Universitätsklinikum
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Stressforsknings – Konference

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The model of effort-reward imbalance

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1. Background:
Importance of work for health and wellbeing

Work can…

- provide a source of regular income and contribute to social security
- provide social status, social identity, and prestige
- structure people's motivation, energy and time use
- provide a source of personal growth and training of capabilities/competencies
- offer opportunities to experience autonomy and recognition (basic psychological needs)

⇨ Features with positive effects on health and wellbeing

Importance of work for health and wellbeing (cont.)

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Work can…

- be unavailable, leading to job loss and long-term unemployment
- dangerous, increasing occupational injuries and occupational diseases (e.g. asbestos)
- precarious, often combined with heavy physical work, low security and low control
- be of poor quality (e.g. high work pressure, harassment, monotony, job instability: ‚stressful work‘)

⇨ Features with negative effects on health and wellbeing

Significant changes in the nature of work and employment

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- Increase of service sector, administrative and IT jobs, including human service professions with high psychomental/emotional workload
- Many jobs require high flexibility, mobility, and adaption to new tasks/technologies, products etc.
- Increase of work pressure, due to competitive labor market, shortage of employment and/or downsizing of personnel
- Fragmentation of occupational careers, de-standardized or atypical work, and growing job instability/insecurity
- Segmentation of labor market; social inequalities in quality of work and employment

Effects of economic globalisation: Labour market consequences in developed countries

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Increased pressure of rationalisation

(mainly due to wage competition)

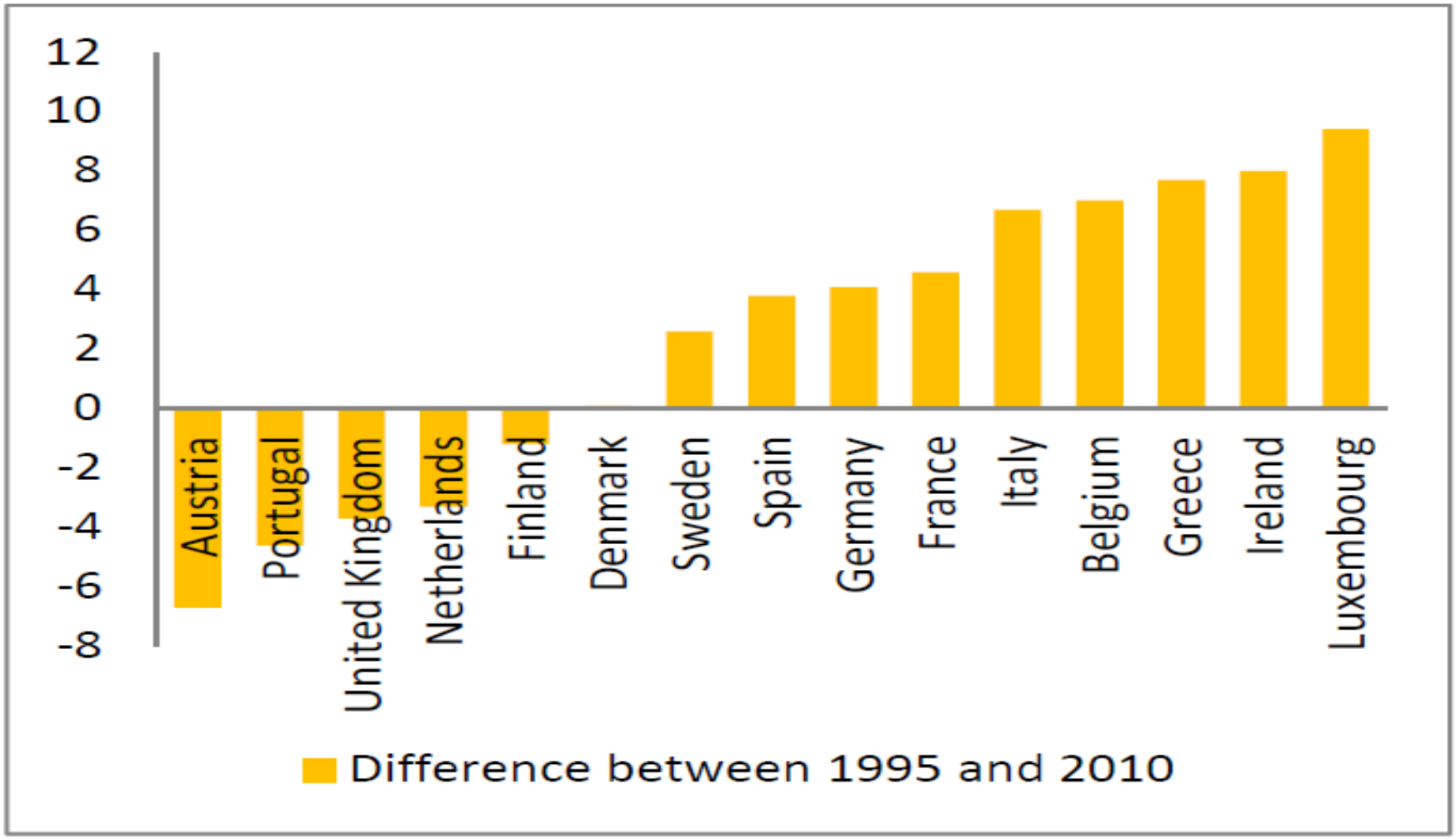
Downsizing, Merging, Outsourcing

Work intensification

Job insecurity

Low wage / salary

Change in Work Intensity by Country in the EU15, 1995-2010 (5th EWCS)



Source: F. Green,T. Mostafa (2013). Job quality indices for Europe. A report based on the 5th EWCS. London

Job insecurity 2004-2010
European Social Survey, 19 EU countries

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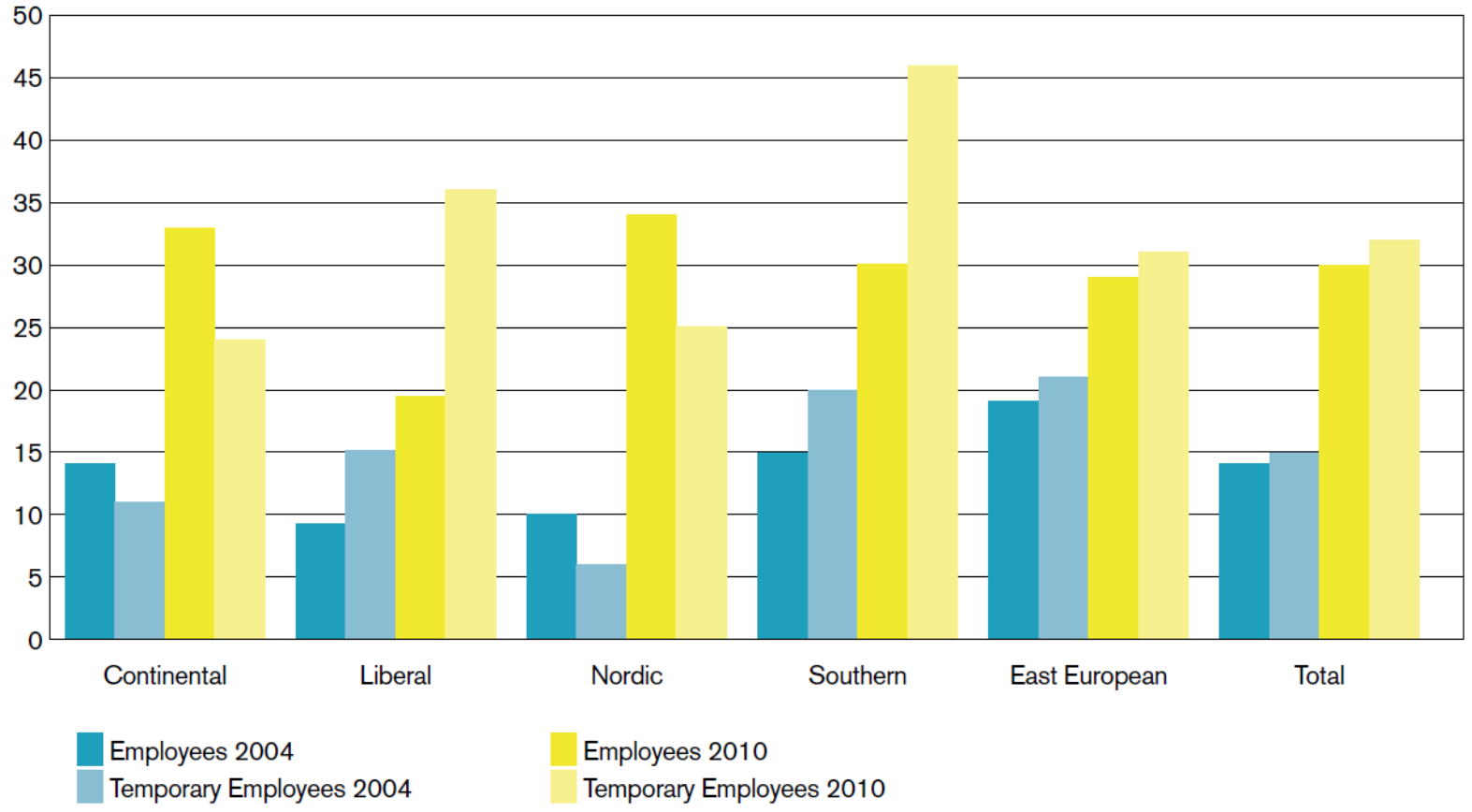
Figure 4 Job Insecurity among All Employees and Temporary Workers 2004-2010



Source: Gallie D (Ed.) (2013) ESS Topline Results Series 3, European Social Survey

High work pressure (e.g. overtime work) and job instability (e.g. downsizing) are unhealthy!

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Examples of recent epidemiological evidence :

Overtime work (>11 hrs/day):

Risk of severe depression:	HR 2.4
Risk of incident CHD:	HR 1.7
Risk of stroke:	HR 1.3

(Virtanen M et al. PLoS One 2012, Eur Heart J 2010; Kivimäki M et al. Lancet 2015)

‚Surviving' severe downsizing:

Risk of all-cause mortality:	HR 1.4
Risk of CHD mortality:	HR 2.0

(Vahtera J et al. BMJ 2004)

Stressful work: Definition and effect on health

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Stress occurs if a person is exposed to a threatening demand (stressor) that taxes or exceeds her/his capacity of successful response → risk of loss of control/desiderata

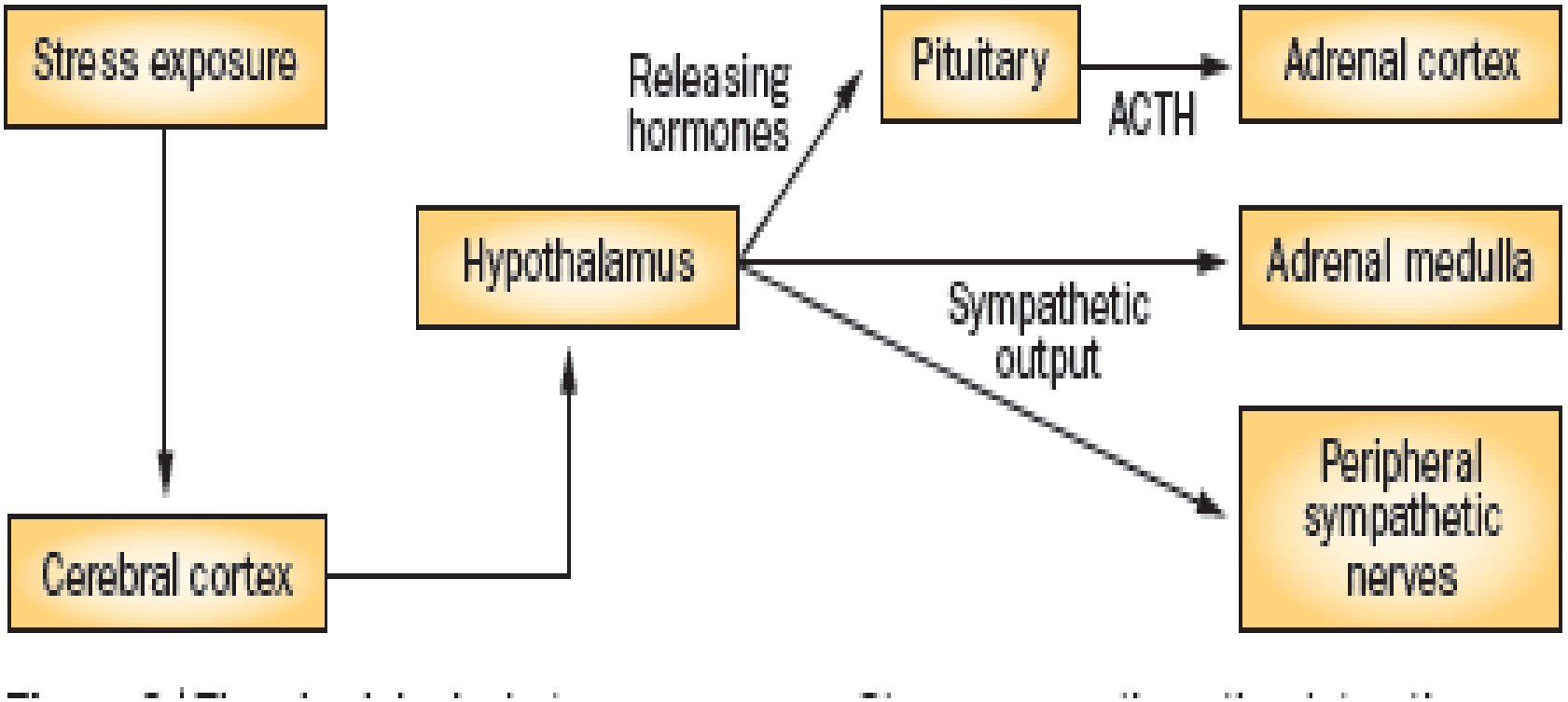
Main dimensions of stress reactions:

- Cognitive evaluation of threat
- Negative emotions (anxiety, anger)
- Activation of stress axes in organism (SAM, HPA)

Critical for health:

