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Full length Research paper

The socioeconomic patterning of perceived stress and hair cortisol in Dutch 10-12 year olds

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The relation between low socioeconomic status and stress in 10 to 12 year olds was examined, using both subjective (self-reports) and objective (hair cortisol concentration) measures of stress. From 33 Dutch 10-12 year olds, data were collected (in April 2014) on the socioeconomic status of the parents (education of the father and mother, mean house value and mean income in the postal area of the child's residence) and stress (reports of stress and self-efficacy and hair cortisol concentration in two segments of individual hair strands). Pearson (partial) correlation and linear regression analyses were used to examine the associations. Most correlations were in the expected direction. Adverse socioeconomic scores correlated with higher stress reports, lower self-efficacy, and higher cortisol levels. Due to the small sample, only two correlations were significant: low education of the mother and reports of both more stress and less self-efficacy in the child (Pearson correlation: 0.44 and–0.43, respectively (p-value = 0.01 for both correlations)). Although the sample was small, the findings clearly suggest a socioeconomic patterning of stress in Dutch 10 to 12 year olds. Adverse socioeconomic conditions, particularly related to the mother's educational level, might predispose children to a heightened susceptibility to stress.

Key words: Children, hair cortisol, mother's education, socioeconomic background, stress.

INTRODUCTION

Low socioeconomic status is known to be related to higher levels of stress (e.g. Baum et al., 1999; Lantz et al., 2005). Working and housing conditions generally are worse in low socioeconomic status groups causing increased concerns and worries. Long-term difficulties, such as financial problems, are much more common as one descends the socioeconomic hierarchy. Simultaneously, social and individual resources for coping with stressors, such as social support and a resilient personality, are also less prevalent at the bottom of the hierarchy (e.g. Mackenbach et al., 1994; Marmot et al., 1991). It is less clear whether such associations of adverse socioeconomic conditions with stress can already be detected in children. Growing up in low socioeconomic status families also exposes the children to the above conditions. Stress in parents might hamper their parenting styles, further compromising resistance to stress in children of parents with low socioeconomic positions. There is a need for more in-depth studies of the socioeconomic patterning of stress in children (e.g. Chen, 2004; Havas et al., 2010). Hence, using socioeconomic and stress measures of 33 Dutch 10 to 12

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year olds, we set out to examine whether the association of low socioeconomic status with stress can already be detected in young teenagers and whether these inequalities in stress can be found with both subjective (self-reports) and objective (hair cortisol concentration (HCC)) (Stalder and Kirschbaum, 2012) measures of stress. One previous study reported an association between low parental education and heightened HCC in pre-school children (Pearson correlation = -0.18; p = 0.001) (Vaghri et al., 2013). The current study contributes by more broadly looking at socioeconomic status, by including both a perceived stress measure and a second HCC measure (allowing the analysis of HCC change), and by containing older children.

MATERIAL AND METHODS

Early 2014, three primary education schools were selected in the South-Limburg region of the Netherlands. Within each school, children from the final two years were selected (these were groups 7 and 8 containing the oldest children). Thirty-three children and their parents gave their informed consent and thus agreed to participate in the study (response rate: 16.8 percent). The children were 10 to 12 years old (mean = 11.41 and SD = 0.63) and 23 (70%) of them were girls. Parents were asked to report their educational level (64% was higher educated, i.e. they had a tertiary higher occupational level or a university education). Eighty to ninety percent of the parents were married and had paid jobs. In May 2014, children were asked to report their levels of stress. The children's hair was cut for measurement of HCC levels on the 19th and 20th of May. Approval for conducting the study was granted by the Medical Ethics Committee of University Hospital Maastricht and Maastricht University (registration number METC 13-4-117).

The 21-items Stress in Children (SiC) questionnaire was used to measure subjective stress (Cronbach's α = 0.84) (Osika et al., 2007). Thinking of "this school year", children could indicate whether particular experiences occurred never, sometimes, often, or very often. An example item is: "I feel lonely". The mean was computed across the 21 SiC items to have a composite stress score. Furthermore, the Self-Efficacy Questionnaire for Children (SEQ-C) having 24 items on the academic, social, and emotional self-efficacy of the children was used (Cronbach's α = 0.88)(Muris, 2001). Children could indicate whether they succeeded not at all, succeeded a bit, succeeded a little bit, succeeded, or succeeded very well in accomplishing varying tasks. An example items is: "How well can you have a chat with an unfamiliar person?". Although, according to social learning theory, not a direct measure of stress perception, self-efficacy describes the persons' beliefs about their ability to handle stressful situations. The mean was computed across the 21 SiC and 24 SEQ-C items to have a composite stress and self-efficacy score. Third, three small hair strands were cut scalp-near from the posterior vertex region of the child's head (n = 28). HCC levels were determined separately for the 0-2 cm segment and for the 3-5 cm segment. Given an average hair growth rate of 1 cm/month, this reflects stress during the past two months ("recent HCC") and stress four and five months ago ("past HCC"). This also allows the analysis of HCC change. Details on the cortisol determination can be found elsewhere (Gao et al., 2013). Analysts were blinded to the characteristics of the children. Educational level of both father and mother were measured with ordinal measures ranging from 1 = no education to 9 = university education. Statistics Netherlands provided data on the mean housing value and the mean fiscal income in the postcode area of the child's residence. As covariates we used age, sex, school group (group 7 or 8). The children were also asked to indicate how often they washed their hair per week. HCC measures can be biased by "washing out"(Dettenborn et al., 2010).

Linear regressions and correlations were used to examine the associations of socioeconomic status with stress. Age, sex, and school group were separately controlled for. The analyses with HCC additionally controlled for hair washing frequency. Sensitivity analyses checked whether findings were similar after log transformation of the HCC measures. Interactions were also tested.

