PROLONGED PERCEIVED STRESS AND SALIVA CORTISOL IN A LARGE COHORT OF DANISH PUBLIC SERVICE EMPLOYEES: CROSS-SECTIONAL AND LONGITUDINAL ASSOCIATIONS

Sigurd Mikkelsen[1], Julie Lyng Forman[2], Samuel Fink[1], Marianne Agergaard Vammen[1], Jane Frølund Thomsen[1], Matias Brødsgaard Grynderup[3], Åse Marie Hansen[3, 4], Linda Kaerlev[5,6], Henrik Albert Kolstad[7], Reiner Rugulies[3, 4, 8], Jens Peter Bonde[1]

[1]Department of Occupational and Environmental Medicine, Bispebjerg University Hospital, Copenhagen, [2]Section of Biostatistics, Department of Public Health, University of Copenhagen, [3]Department of Public Health, University of Copenhagen, [4]National Research Centre for the Working Environment, Copenhagen, [5]Research Unit of Clinical Epidemiology, Institute of Clinical Research, University of Southern Denmark, Odense, [6]Centre for Clinical Epidemiology, Odense University Hospital, Odense, [7]Department of Occupational Medicine, Danish Ramazzini Centre, Århus University Hospital, Århus. [8]Department of Psychology, University of Copenhagen.

Declaration of conflict:

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Background

1. Acute stress activates the hypothalamic-pituitary-adrenal (HPA) system, - cortisol secretion increases within minutes
2. Does frequent or chronic psychological stress affect the HPA activity?
3. Changes in cortisol secretion pattern has been associated with diseases (e.g. hypertension, CHD, cancer, depression, upper respiratory disease), which have also been linked to prolonged psychological stress.
4. Are adverse health effects associated with prolonged stress mediated through the changed activity of the HPA system?
5. If so, prolonged stress should be associated with cortisol secretion

Material

The PRISME study is a large prospective study of mental health and psychosocial factors at work.

Population sampling frame: 10000 public service employees,

Baseline study in 2007, 4467 respondents (45%)

Follow-up study in 2009, 3217 respondents (72%)

Cohen's Perceived Stress Scale (PSS)

Short version, 4 items

PSS measures the degree to which situations in one's life are appraised as unpredictable, uncontrollable, and overloading

During the last 4 weeks how often…

1. Have you felt that you were unable to control the important things in your life?
2. Have you felt confident about your ability to handle your personal problems?
3. Have you felt that things were going your way?
4. Have you felt difficulties were piling up so high that you could not overcome them?

Response scores: 0 = never, 1 = almost never, 2 = sometimes, 3 = fairly often, and 4 = very often. Items 2 and 3 were scored in the reverse direction. Scale scores were calculated as the mean of item scores

Cortisol

Sampling Salivette tubes distributed by postal mail

One saliva sample in the morning , 30 minutes after awakening
One saliva sample in the evening, approximately at 20:00

Prelabeled sampling tubes with identification number,
respondent filled in information on day and sample time.

Saliva sampling log: date, awakening time, saliva sampling time, sleep, working day, etc.

Samples with date and time inconsistencies, outliers, pregnancy, were excluded from analyses

Potential confounders

age, gender,
vocational education, personal income
[smoking, alcohol, leisure time physical activity, BMI]
[general health, ever diagnosed with depression, anxiety disorder, CVD]
[disturbed sleep during the last 4 weeks]
work schedule (daytime vs other schedules)

[sleep duration the night before saliva sampling]
working on the day of saliva sampling (yes/no)
[awakening time on the day of saliva sampling]
[saliva sampling times
  morning (time since awakening)
  evening (clock time)]

Analysis*

Cross-sectional and longitudinal effects were separated and mutually controlled

Cross-sectional effect (between person effect) measured by:
mean of PSS in 2007 and 2009 (PSS-mean)

Longitudinal effect (within person effect) measured by:
difference between PSS scores in 2007 and 2009 (PSS-dif)

