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Educational level, salivary cortisol, and all cause mortality

Results from the AGES-Reykjavik Study

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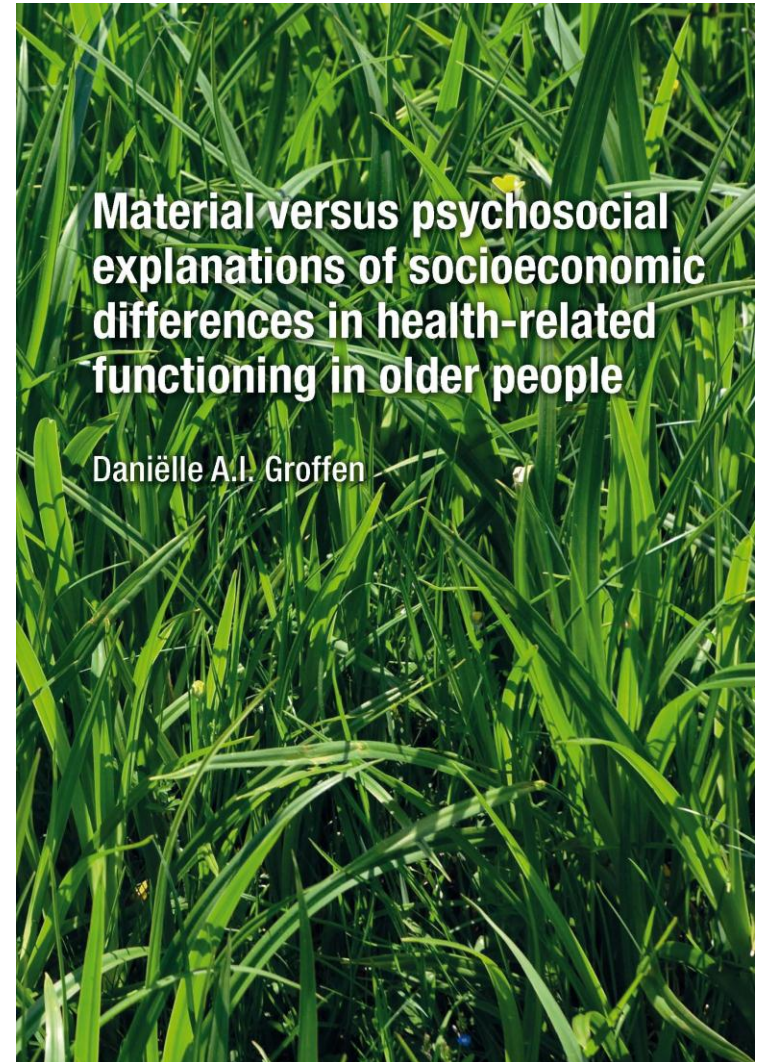
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Background

- Living in a socioeconomic hierarchy is a chronic source of stress
- Psychosocial factors
- Via unhealthy lifestyles and stress hormones this might lead to poor health



