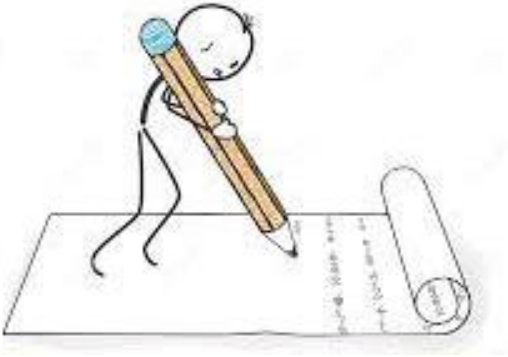


(Holtermann et al 2021, European Heart Journal)

Are physical activity intervention beneficial for all workers?

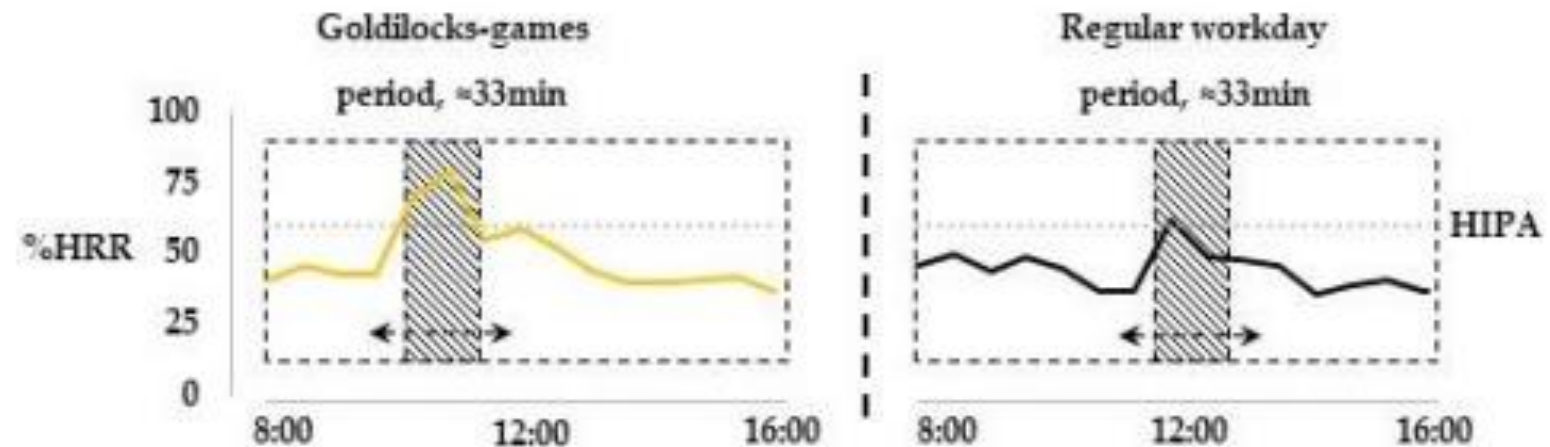


Take home message



- Avoid overstrain of blue-collar workers by balancing 24h physical activity
- Consider to integrate capacity-improving physical activity in the habitual physical activity
- Re-design the occupational physical activity to improve capacity (Goldilocks principle)

**WHAT
TO DO?**

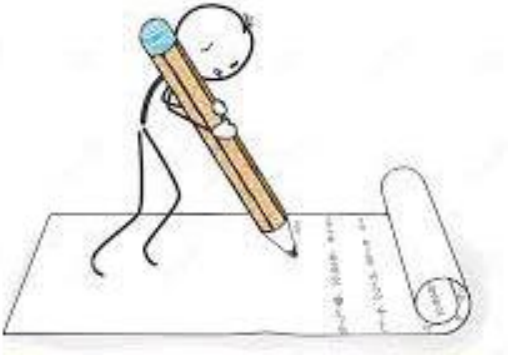


Effects of the Goldilocks principle on cardiorespiratory fitness

Table 2. Intervention effects on primary and secondary outcomes. [CI=confidence interval; HRR=heart rate reserve; Ilr=isometric log-ratio; SD=standard deviation.]

Variable	Time	Intervention group		Control group		Estimated treatment effect		P-value
		N	Mean (SD)	N	Mean (SD)	Mean	95% CI	
Primary outcome								
Heart rate (hours/day)								
<60% HRR	Baseline	31	6.08 (0.89)	38	6.49 (1.10)			
	Follow-up	31	6.17 (1.02)	38	6.31 (0.85)			
≥60% HRR	Baseline	31	0.08 (0.15)	38	0.02 (0.04)			
	Follow-up	31	0.07 (0.13)	38	0.03 (0.05)			
Ilr1 ≥60% HRR vs. <60% HRR						-0.36	-1.10-0.37	0.34
Secondary outcomes								
HR during sleep (beats/minute)								
	Baseline	33	48.2 (7.2)	44	48.0 (6.2)			
	Follow-up	33	47.6 (8.3)	44	47.9 (6.8)	0.51	-1.51-2.55	0.63
Physical behaviors (hours/day)								
Non active	Baseline	42	5.37 (0.75)	56	5.70 (0.65)			
	Follow-up	42	5.41 (0.84)	56	5.54 (0.63)			
Active	Baseline	42	1.11 (0.30)	56	1.23 (0.36)			
	Follow-up	42	1.20 (0.31)	56	1.28 (0.38)			
Ilr2, active vs. non active						0.01	-0.05-0.06	0.25
Pain (0-10)								
	Baseline	45	3.7 (3.0)	58	2.7 (2.3)			
	Follow-up	45	3.6 (2.9)	58	3.0 (2.3)	-0.28	-1.02-0.46	0.47
Physical exhaustion (0-10)								
	Baseline	46	3.9 (2.3)	58	4.1 (2.0)			
	Follow-up	46	3.5 (2.4)	58	3.9 (2.2)	-0.17	-0.97-0.65	0.69
Energy at work (0-10)								
	Baseline	46	6.9 (1.7)	58	7.5 (1.3)			
	Follow-up	46	7.4 (1.6)	58	7.2 (1.5)	0.65	0.08-1.21	0.03
Need for recovery (1-5)								
	Baseline	44	3.3 (0.8)	58	3.1 (0.7)			
	Follow-up	44	3.2 (0.9)	58	3.3 (0.8)	-0.32	-0.54--0.09	0.01
Work productivity (0-10)								
	Baseline	45	7.3 (1.5)	58	7.3 (1.4)			
	Follow-up	45	7.7 (1.3)	58	7.3 (1.3)	0.27	-0.31-0.85	0.36

Take home message



- Work environment should maintain or improve health



- Integrate core task and individual factors with primary and secondary prevention



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