- Chronic stressors requiring active coping → risk of stress-related disorders (depression, CHD)
- Adverse work is a major chronic stressor in adult life: to be defined by a theoretical model

Psychosocial stress and physiological pathways to stress-related disorders



Source: Steptoe A, Kivimäki M (2012) Stress and cardiovascular disease. Nature Reviews Cardiology 9, 360-370

The brain reward circuits

(Source: T. Perrin et al. Wellbeing in dementia.2008)

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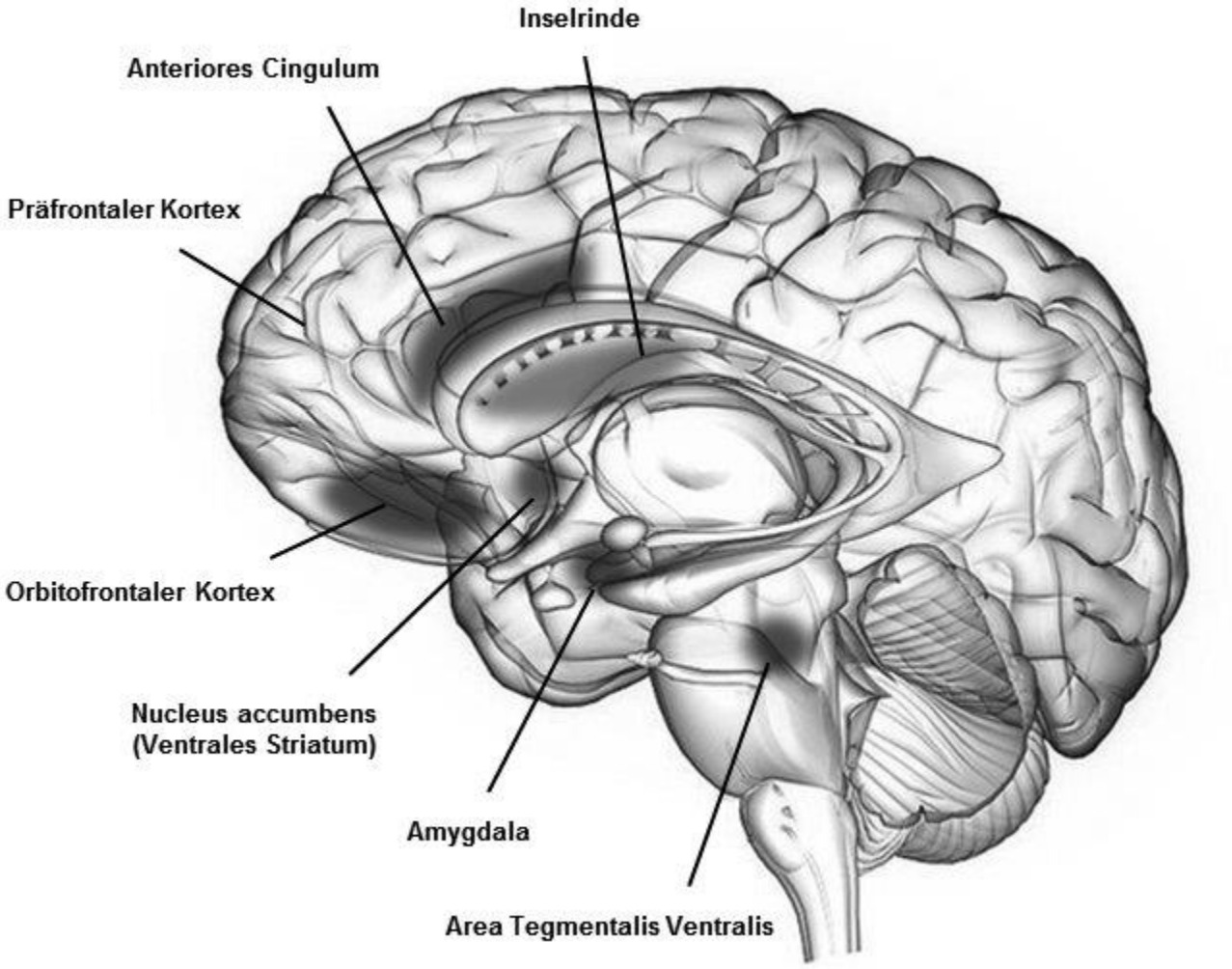

How to identify and assess stressful psychosocial work environments?

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- Multiplicity of different jobs, different ways of division of work (e.g. blue-collar jobs in automation)
- Rapid change of job content due to technological progress and economic constraints (impact of ICT; short production cycles)
- Newly emerging professions and occupations (e.g. service, entertainment)
- Dissolution of established organizational structures of working life (tele-work; home work, self-employment)

- Need for a theory to structure/ reduce complexity and to identify critical dimensions of work environments

2. The model of effort-reward imbalance
Four functions of a theoretical model

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- To reduce complexity through identification of 'meaningful, critical dimensions' (*heuristic function*)
- To define and measure these dimensions at a level of abstraction that allows for generalization of knowledge (*comparative function*)
- To link these dimensions to an explanatory model of work-related health ('stress theory') (*explanatory function*)
- To feed back explanatory knowledge to practice (*pragmatic function*)

Three complementary theoretical models

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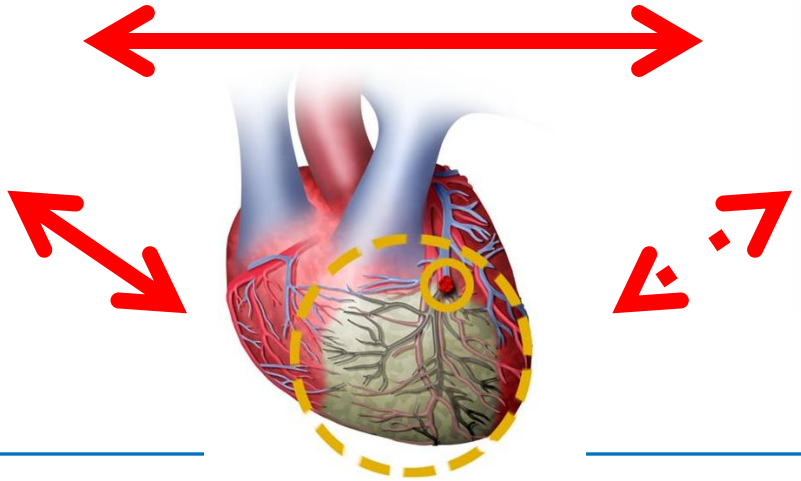

Chronic psychosocial stress at work: Complementary stress-theoretical models

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- Demand-control model
  (R. Karasek, 1979;
  R. Karasek & T. Theorell, 1990)
  - Focus on job task profile: high demand/low control
- Effort-reward imbalance model
  (J. Siegrist, 1996;
  J. Siegrist et al., 2004)
  - Focus on work contract: high effort/low reward
- Organizational injustice model
  (J. Greenberg et al.,1982;
  M. Elovainio et al., 2002)
  - Focus on unfair procedures and interactions

The model of effort-reward imbalance
(J. Siegrist 1996)

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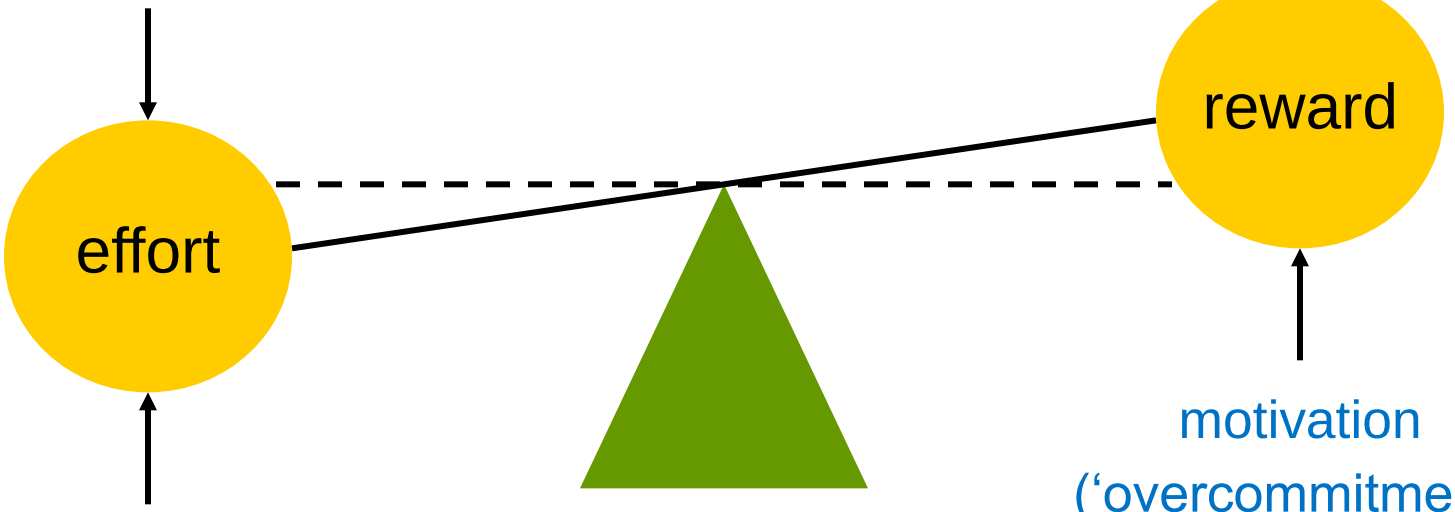
Extrinsic components

- labor income
- career mobility / job security
- esteem, respect

demands / obligations



motivation
(‘overcommitment‘)

motivation
(‘overcommitment‘)

Intrinsic component

Source: Based on Siegrist, J (1996): J Occup Health Psychol, 1: 27-41.

Why do people continue to work in ‚high cost – low gain' conditions?

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- **Dependency**
  The working person has no alternative choice in the labour market: accepting contractual unfairness is preferred to job loss.
- **Strategic choice**
  The working person accepts imbalance in order to improve future career development (anticipatory investment).
- **Over-commitment**
  The working person exhibits a motivational pattern of excessive work-related commitment where investments often exceed gains. Overcommitment is either due to personality or due to pressure at work.

Innovative features of the effort-reward imbalance model

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- It captures main features of modern work due to economic globalisation (competitive wages, high work pressure, low job security, lack of esteem).
- It is based on an evolutionary old principle of human exchange (social reciprocity between give and take; i.e. justice of exchange)
- It identifies three core dimensions of reward (separate and combined effects): money, social status, esteem, and links sociology to neuroscience (brain reward system)
- It combines features of the work situation and of the working person (over-commitment) (3 hypotheses).

How did the ERI model evolve?

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Origin:

- The model of Effort-Reward Imbalance (ERI) is an original conceptualization of work stress that gradually evolved from a mixture of 'intuition' during field work of our research team in the late 1970s/ - early 1980s with cardiac patients and from own theoretical reasoning.

Relevant theoretical notions:

- sociology and social psychology of 'self' and 'social roles' (G.H. Mead, G. Simmel, R.K. Merton)
- norm of reciprocity in social exchange (A. Gouldner 1960)
- social psychological analysis of equity/inequity (J.S. Adams 1965)

Theoretical focus:

- Failed reciprocity in costly transactions ('high cost/low gain') in core social roles (occupation) violates basic norm of fair exchange and social recognition/reward ('justice of exchange').

Measuring the work stress models: mainstream approach

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Standardized self-administered questionnaires, available in main languages across EU

- Psychometrically validated scales and scales structure (CFA) of ERI
  - > reliability, sensitivity to change
  - > discriminant validity
  - > criterion validity
  - > specificity and sensitivity of thresholds
- Partial validation by observational / administrative data
- More information on measurement:
  - www.uniklinik-duesseldorf.de/med-soziologie

Reference: Chapter 2 in Siegrist J, Wahrendorf M (eds) Work stress and health in a globalized economy. The model of effort-reward imbalance. Springer International Publications 2016

Measurement of the effort-reward imbalance model

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- Scale ‚*effort*' (6 Likert-scaled items) = perceived demands
- Scale ‚*reward*' (11 Likert-scaled items) = experienced or promised gratifications
  - 3 subscales: (a) salary and promotion, (b) esteem, (c) job security
  - ‚*ratio effort/reward*' = sum score ‚effort' / (sum score ‚reward' × 6/11)
- Scale ‚*over-commitment*' (6 Likert-scaled items) = pattern of coping with demands and rewards

>In addition to the original questionnaire (16+6 items):

Validated short questionnaire (10+6 items)