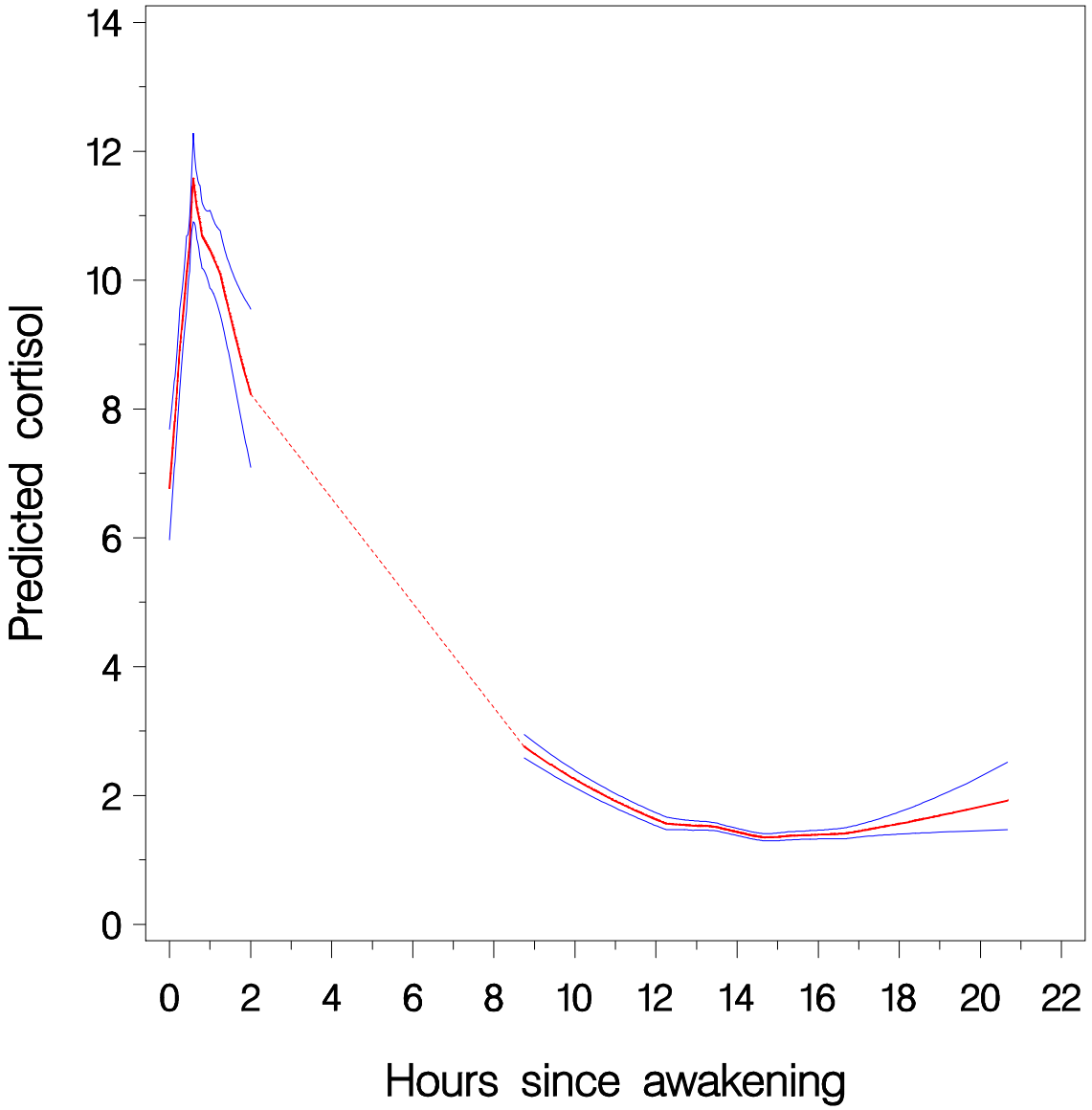
Model:
$\text{Ln(cortisol)} = \beta_1 * \text{PSS-mean} + \beta_2 * \text{PSS-dif} + [\Sigma(\beta_x * \text{covarate}_{x)}]$

Linear mixed model regression analyses for repeated measurements

Interactions between PSS and cortisol slopes in the morning and evening

*Fitzmaurice. Applied longitudinal analysis. Wiley 2011

Diurnal distribution of saliva cortisol concentrations (nmol/l), mean and 95% CI, 2007



Distribution of PSS-scores in 2007 and 2009

	2009				
2007	0 – <0.50	0.50-<1.50	1.50-<2.50	**2.50-4.00**	Total
0 – <0.50	141	151	22	0	314
0.50-<1.50	229	1030	247	14	1520
1.50-<2.50	36	354	282	29	701
2.50-4.00	2	15	33	**12**	**62**
Total	408	1550	584	**55**	**2597**

0 – <0.50: never
0.50-<1.50: almost never
1.50-<2.50: sometimes
2.50-4.00: fairly often or very often

Results

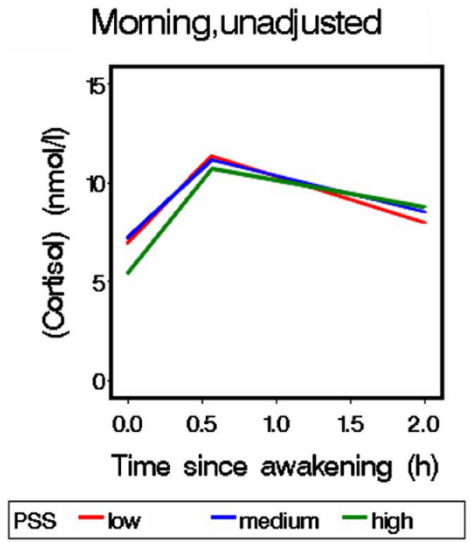
Morning	Perceived Stress Scale	Adjusted model			
		N	Effect ratio	95 % CI	p
	Continuous				
	Cross-sectional effect	5226	1.03	0.99-1.07	0.14
	Longitudinal effect	3650	0.97	0.92-1.04	0.42
	Hausman test				0.14
	Categorical				
	Cross-sectional effect				
	0.00 - <1.50	3797	1		
	1.50 - <2.50	1322	1.03	0.98-1.09	0.23
	2.50 - 4.00	107	1.08	0.92-1.27	0.35
	Longitudinal effect				
	0.00 - <1.50	2731	1		
	1.50 - <2.50	851	1.00	0.93-1.08	0.99
	2.50 - 4.00	68	0.96	0.77-1.19	0.68
	Hausman test				0.59