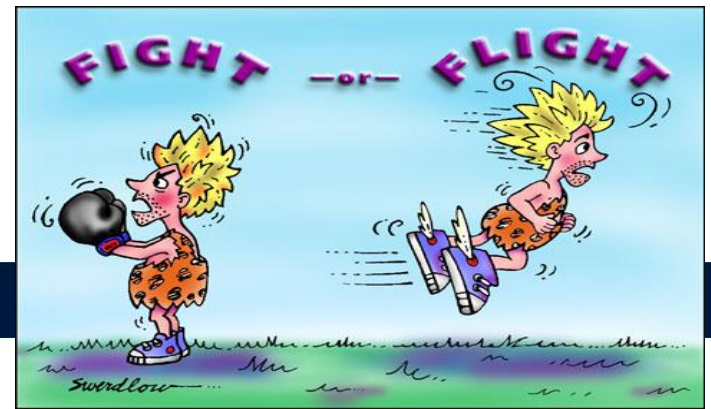
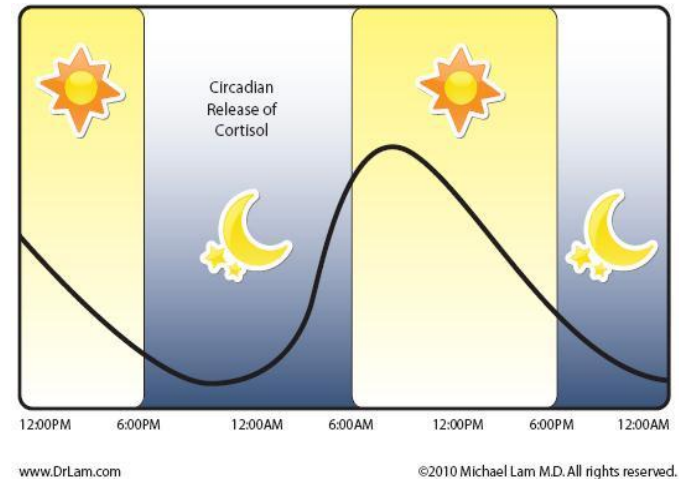
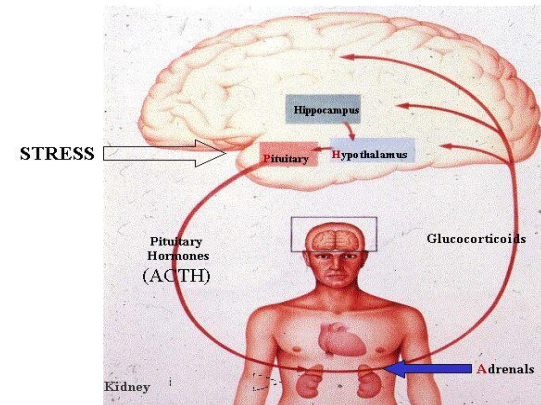
Background

“It would also be of interest to study the possible biological mechanisms underlying the relation between stress and poor health outcomes. Biochemical markers of stress responses, such as salivary cortisol might provide more information on these pathways.”

(Groffen, D.A.I. 2011, p.130-131)

Cortisol

- Biomarker of stress response
- Highest during early morning hours (30-45 minutes after waking up)
- Drop during the day
- “fight or flight” mechanisms (acute stress)



Allostatic load

“The physiological consequences of chronic exposure to fluctuating or heightened neural or neuroendocrine response that results from repeated or chronic stress”

(McEwen, 1993)

Hypotheses

- Cortisol levels remain higher in stressful situations
- Living in a socioeconomic hierarchy is considered to be a chronic stressor
- Cortisol levels remain higher in lower SES groups
- Low SES is related to poor health
- Cortisol is an independent predictor of morbidity and mortality
- Cortisol is a mediator in the relation between SES and poor health

The AGES-Reykjavik Study

- Population based cohort
- 1967-1992: Reykjavik Study (n=30,795; 33-65)
 - 13-38 years of follow up (mean: 28.8)
- 2002-2006: AGES-Reykjavik Study (n=5,764; 66-93)



ICELANDIC HEART ASSOCIATION

Cortisol measurement in AGES

- 2002-2006
- Morning and evening salivary cortisol samples
- Log transformation
- Diurnal variation
 - $((\text{morning} - \text{evening}) / \text{morning cortisol}) * 100$
- Included if at least 1 valid measurement available
 - Multiple imputation of missing or invalid (< 0.34 nmol/l or > 100 nmol/l) samples
- Exclusions:
 - Use of corticosteroids in any form
 - Evening cortisol > 5 nmol/l $>$ morning cortisol

Health outcomes

- Coronary Heart Disease
 - Hospital admissions/ICD10 codes
 - fatal and non-fatal
 - Exclusion of prevalent cases at time of cortisol measurement
 - Hip fractures
 - Hospital admissions/ICD10 codes
 - Exclusion of prevalent cases at time of cortisol measurement
- **All cause mortality**
- Available until May 2011
 - Cause specific deaths available until may 2009