Sensitivity and specificity of scales: ROC-curve; depressed vs. healthy people

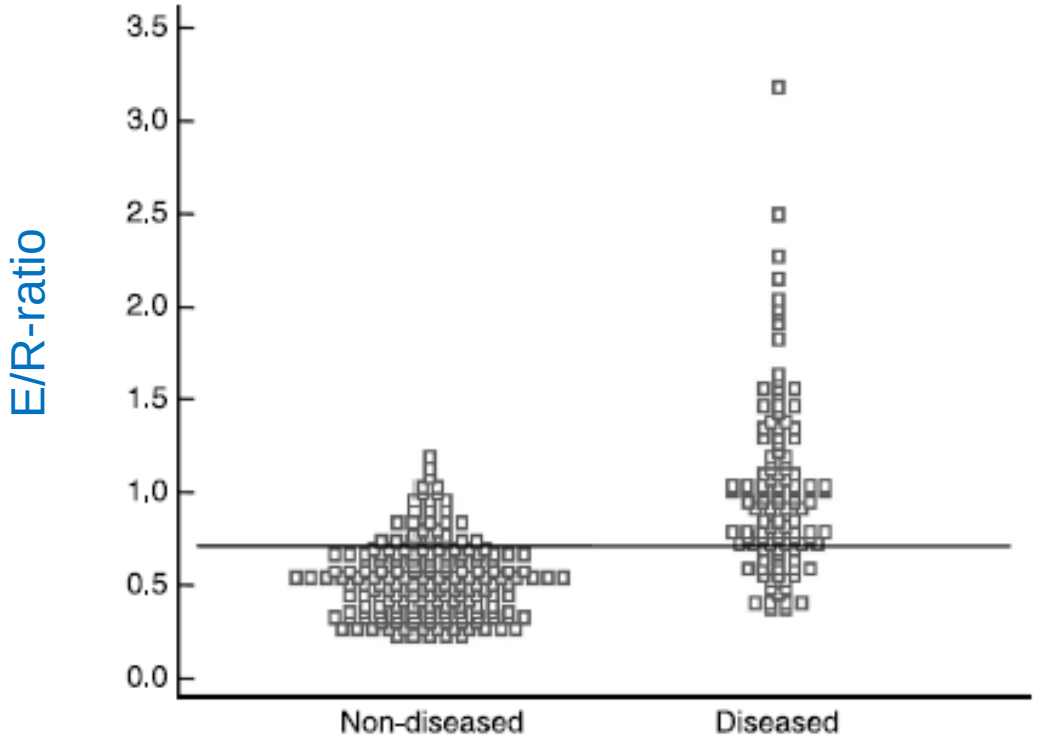
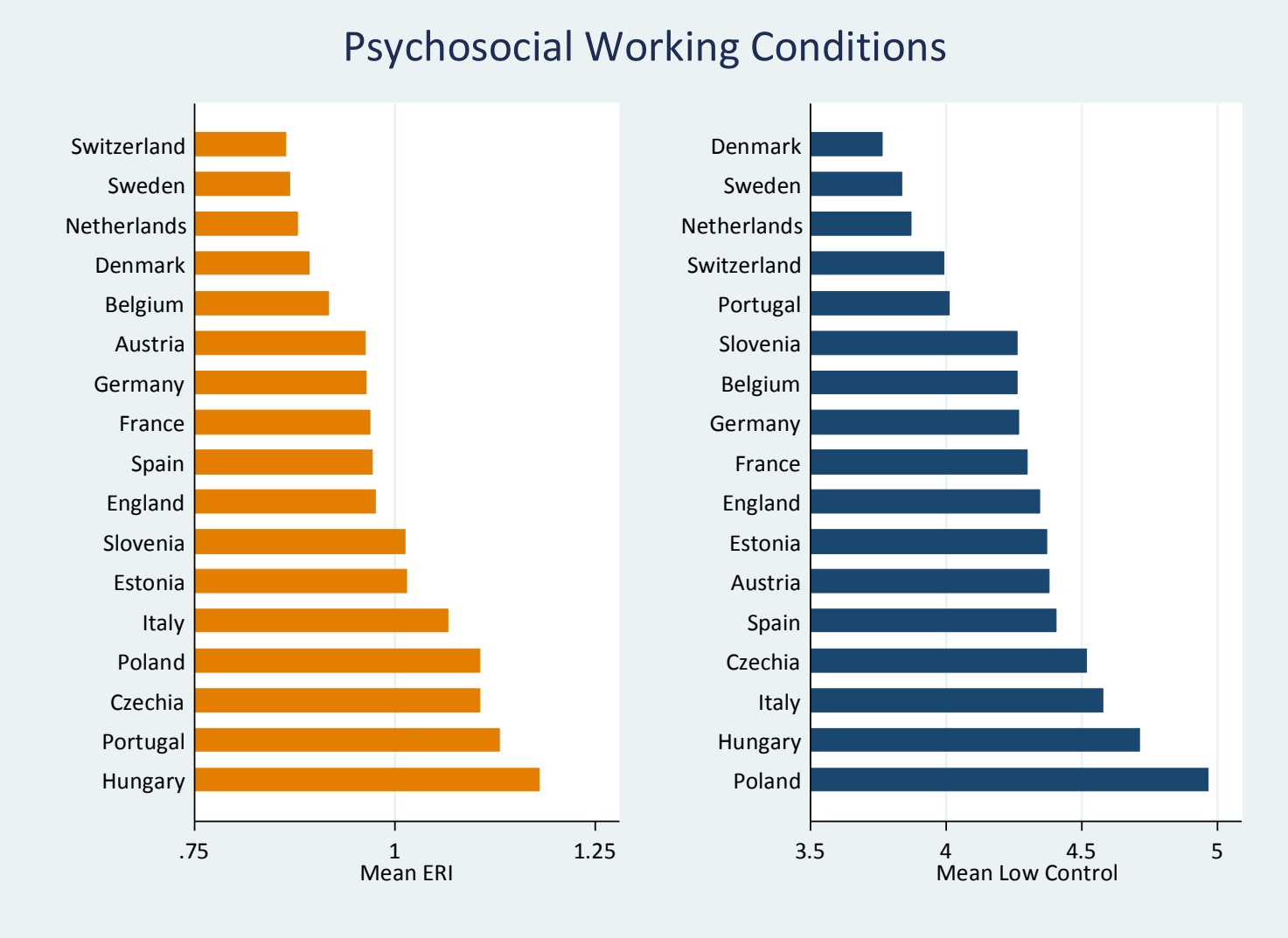


Figure 1. Distribution of ERI ratio in the diseased and non-diseased group ($N = 115$ vs. $N = 187$). The horizontal line indicates the cut-off point ERI > 0.751. It can easily be seen from the figure that a higher cut-off point would lead to a higher rate of misclassifications of diseased subjects, meaning a loss in sensitivity.

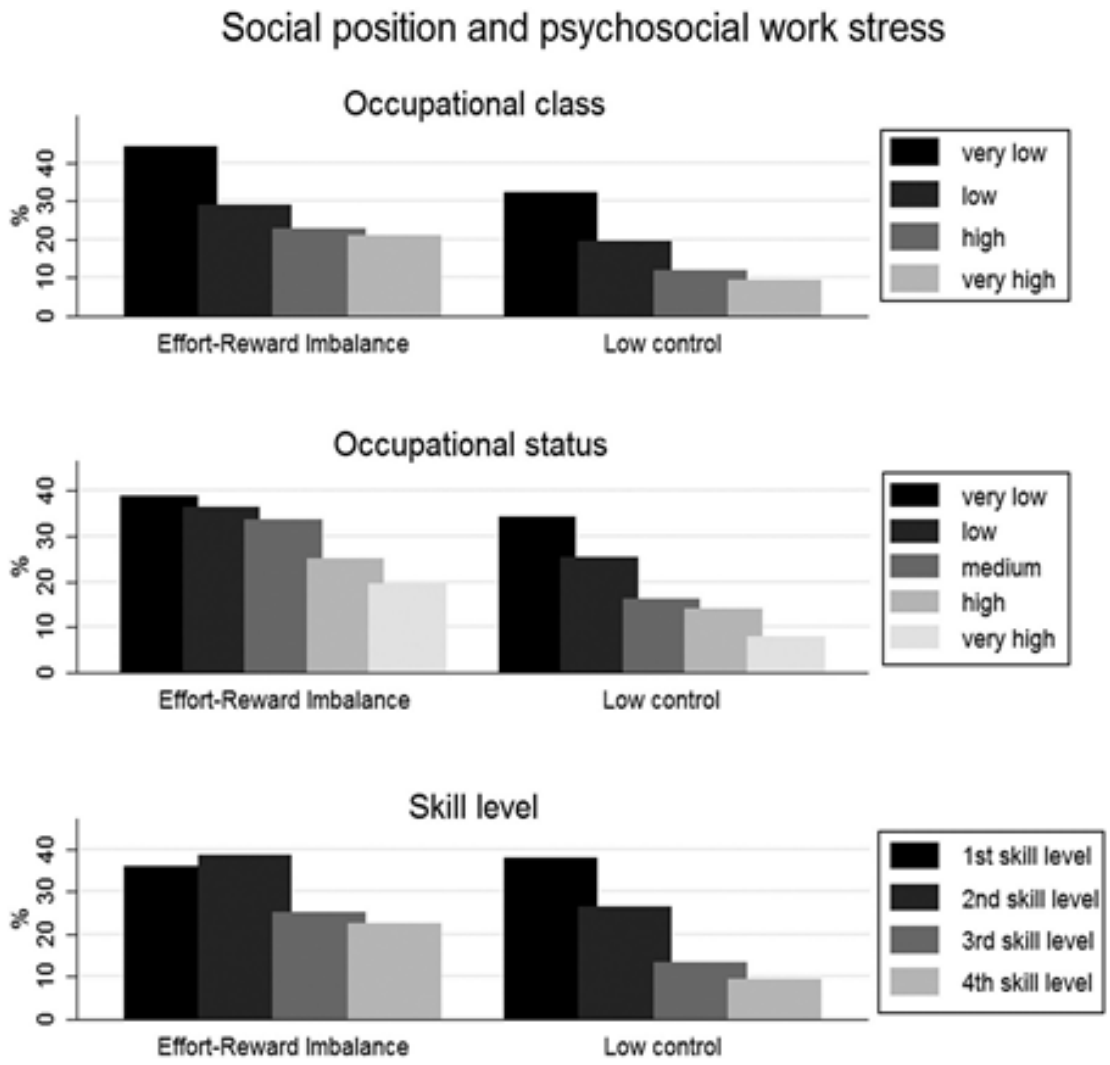
Source: D. Lehr et al. (2010) J Occup Organizat Psychol 83: 251-261

Mean level of work stress in 17 European countries (SHARE, ELSA, n = 14 254, aged 50-64)



Source: Based on T. Lunau et al. (2015): PLoS One 10 (2) e0421573

The social gradient of effort-reward imbalance and low control at work in the European workforce



Prevalence of stressful work according to three occupational classifications; N = 6398 employed men and women (50-64 yr.) from 11 countries (SHARE based on weighted data)

Source:
Wahrendorf M et al. (2013) European Sociological Review 29: 792-802

3. Scientific evidence on associations with health (Bradford Hill criteria!)

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- Prospective Study (exposition → incident disease; statistical control of confounders)
- Strength of association
- Dose – response relationship
- Evidence on biological pathways from exposure to disease
- Consistency of results across contexts/cultures and study designs
- Risk reduction through exposure reduction (experimental evidence, e.g. RCT)

Cave:

- Specificity of association of exposure with disease (often not applicable due to multiple health effects of exposure)

3.1. Effort-reward imbalance and depression
Prospective studies, consistency, effect size

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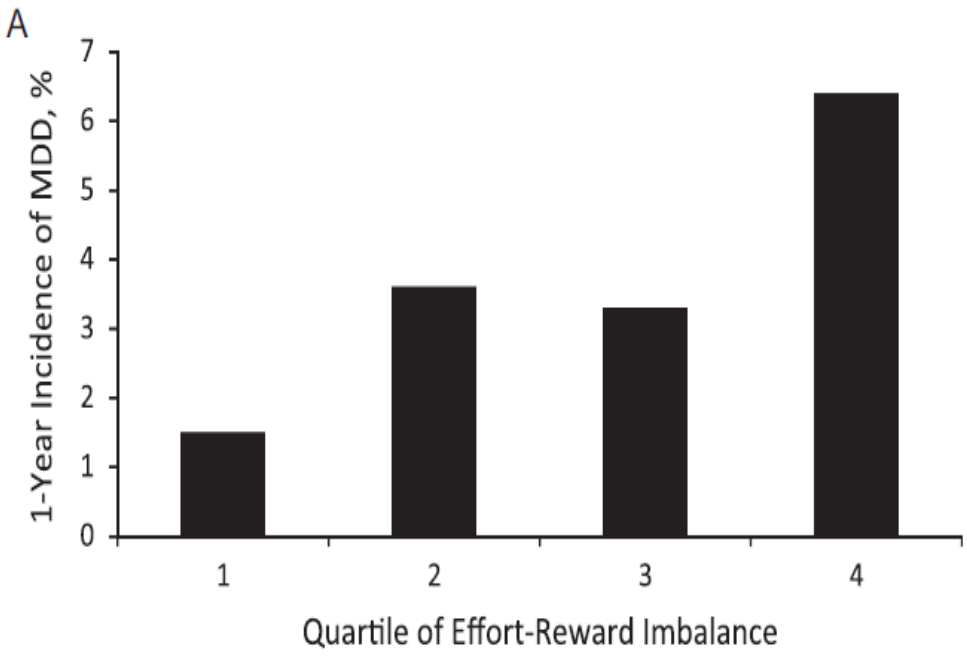
- Systematic review R. Rugulies et al.: Chapter 6 in J. Siegrist & M. Wahrendorf (eds.) Work stress and health in a globalized economy. Springer 2016 (pp. 103-143):

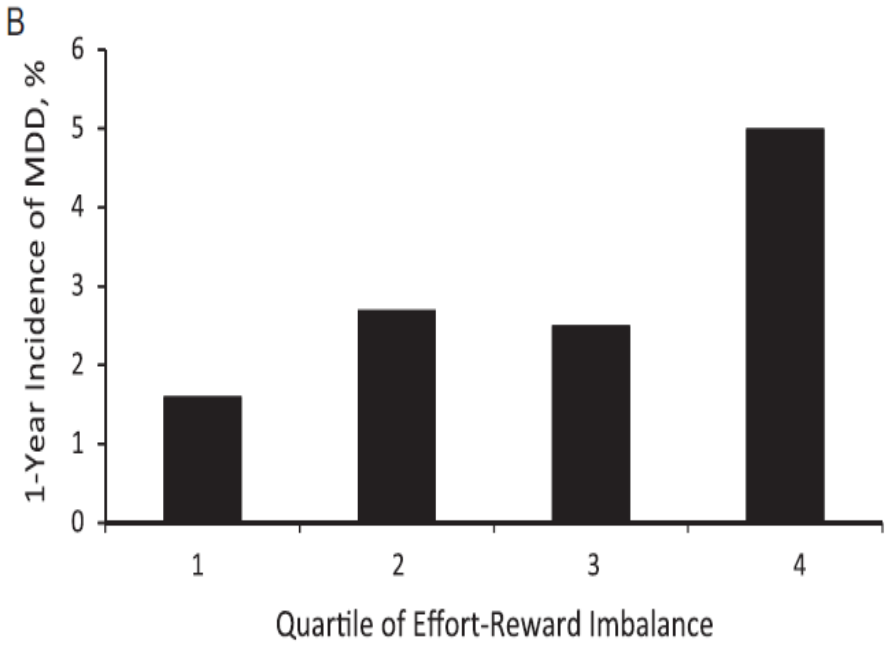
- 9 studies: >80.000 participants from 15 countries (EU, US,CA); follow-up 1,0-8,9 yrs.; outcome based on quest. (e.g. CES-D) or clinical diagnosis

→ „Effect estimates were relatively similar ranging from 1.49 to 2.32 in the highest exposure group“ (p. 124)

Role of gender: 1-year incidence on major depression and work stress quartiles (Effort-Reward Imbalance) Canada (n = 2752, men and women)



Men



Women

Source: Wang, J (2012): Am J Epidemiol 176: 52-59, (p. 55).