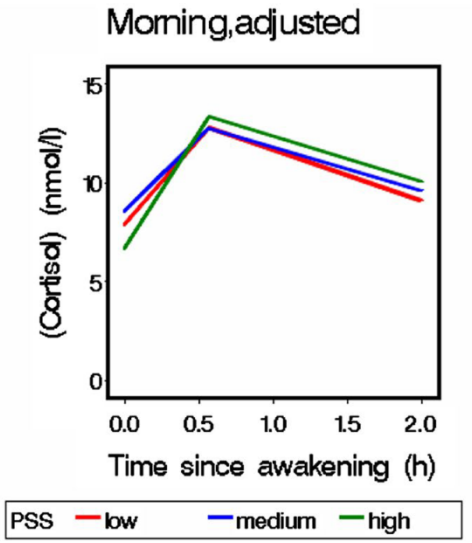
Results

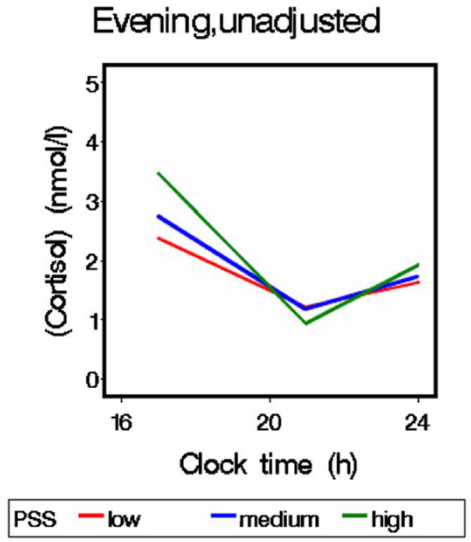
Evening	Perceived Stress Scale	Adjusted model			
		N	Effect ratio	95 % CI	p
	Continuous				
	Cross-sectional effect	5727	0.98	0.94-1.03	0.49
	Longitudinal effect	4360	1.06	0.99-1.14	0.10
	Hausman test				0.08
	Categorical				
	Cross-sectional effect				
	1.00 - <2.50	4141	1		
	2.50 - <3.50	1460	0.99	0.93-1.05	0.70
	3.50 - 5.00	126	0.90	0.75-1.09	0.27
	Longitudinal effect				
	1.00 - <2.50	3209	1		
	2.50 - <3.50	1059	1.08	0.99-1.17	0.09
	3.50 - 5.00	92	1.01	0.79-1.29	0.94
	Hausman test				0.59

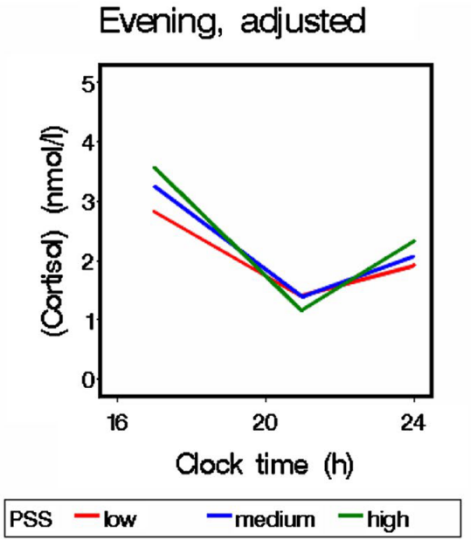
Interactions between diurnal slopes and PSS

None significant









Discussion

Longitudinal and cross-sectional associations between exhaustion and cortisol were estimated in the same model because longitudinal associations may be biased by cross-sectional associations and vice versa*.

Cross-sectional results are based on between person comparisons and may be sensitive to uncontrolled confounding and selection bias.

Longitudinal results are based on within person comparisons. Unmeasured time-invariant factors (eg. personality and physiology) are not confounders for longitudinal associations, but may also be sensitive to time-varying confounding and selection bias.

A significant difference in effect-estimates for cross-sectional and longitudinal associations may indicate insufficient control of time-invariant confounders in the cross-sectional analyses. We found no significant differences.

*Fitzmaurice. Applied longitudinal analysis. Wiley 2011

Previous studies

1. Associations between PSS and HPA-axis functioning are non-consistent
2. Most studies are small and cross-sectional
3. Only few participants with a high level of PSS
4. A few longitudinal studies of PSS-cases
5. No longitudinal studies based on population samples

Conclusion

Changes in perceived stress, measured by the perceived stress scale, was not associated with the level or slopes of the diurnal cortisol trajectory, neither in cross-sectional analyses nor in longitudinal analyses.

Perceived stress was experienced ‘fairly often’ or ‘very often’ during a 4 week period by approximately 2% of participants, and less than 0.5% reported this level of perceived stress both at baseline and at follow-up.