Methods

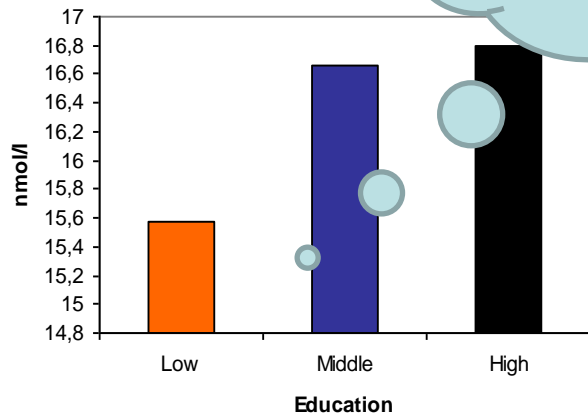
- N=4,776
- Cox Proportional Hazard Models / time to event
- Event= All cause mortality until May 6th, 2011, n=1,031

- Confounders
 - **Model 1:** Age, sex
 - **Model 2:** Season and day of sampling, working status, blood pressure, diabetes mellitus, depressed mood, sleeping problems, CHD
 - **Model 3:** Lifestyle factors (smoking, drinking, physical activity, BMI)

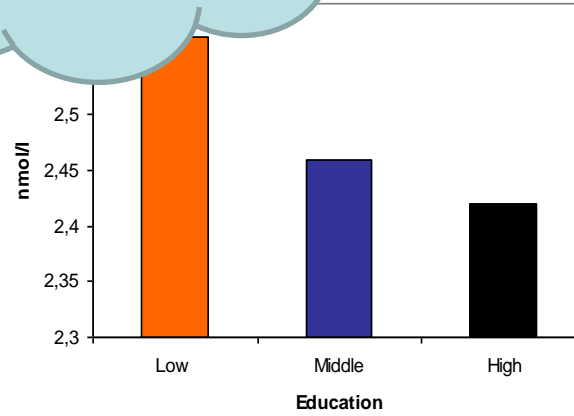
Education and cortisol secretion

Low SES
less
responsiveness
hypothesis?