Relative contribution of ERI (reward) compared to other occupational factors

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I. Niedhammer et al. (2015) BMC Public Health 15:200

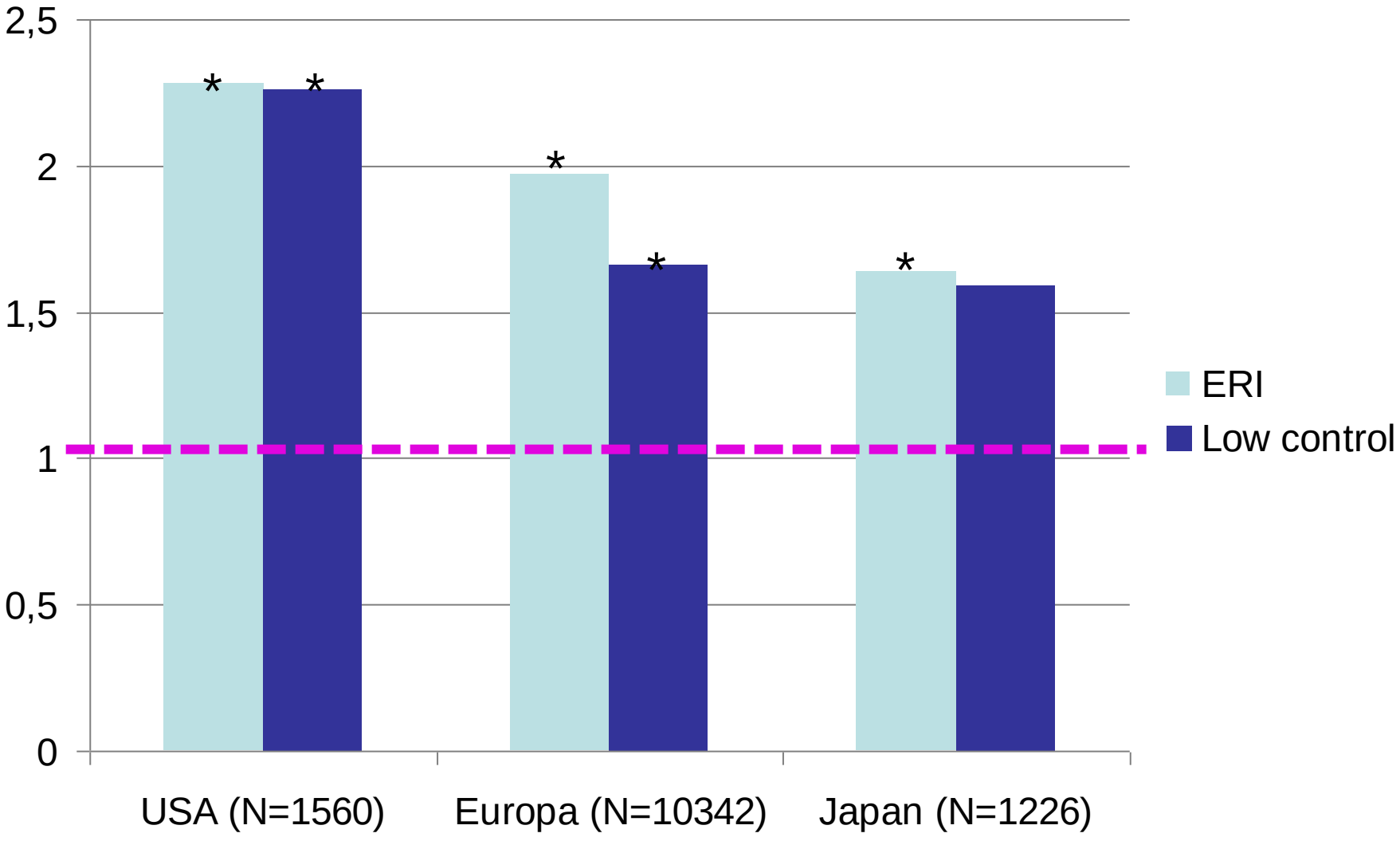
Prospective French national SIP study:

- 4717 workers in France; 2006 and 2010
- Outcome: Incident major depressive disorder (MINI)
- Exposure: 10 psychosocial work factors; 4 working time factors; 3 physical work factors

Main result:

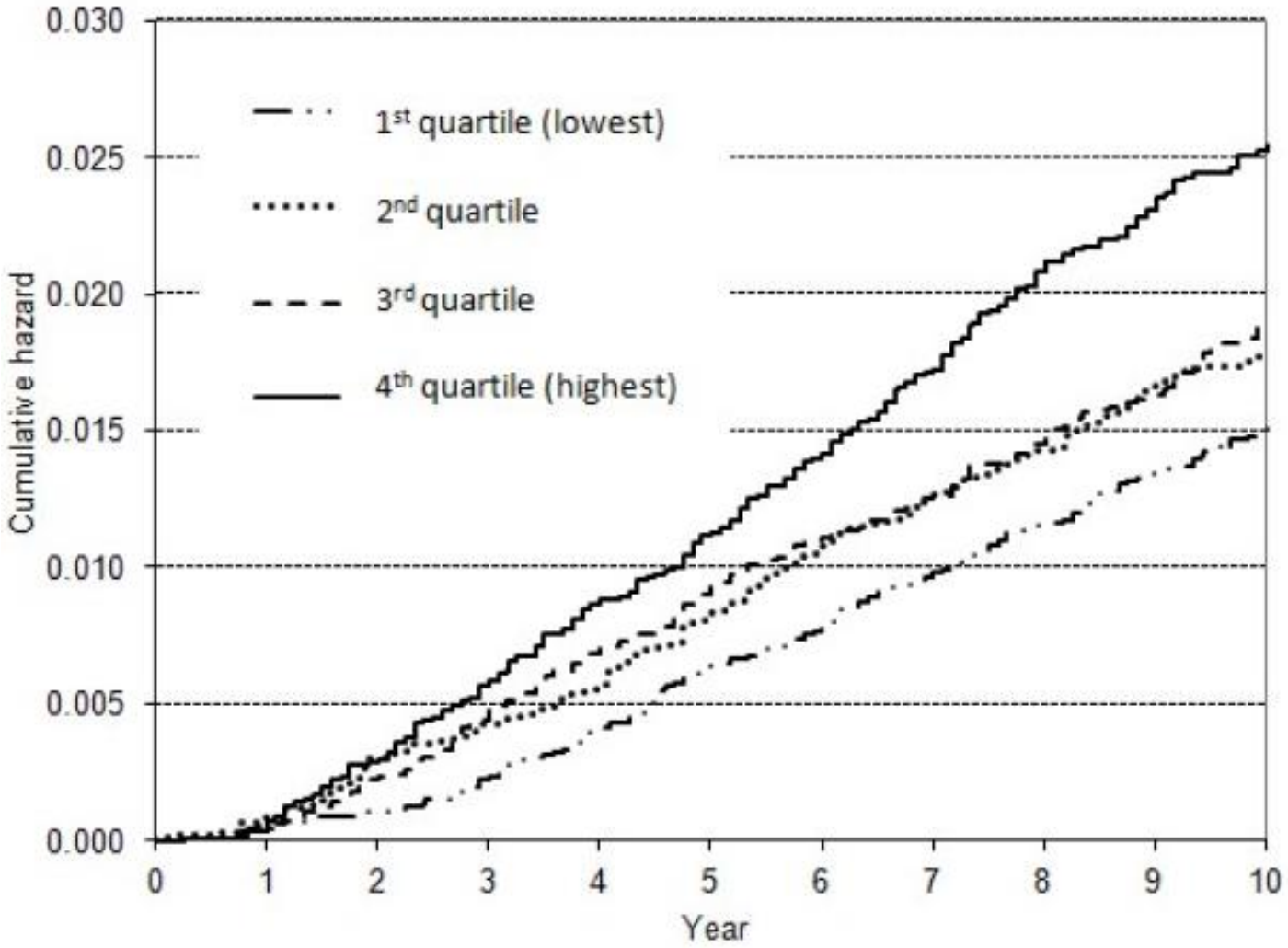
- Taking all occupational factors into account simultaneously and adjusting for covariates: 2 significant effects:
  - Low reward OR 1.60 (1.08-2.39)
  - Job insecurity OR 1.63 (1.08-2.48)

Cross-cultural consistency: ERI/ Low control and depressive symptoms: 17 countries in three continents (SHARE, ELSA, HRS, JSTAR)



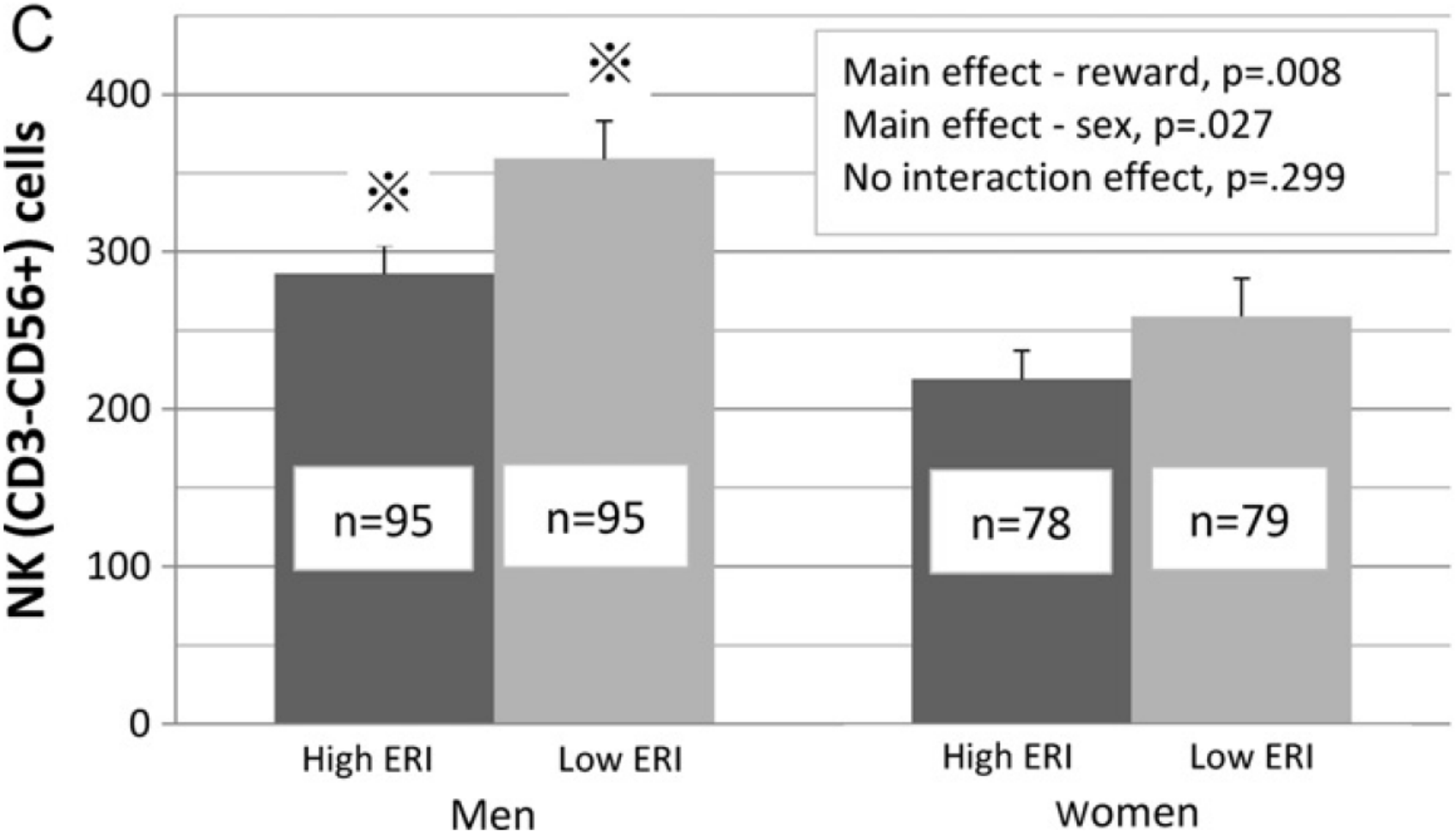
Source: J. Siegrist et al (2012) Globalization and Health 8:27.