RESULTS

Perceived stress and self-efficacy were more strongly related to past HCC levels than to recent HCC levels (not tabulated). Pearson correlations of perceived stress with past and recent HCC were 0.19 and -0.08, respectively and Pearson correlations of self-efficacy with both HCC measures were -0.27 and -0.02. With some exceptions, most notably related to father's educational level, socioeconomic status indicators were consistently related to the stress measures with partial correlations stronger than -0.15 (Table 1). Having a mother with a high educational level was significantly correlated with less stress perceptions (correlation = -0.44) and higher self-efficacy (0.43). Controlling for age, sex, group (model 1), and the number of times children washed their hair per week (model 2) did not very much affect the pattern of correlations. Sensitivity analyses indicated that log transformations of the HCC variables or using Spearman correlations did not change the general pattern of findings. Of the 48 interactions of the four socioeconomic indicators with age, sex, or school group for the four stress measures, only 3 were statistically significant at the 0.05 level which is about what could be expected by

Table 1. Pearson (unadjusted) and partial (adjusted) correlations between socioeconomic and stress measures, adjusted for age, sex, and school group (model 1) and additionally for the number of times per week that the hair was washed (model 2).

	Hair cortisol concentrations		**Subjective stress**	
	Recent HCC M = 9.09 SD = 5.56	Past HCC M = 7.47 SD = 5.59	Stress M = 2.08 SD = 0.38	Self-efficacy M = 3.44 SD = 0.65
Education father[a]				
Unadjusted	0.04	-0.16	0.03	0.05
Model 1	-0.01	-0.24	-0.03	0.09
Model 2	0.01	-0.21		
Education mother[a]				
Unadjusted	-0.10	-0.14	**-0.44 ***	**0.43 ***
Model 1	-0.15	-0.22	**-0.45 ***	**0.39 ***
Model 2	-0.13	-0.18		
Mean house value (pc) [b]				
Unadjusted	-0.21	-0.27	-0.12	0.45
Model 1	-0.01	-0.20	-0.26	0.22
Model 2	0.06	-0.18		
Mean income (pc) [b]				
Unadjusted	-0.08	-0.02	-0.26	0.30
Model 1	-0.13	-0.11	-0.20	0.17
Model 2	-0.10	-0.04		

[a] Education ranges from 1 = no education to 9 = university education.
[b]pc means variable is on postcode level.
* p< 0.05.

chance (1 out of 20). Mean HCC increased from 7.47 to 9.09 (p-value of paired t-test: 0.04), but the change in HCC was not consistently related to the four socioeconomic indicators (correlations ranging from 0.28 to -0.11).

DISCUSSION

In our sample with thirty-three 10 to 12 year old Dutch children, we found a pattern of higher stress reports, lower self-efficacy, and higher HCC in children whose parents had a low educational level or who lived in an area with poor housing or a low average income. Probably due to the small sample, only having a low-educated mother was significantly related to higher stress reports and lower self-efficacy. Correlations were absent or small for father's educational level, recent HCC levels, and changes in HCC.

Our findings indicate that differential vulnerability to stress, related to socioeconomic conditions, can already be detected in children. Children in adverse socioeconomic conditions may already have been exposed to stress-inducing environmental characteristics, such as poor housing conditions and financial problems. Psychosocial stressors at the parents' work may also spill over into the family and may have chronically aroused the children. Life-events may also be more common(King and Ogle, 2014). In further analyses, we, however, found no indication that children from lower socioeconomic backgrounds had experienced more life-events (not tabulated). Diseases may also be more prevalent in low socioeconomic status children and be a cause of stress. Using medication was, however, not consistently related to the socioeconomic indicators of the children (not tabulated). Controlling the correlations for these possible pathways thus did not change our findings. This further also indicates that the cortisol findings were not biased by glucocorticoid containing medication affecting HCC levels (e.g. asthma medication)(Stalder et al., 2012).

Some limitations should be addressed. First, a major limitation is the small N, the large non-response, and the comparatively high educational level of the participating parents. This might have led to an underpowered study and underestimated associations. An indication for the power problem is that the Pearson correlation between mother's education and HCC in the recent Vaghri study (Vaghri et al., 2013) did not much differ from ours (-0.18 versus -0.10/-0.22), while theirs was statistically significant using a ten times larger study. Second, self-efficacy describes the persons' beliefs about their ability to handle stressful situations and not stress per se(Litt, 1988). We therefore additionally tested whether low socioeconomic status was more strongly related to stress and HCC in the children who scored below the median on the self-efficacy list (compared to the ones who scored

above the median). We, however, found no consistency across socioeconomic measures in the direction of this interaction between socioeconomic status and self-efficacy (not tabulated). Third, some deviations from the socioeconomic patterning may need further study. Mother's educational level was more relevant than father's educational level, but this finding is not uncommon for child health outcomes (Caldwell, 1979). It is unclear why socioeconomic status was more strongly related to the past HCC measure than to the recent measure and why socioeconomic status was not related to changes in HCC.

CONCLUSION

Although the sample was small, the findings clearly suggest a socioeconomic patterning of stress in Dutch 10 to 12 year olds. Adverse socioeconomic conditions, particularly related to the mother's educational level, might predispose children to a heightened susceptibility to stress. More research is needed with larger samples that also look at children of other ages, at the mechanisms through which socioeconomic conditions affect stress in young people, at the consequences for the pupils' school careers and longer-term health, and at what parents, schools, and public health practices could do about tackling stress in children.

CONFLICT OF INTEREST

There were no conflicts of interest.

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