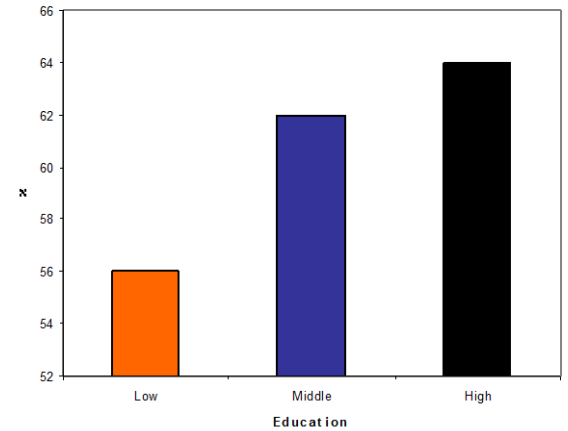
Morning cortisol



Diurnal variation

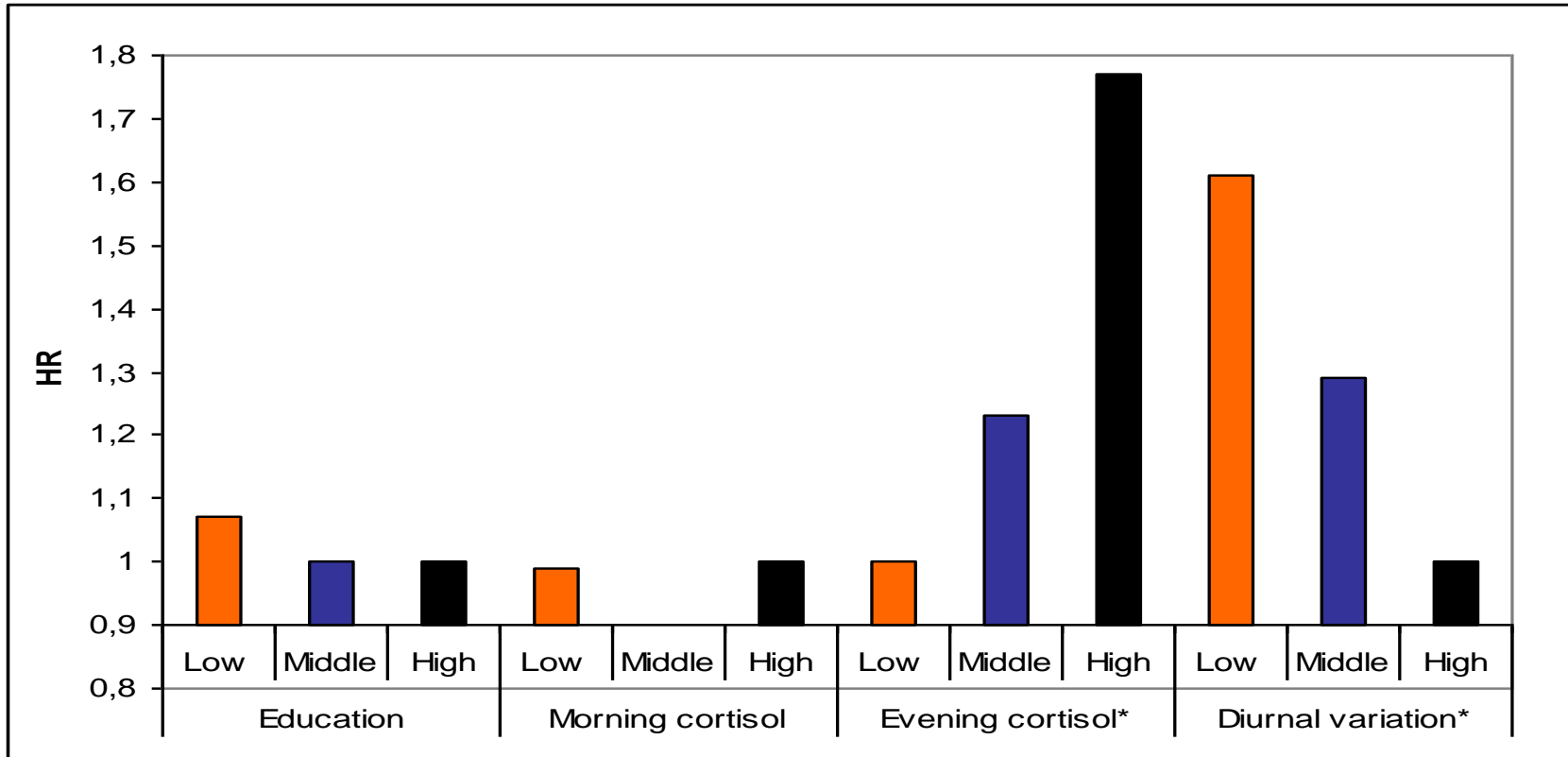


Diurnal variation



Fully adjusted estimated marginal means.

All cause mortality



Please note: Morning and evening cortisol and diurnal variation are categorized for ease of presentation. Use of continues, log transformed measures of cortisol secretion yielded similar results. Analyses for education are adjusted for cortisol. Analyses for cortisol are adjusted for education.

Discussion

- Low SES-Less responsiveness hypothesis
- Healthy survivor effect
- Effect of evening cortisol and diurnal variation on health outcomes
 - All cause mortality
 - Hip fractures, independently of Bone Mineral Density
 - Less strong effect on coronary heart disease
- The effect of cortisol on all cause mortality could not be explained by (mortality because of) CHD
- Other explanations?
 - (additional analyses in progress)

Conclusion

- This study found evidence for socioeconomic differences in cortisol secretion in an older Icelandic population.
- These findings are consistent with the hypothesis that the stress response gets blunted after a whole life of living in adverse socioeconomic circumstances.
- Cortisol levels were strong and independent predictors of all-cause mortality

Recommendations for future research

- Prevention purposes
- To take a closer look at the factors and mechanisms that buffer the effect of stress on cortisol secretion and health outcomes
- For example physical activity

Thank you for your attention!