Dose-response relation: Cumulative hazard curves of disability pension due to depression by quartiles of work stress (ERI) (n =51.874)



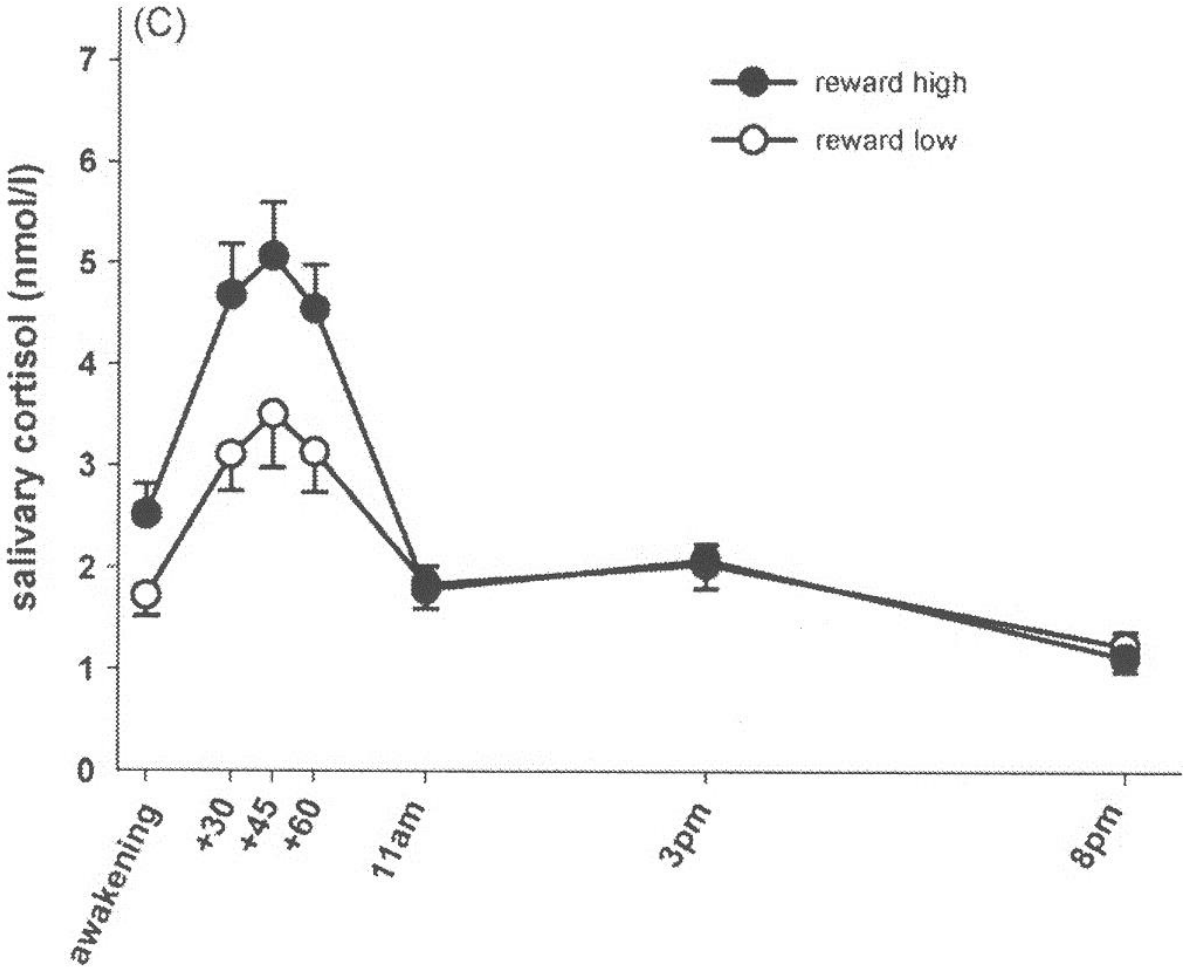
Source: Juvani A et al. (2014): Scand J Work Environ Health, 40: 266-277.

Biological pathways: ERI and natural killer cells in 347 Japanese employees



Source: Nakata A et al (2011), Biol Psychol 88:270-279, (p. 277).

Biological pathways: Cortisol awakening response after dexamethasone-test in teachers (N=135)



Source: Bellingrath S et al (2008) Biol Psychol 78: 104-113

Risk reduction: Organizational intervention in a Canadian hospital vs. control hospital*

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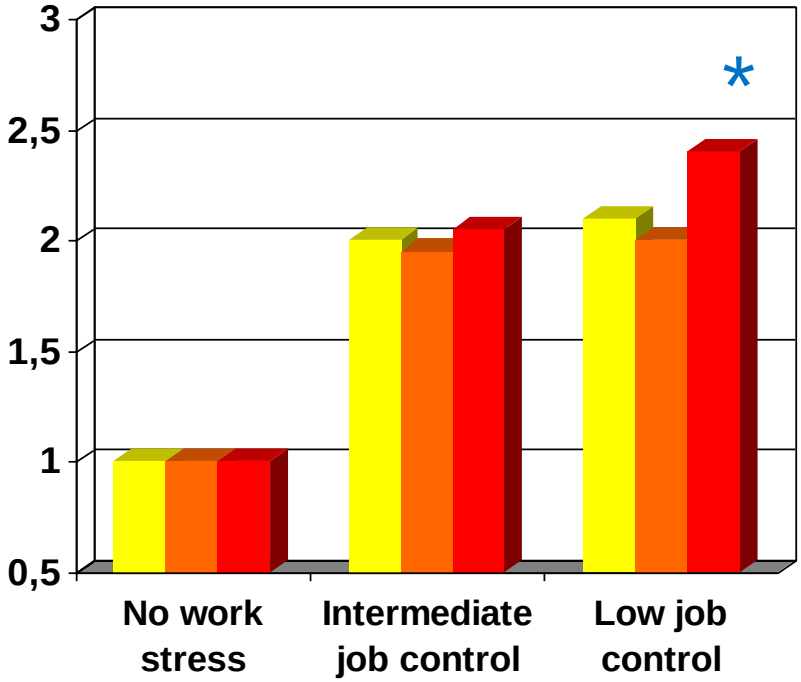
	Means at t2 adj. for t0		
Variable	experimental	- control hospital	p
Demand	11.9	12.6	.008
Control	70.0	68.7	.051
Social support	23.7	23.0	.011
Reward	31.2	30.2	.003
Effort-reward imbal.	1.0	1.1	.001
Work-rel. burnout	43.2	48.3	.003

*36 month-follow-up, two Canadian hospitals, N=248 (intervention) vs. 240 (control hospital) (ANCOVA, adj. for baseline values)

Source: R. Bourbonnais et al. (2011), Occup Environ Med, 68: 479-486.

3.2. Effort-reward imbalance and coronary heart disease

The Whitehall II-Study: 4393 male and female civil servants



adjusted for age, sex, length of follow-up

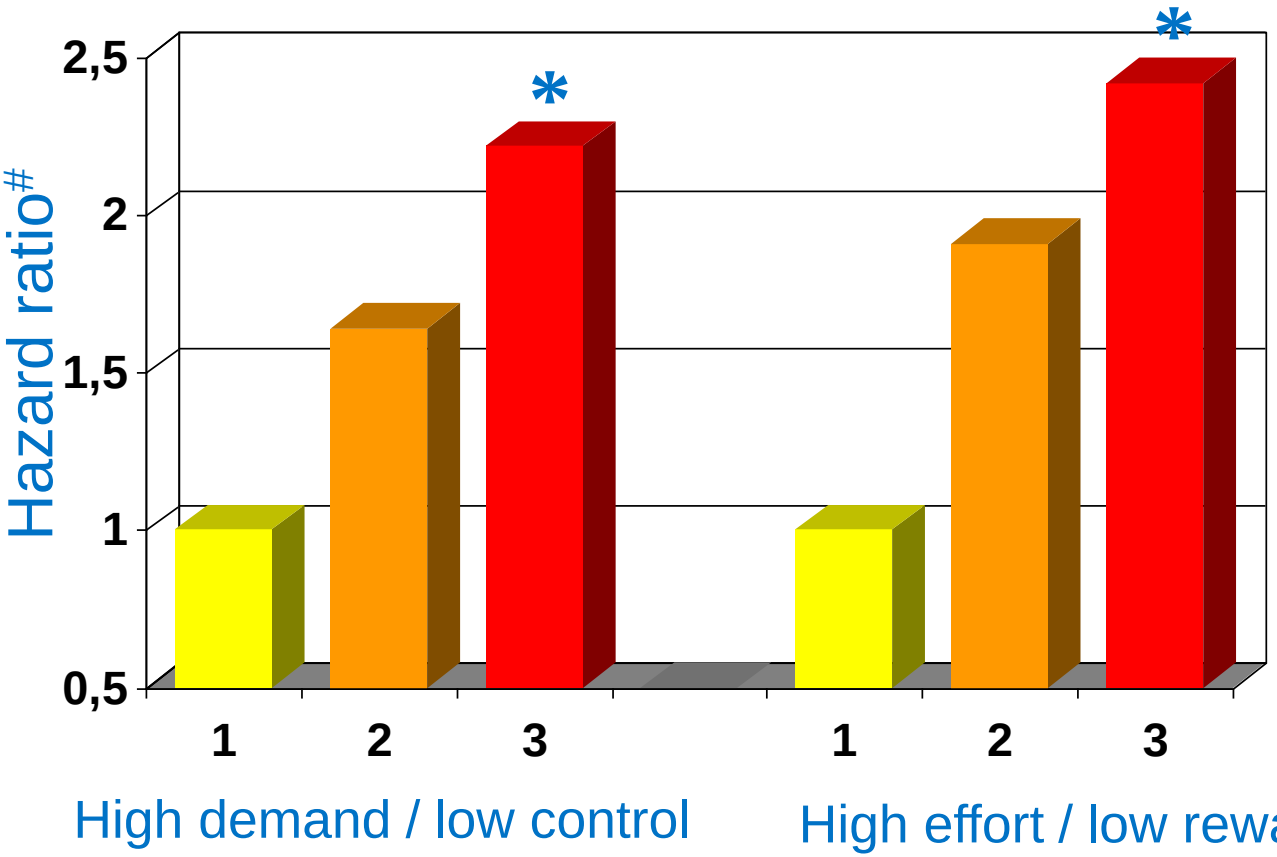
\+ alternative work stress model

\+ grade, coronary risk factors, negative affect

* p < .05

Source: H. Bosma et al. (1998), Amer J Publ Health, 88: 68-74

Work stress and cardiovascular mortality: Finnish Cohort Study, n = 812 employees

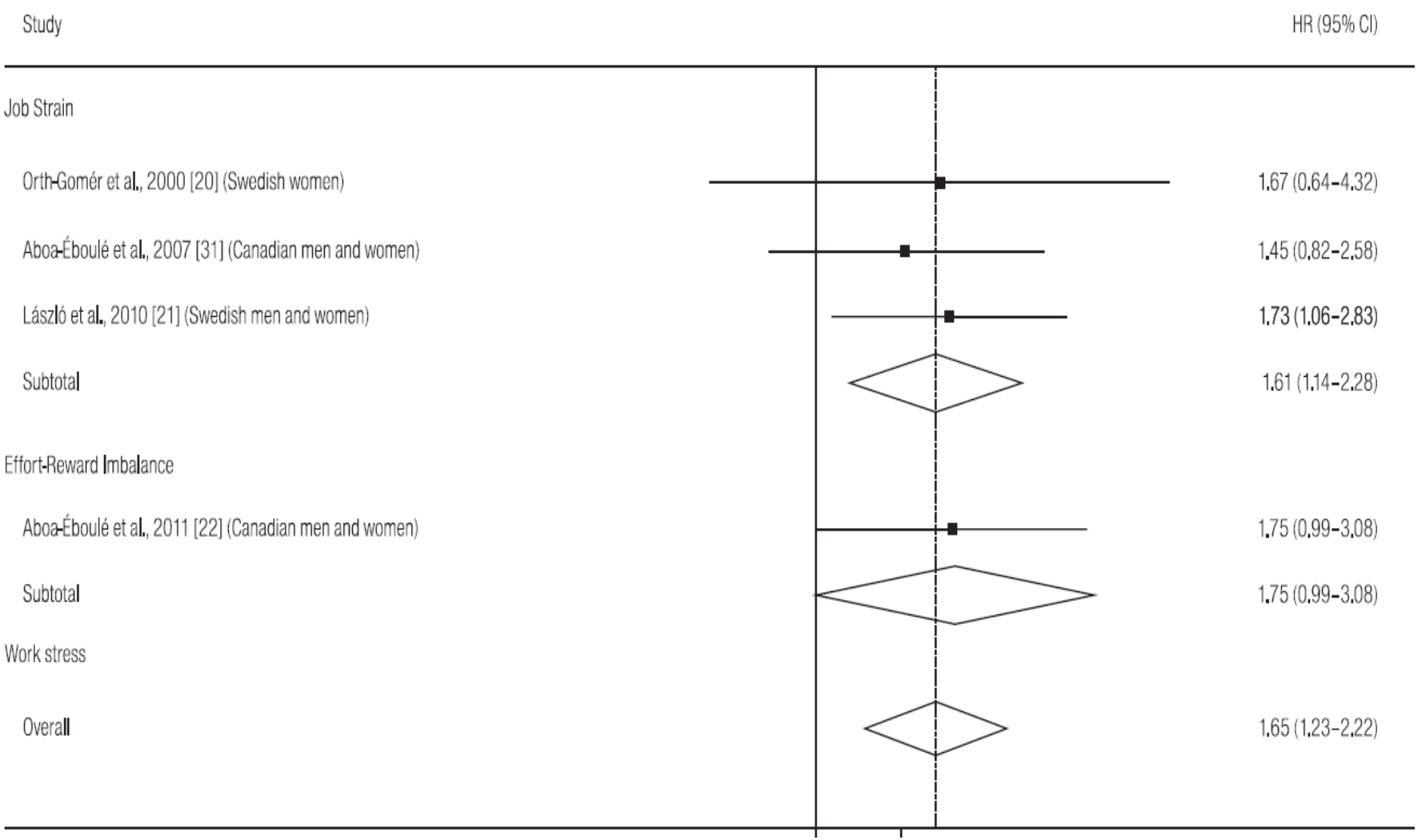


Tertile (work stress):
1 = no
2 = low
3 = high

#adj. for age, sex, SEP, smoking, phys. act., SBP, cholest., and BMI

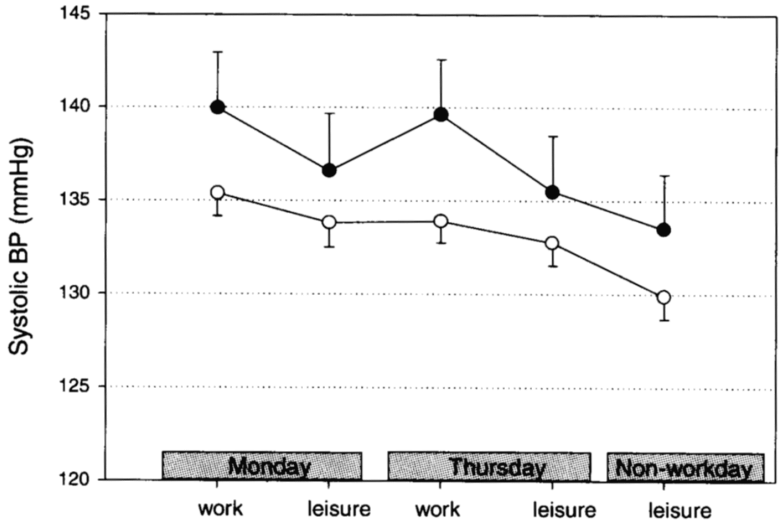
Source: Based on Kivimäki, M, et al. (2002), BMJ, 325: 857

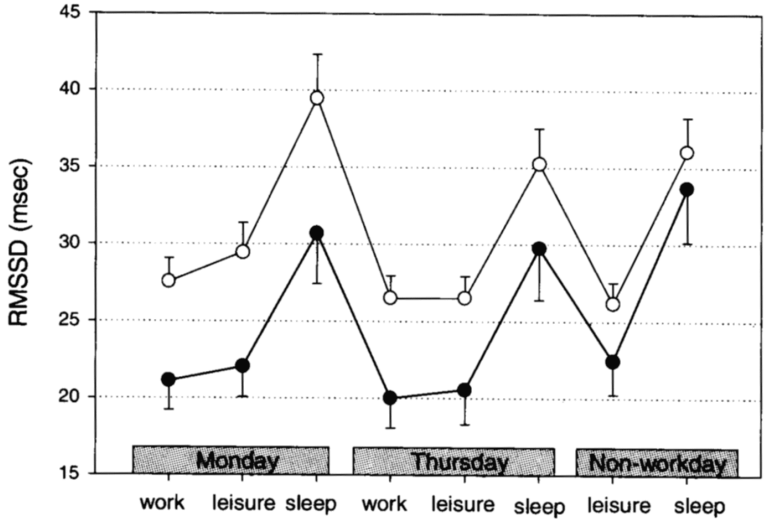
Work stress (Job Strain; ERI) and recurrent coronary heart disease: meta-analysis

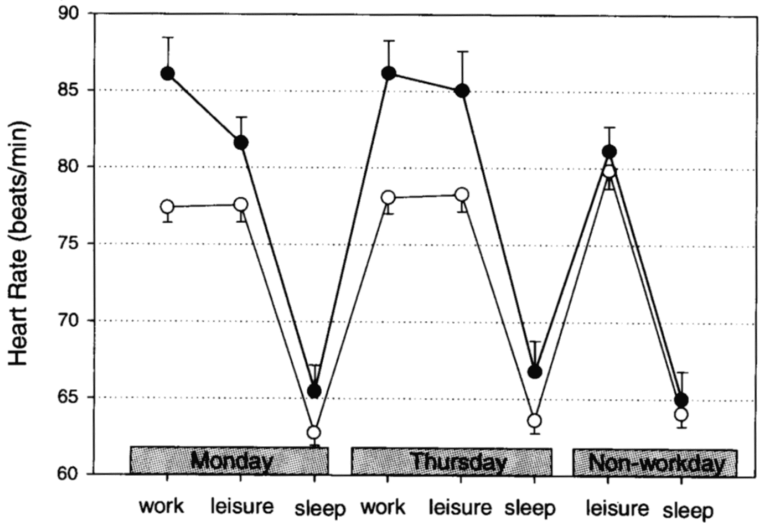


Source: Li J et al (2015) Int J Occup Med Environ Health, 28(1):8-19.

Cardiovascular monitoring over 3 days in healthy male computer employees and work stress







Low Imbalance
High Imbalance

Source: Vrijkotte et al. (2000), Hypertension, 35: 880.

Inflammatory response (CRP) during experimentally induced mental stress according to level of effort-reward imbalance (N=92)

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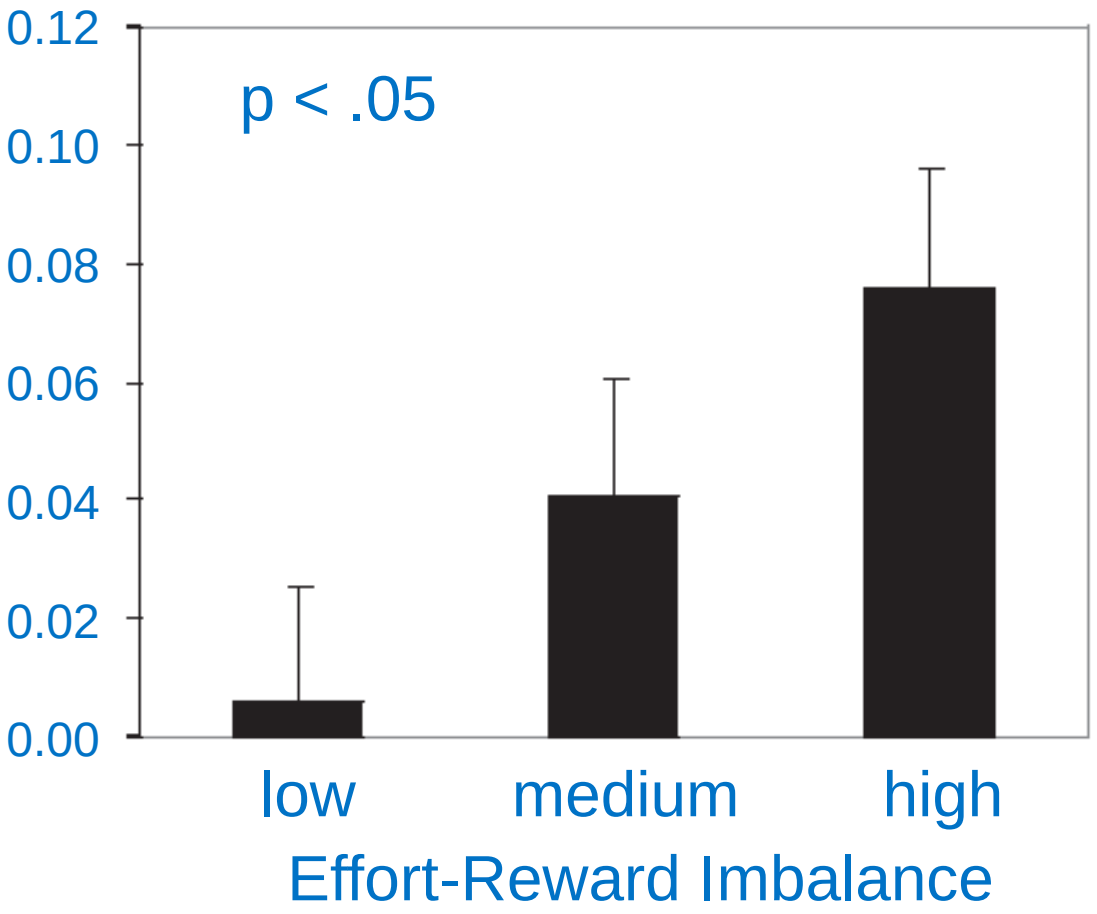
CRP change[#] (µg/ml) as function of effort-reward imbalance



[#] adjusted for age, BMI, baseline levels

Source: Based on Hamer, M. et al. (2006), Psychosom Med, 68: 408-413.

3.3 Effort-reward imbalance and other outcomes (prospective studies)

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- Type 2 diabetes: Kumari MHJ 2004 Ann Intern Med
- Metabolic syndrome: Loerbroks A 2015 Int J Cardiol
- Hypertension: Gilbert-Ouimet M 2012 J Psychosom Res
- Sleep disturbances: Rugulies R 2009 J Psychosom Res
- Alcohol dependence: Head J. 2004 OEM
- Musculoskeletal disorders: Krause N 2010 Scand JWEH
- Sick leave (short and long spell) : Head J 2007 J Psychosom Res

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- Intention to leave the profession: Derycke H 2010 J Occup Org Psychol; Li J 2013 Int J Health Serv; Soderberg M 2014 BMC Publ Health

4. Future directions of analysis

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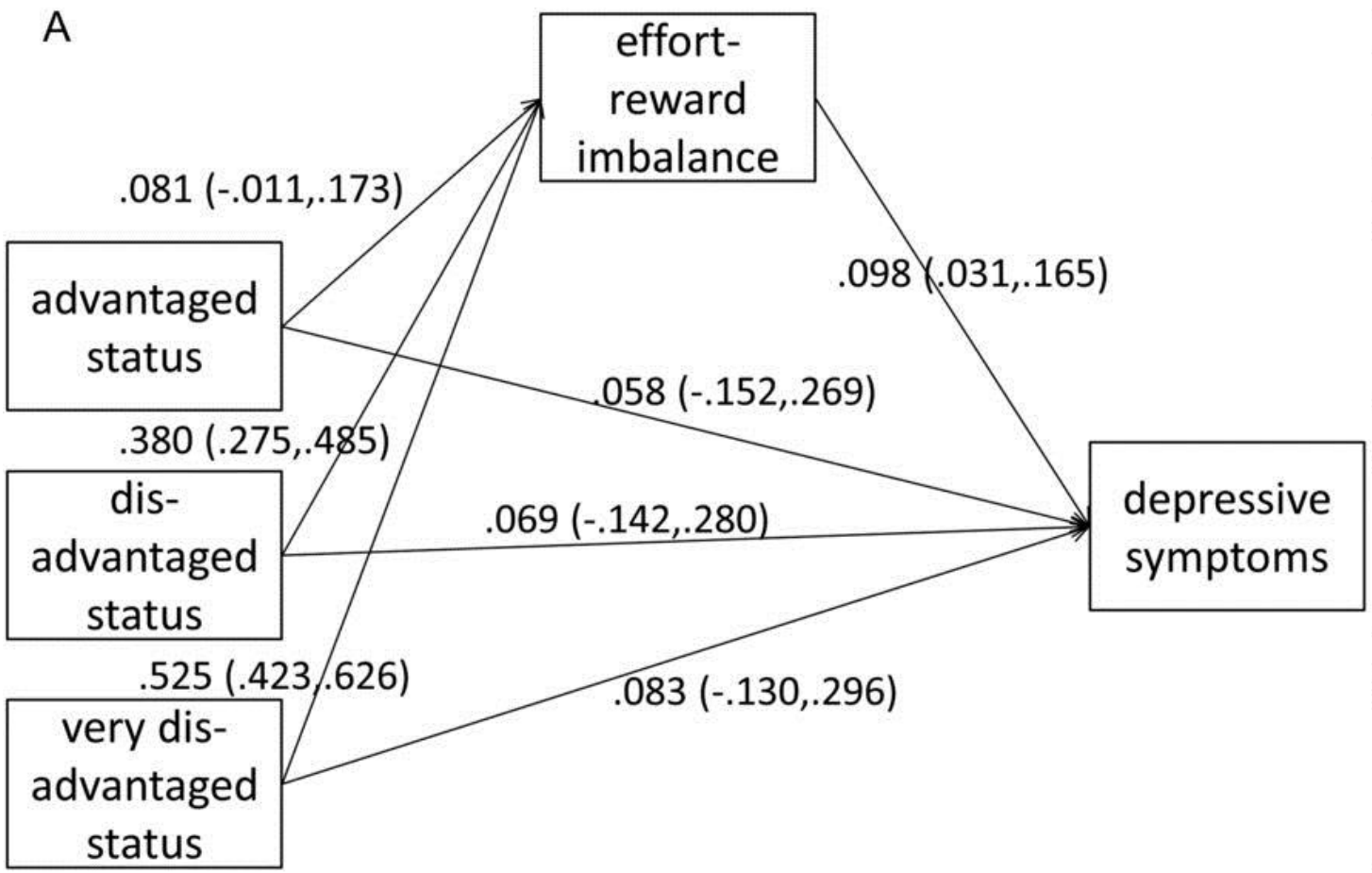
- Explore additive/cumulative effects of ERI with DC and other occupational factors, including work-life balance
- Analyse the role of ERI in mediation and moderation of social inequalities in work-related health
- Design experimental studies of ERI and analyse effects on psychobiologic parameters; include fMRI neuroscience data
- Study ERI and health outcomes in a life course perspective, including impact on active aging
- Apply multi-level analysis in cross-country studies examining effects of national labour and social policies on ERI and health

Mediation: SEP, work stress (ERI) and depressive symptoms: Adj for country, sex and age, N=2798.



H Hoven et al. J Epidemiol Community Health 2015;69:447-452

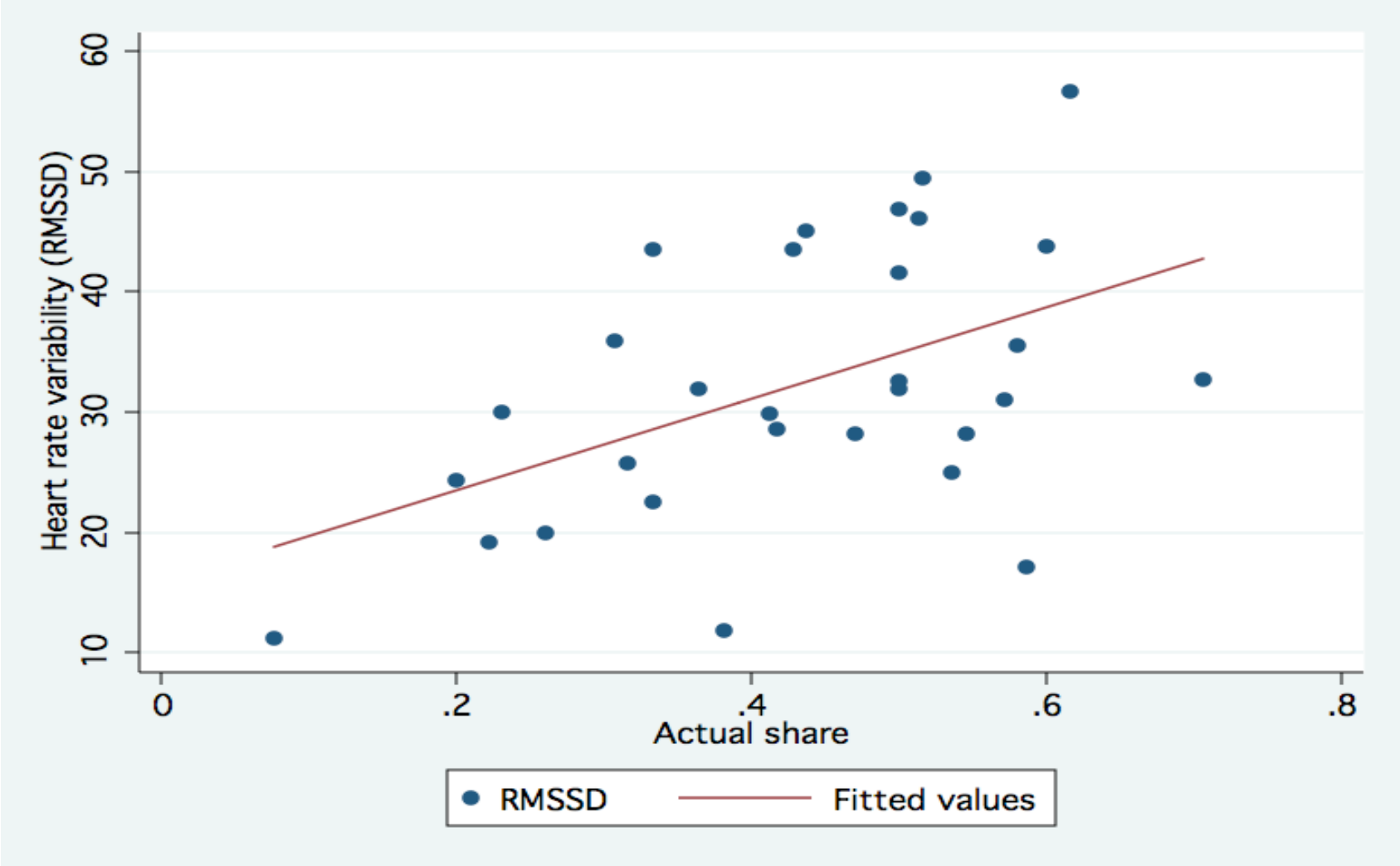
Moderation: Stronger effects of ERI on depression among workers with low socioeconomic positions (SEP) (Denmark; N=1729)

	n	OR (%95 CI)
ERI low / SEP high	652	1 (Reference)
ERI low / SEP low	611	1,45 (0,72 -2,92)
ERI high / SEP high	313	1,26 (0,59 - 2,70)
ERI high / SEP low	153	2,43 (1,07 - 5,53)

Logistic regression analysis. Adjusted for age, sex, family status, health behavior, sleep distiurbance, subkjective health and depression at baseline

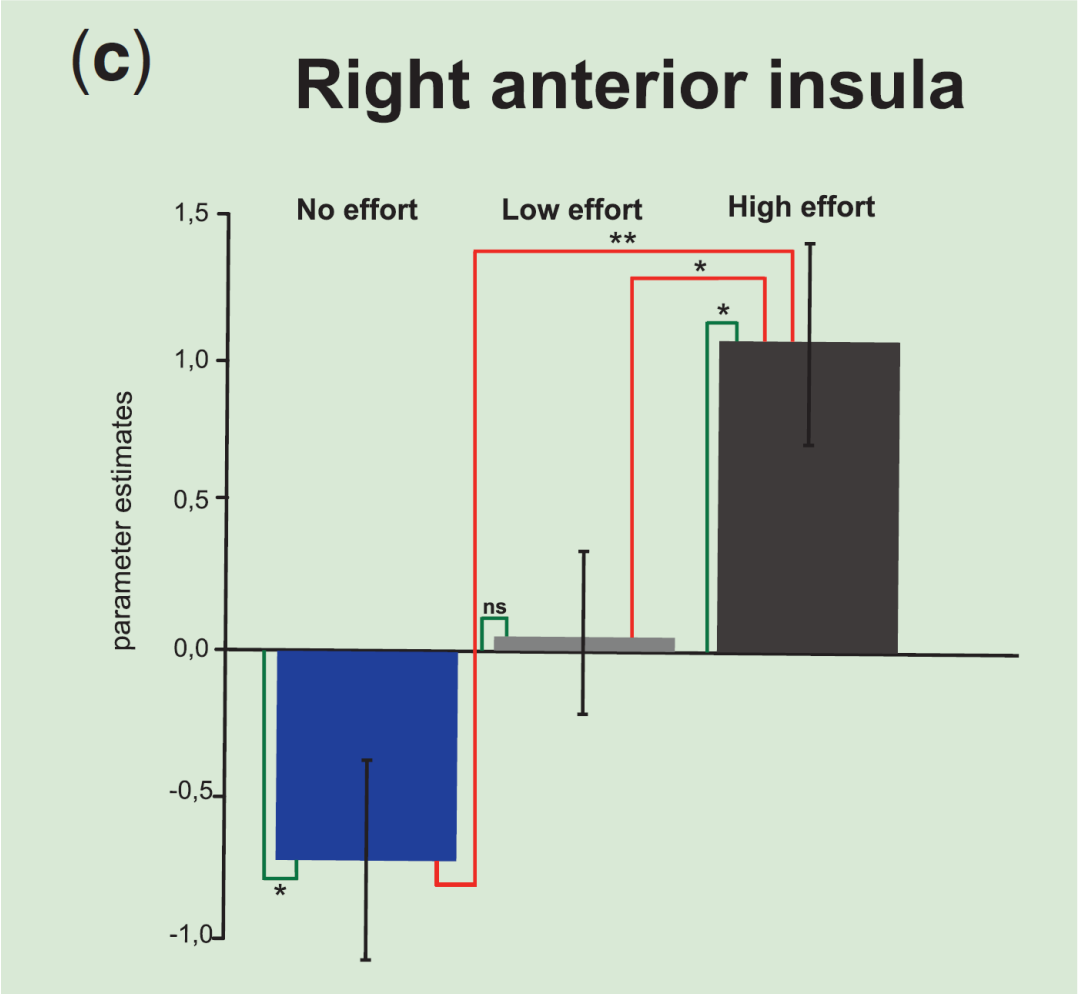
Source: R Rugulies et al. (2013) Eur J Public Health 23: 415-420

Experimental design of ERI and heart rate variability
30 agents and 30 principals (students)



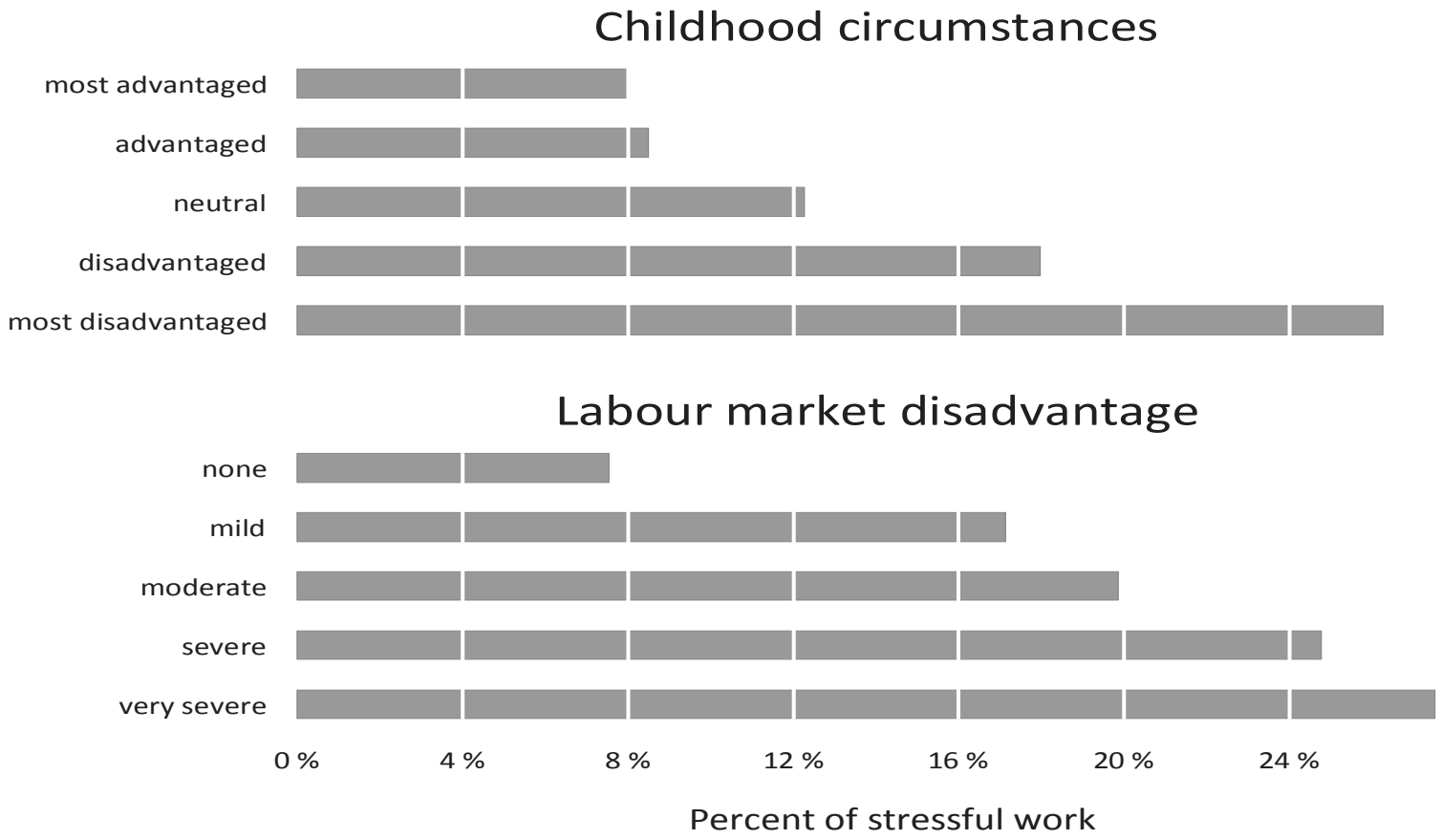
Source: A, Falk et al. (2011) IZA Discussion Paper 5

Experience of loss activates reward-sensitive brain area (anterior insula) only following high effort



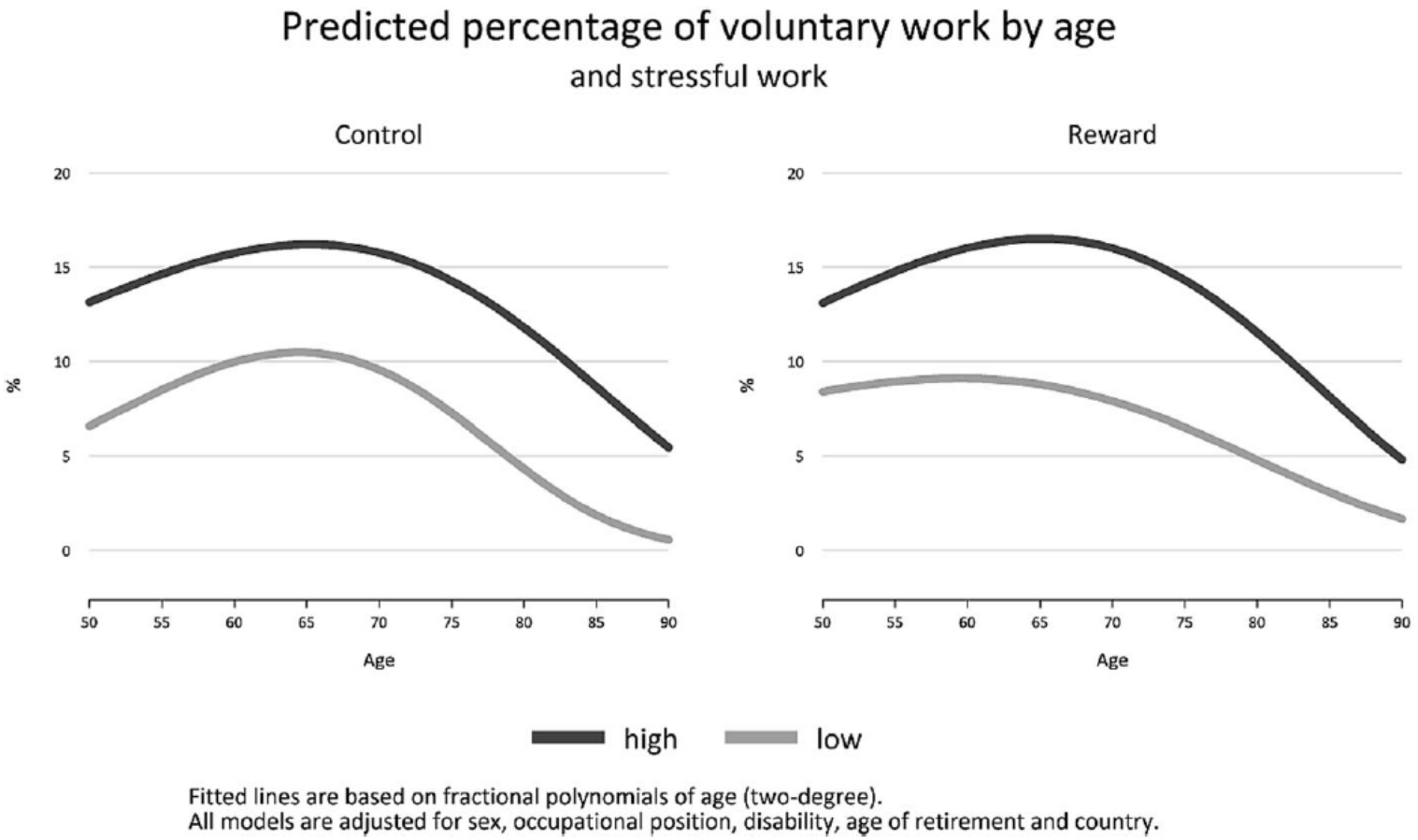
Source: J. Hernandez Lallement (2013) Soc Cogn Affect Neurosci
doi:10.1093/scan/nss147

Associations of childhood and early adulthood disadvantage with stressful work lin early old age



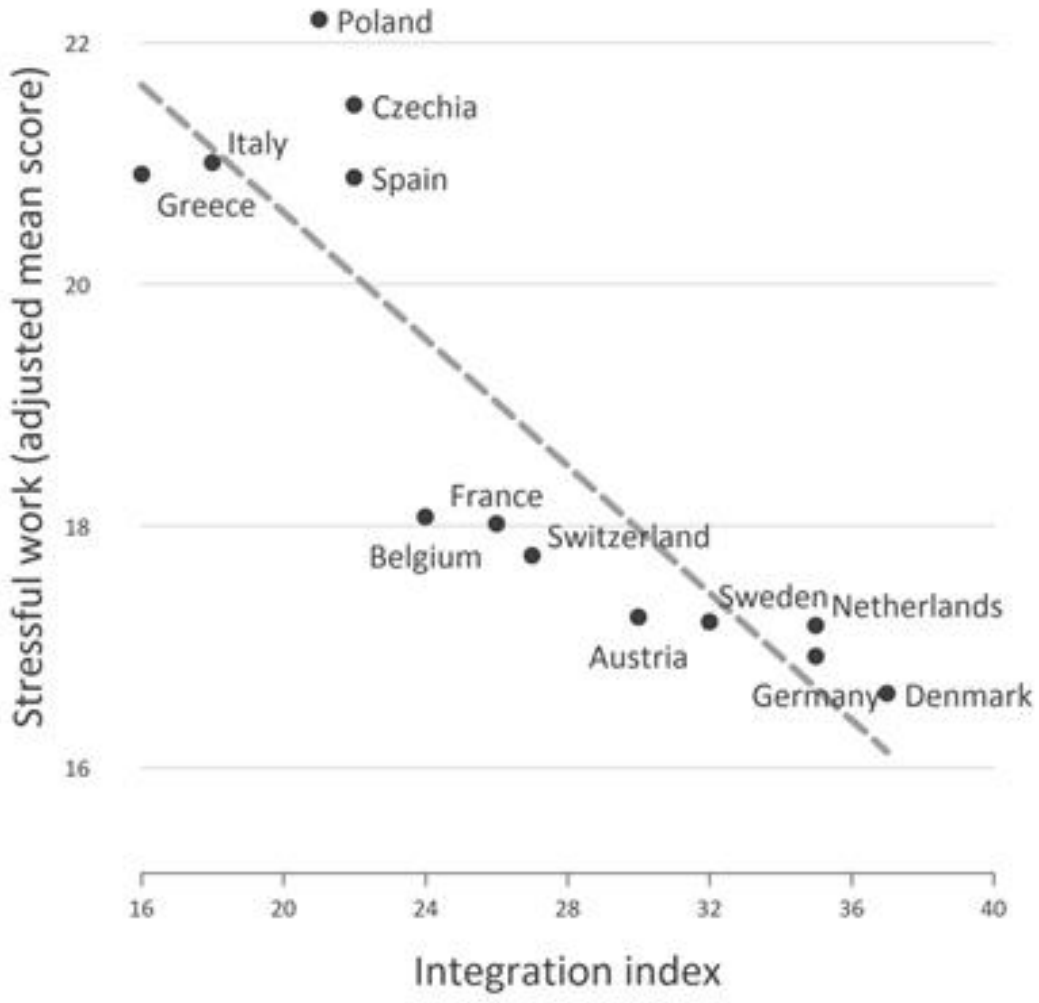
% stressful work by childhood deprivation (upper part) and labour market disadvantage (lower part). N = 11,181 older men and women (SHARE). Source: M. Wahrendorf, J. Siegrist (2014) BMC Public Health 14: 849.

Quality of work in midlife and volunteering after labor market exit (SHARE; n=11.751 retired men and women; 13 countries)



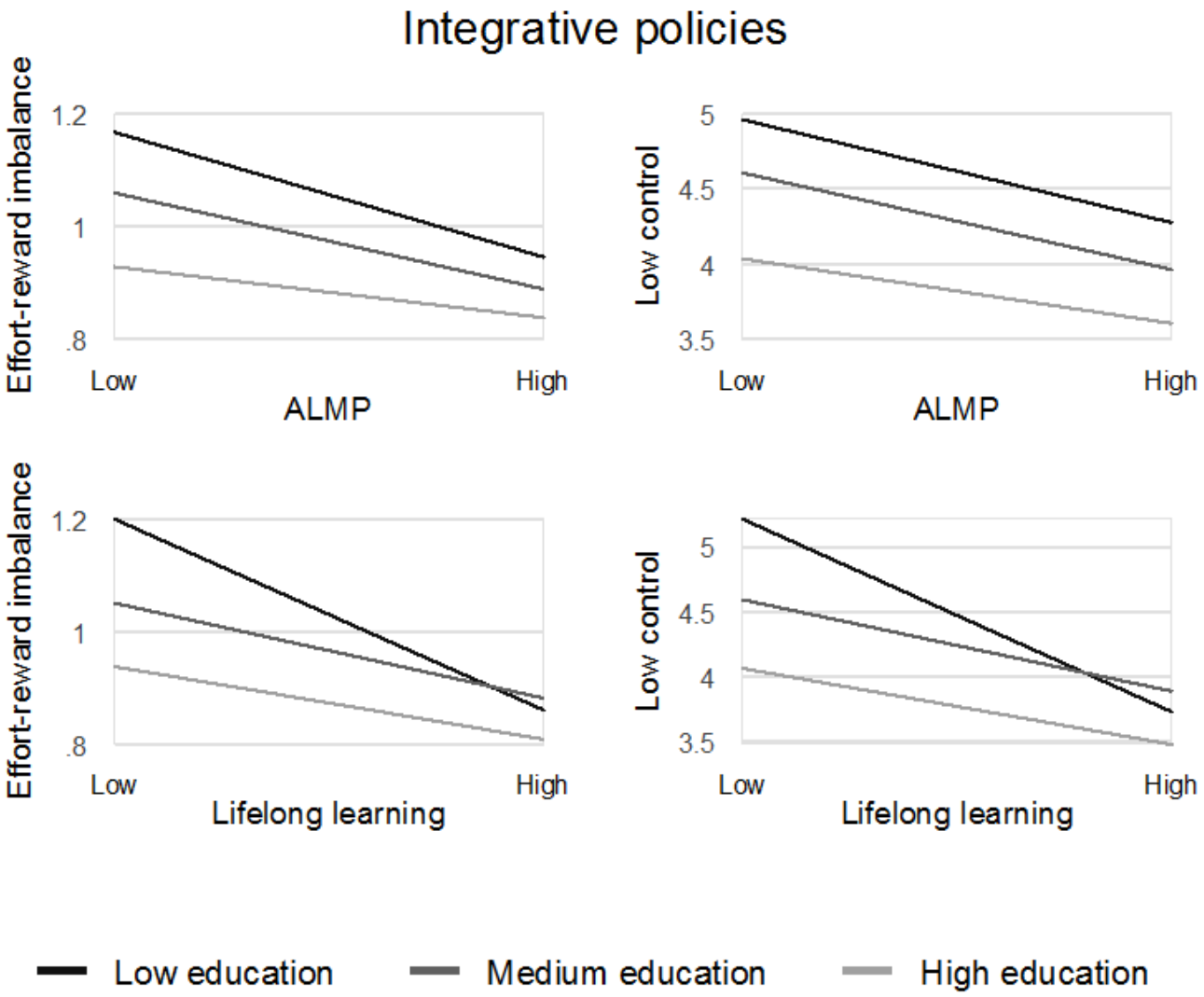
Wahrendorf et al. (2016) Journal of Population Ageing Volume 9, Issue 1, pp 113–130

Multi-level cross-country analysis with SHARE data: Country-level work stress and labour market integration policies



Source: Wahrendorf M, Siegrist J. (2014) BMC Public Health 14: 849

Social gradient of stressful work according to extent of implementation ofdistinct labour market policies (SHARE)



Lunau T. et al. (2015) PLoS One. DOI: 10.1371

Odds ratios of depressive symptoms by work stress: mitigation of effect by distinct labour policies?

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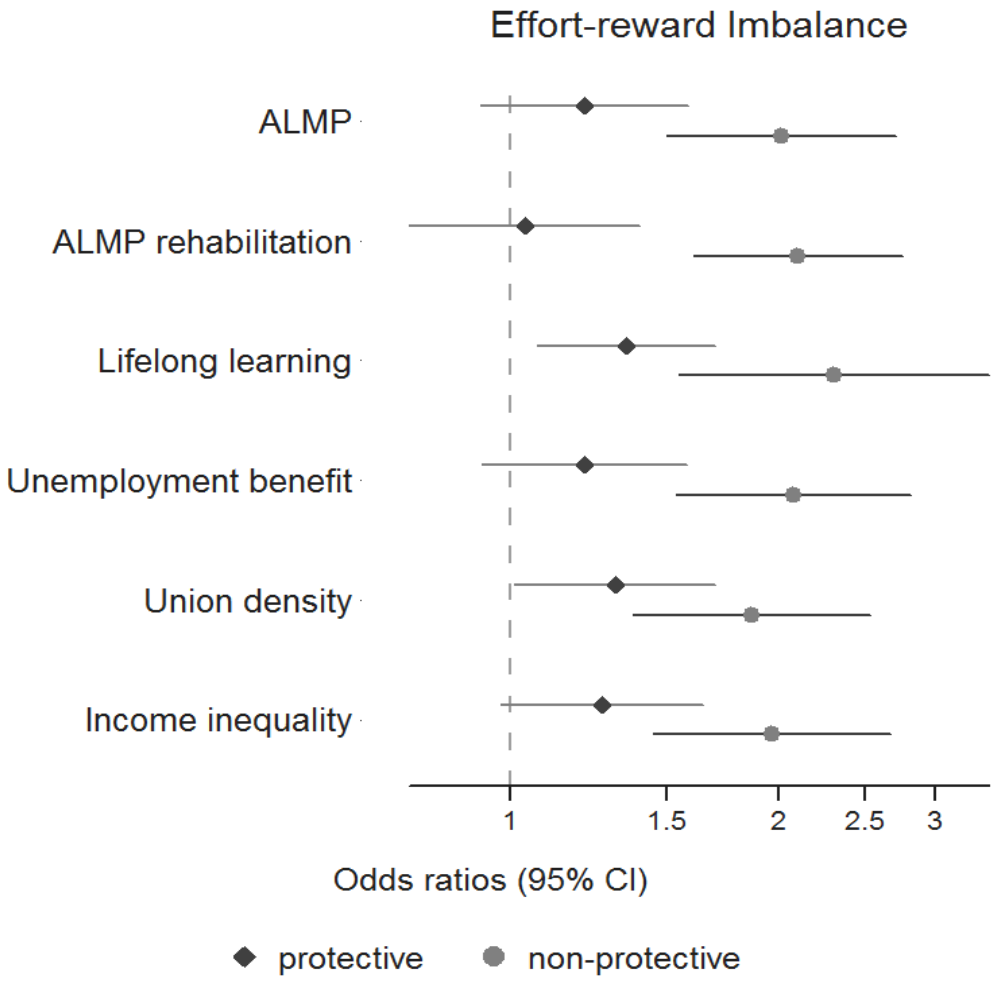
Based on SHARE, HRS, ELSA; n = 5650, m/w aged 50-64. 13 countries



Source: Lunau T. et al. (2013), BMC Public Health, doi:10.1186/1471-2458-13-1086

Summary: The model of effort-reward imbalance

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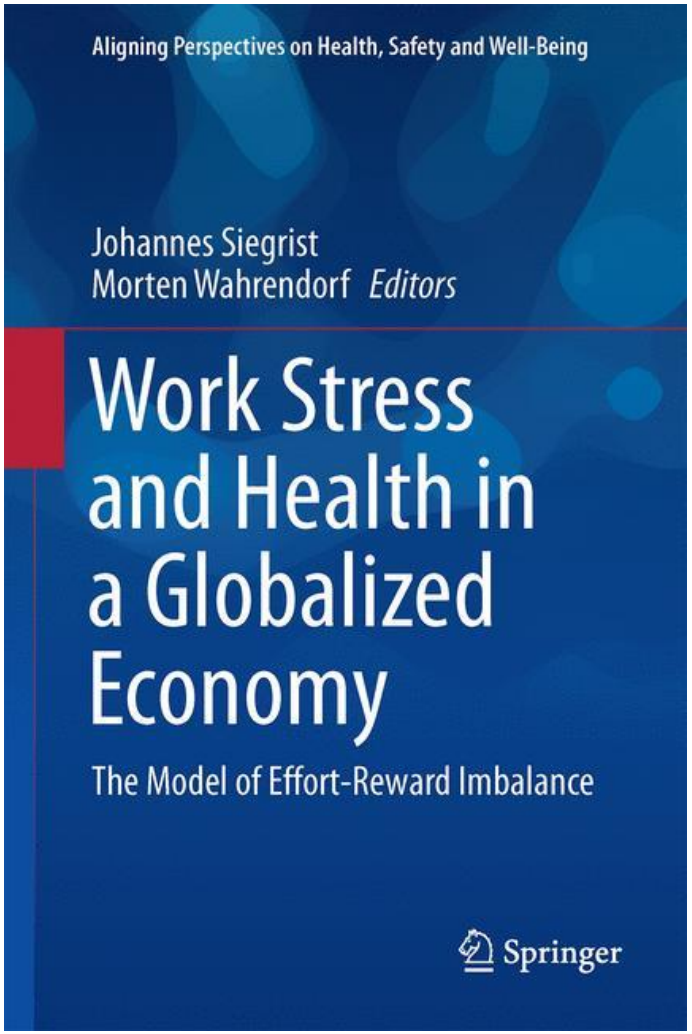
- During the past three decades
  - a large amount of new scientific knowledge has been produced
  - based on different study designs, including a variety of working populations from different countries and covering a spectrum of physical and mental disorders
- This knowledge
  - has proven to be useful for practice and policy
  - has stimulated further scientific developments
- Yet, a substantial gap between science and policy persists!

"Do something, do more, do better!"


Aligning Perspectives on Health, Safety and Well-Being
Johannes Siegrist
Morten Wahrendorf Editors
Work Stress and Health in a Globalized Economy
The Model of Effort-Reward Imbalance
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Thank you !