



Hair cortisol, lifetime traumatic experiences and psychopathology in unaccompanied refugee minors

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ABSTRACT

Attenuated cortisol secretion has been linked to traumatic experiences and the developmental psychopathology. Unaccompanied refugee minors (URM) form a highly vulnerable group in this context, usually exposed to multiple and severe traumatic experiences and characterized by a high, comorbid symptom-load. Here, we provide a first investigation in URM seeking to elucidate associations between long-term cortisol output, assessed through hair cortisol concentrations (HCC), lifetime traumatic events and psychological symptoms. Ninety-one male URM from Syria and Afghanistan (mean age = 17.4 years), living in group homes of the Child Protection Services in Leipzig, Germany, were examined. HCC were measured from scalp-near 3 cm hair segments and data on LTE, PTSD symptoms, depression, anxiety and somatic symptoms as well as emotional and conduct problems assessed. Results revealed HCC to be negatively related to lifetime traumatic events (total number, trauma types). In addition, a tentative finding of a positive association between HCC and emotional problems emerged. Results are discussed with regard to their relevance for HCC as a biomarker of the long-term endocrine consequences of chronic adversity and trauma exposure.

1. Introduction

Activity of the hypothalamic-pituitary-adrenal (HPA) axis with its downstream endocrine effector cortisol is frequently assessed in research investigating the impact of chronic adversity on mental health and psychological functioning. The assessment of cortisol secretion in such research is traditionally conducted using blood, salivary or urinary sampling. While these methods are well-suited for capturing short-term cortisol output, their results exhibit high situational variability and thus provide only a poor reflection of long-term secretory patterns. Over the past decade, the analysis of hair cortisol concentrations (HCC) has gained acceptance as a reliable, valid and robust strategy to assess cumulative long-term cortisol secretion (reviews: [Staufenbiel et al., 2013](#); [Stalder et al., 2017](#)).

One particular interest of research utilizing HCC assessments has been to investigate long-term endocrine dysregulation linked to severe adversity, trauma exposure and ensuing psychopathology. The overall picture emerging from such research suggests that, after an initial phase of hypercortisolism, trauma exposure eventually results in a dose-dependent attenuation of long-term cortisol output (review: [Steutte-Schmiedgen et al., 2016](#)). Furthermore, it has been proposed that such long-term cortisol attenuation may not merely be an endocrine

correlate of severe adversity/trauma but could indeed be part of a risk mechanism for developmental psychopathology ([White et al., 2017](#)) or posttraumatic stress disorder (PTSD; [Steutte-Schmiedgen et al., 2016](#)). Despite such conceptions, specific evidence linking HCC to psychiatric symptoms or particular disorders, e.g. mood disorders/depression, has not always been consistent (review: [Stalder et al., 2017](#)); thus, warranting further research in this area.

While endocrine dysregulation in the context of trauma and psychopathology has often been studied in Western populations, such adverse conditions are even more prevalent in the worldwide increasing group of war-affected and/displaced individuals, who are frequently exposed to multiple stressors, such as armed conflicts, terror, torture or violence ([UNHCR, 2017](#)). However, research utilizing HCC assessments in such population is relatively scarce to date. The present study seeks to extend current evidence on the interrelations between trauma exposure, endocrine dysregulation and psychopathology in this context by studying a group of unaccompanied refugee minors (URM), a particularly vulnerable subgroup of refugees with multiple, cumulative and severe trauma and symptom load ([Witt et al., 2015](#)). Following previous evidence linking trauma exposure to HCC ([Steutte-Schmiedgen et al., 2016](#)) and, specifically, data from one recent study on asylum seekers ([Mewes et al., 2017](#)), we predicted HCC to be negatively associated

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Table 1
Descriptive sociodemographic and psychometric data and associations of study variables with hair cortisol concentrations.

	Descriptives		Associations with HCC	
	M	SD	r	95% CI
Age ^a	17.40	1.17	-.045	-.257, .170
BMI ^b	22.05	3.10	-.017	-.176, .150
Education in the country of origin ^a	6.60	3.10	.034	-.250, .334
Length of the flight ^a	0.70	1.10	-.130	-.345, .085
Length of stay in Germany ^a	1.70	0.60	.150	-.136, .382
Hair cortisol concentration, HCC ^c	1.56	0.21		
Lifetime trauma, total number (LEC-5 total)	10.55	5.62	-.252 [*]	-.449, -.273
Lifetime trauma, different types (LEC-5 types)	7.68	3.04	-.273 [*]	-.461, -.076
PTSD symptoms (PCL-5) ^c	1.24	0.80	.112	-.136, .341
Depression symptoms (PHQ-9) ^c	0.93	0.72	.061	-.204, .315
Anxiety symptoms (GAD-7) ^c	1.00	0.66	.177	-.074, .401
Somatic symptoms (SSS-8) ^c	0.94	0.80	.116	-.144, .374
Emotional problems (SDQ) ^d	4.64	2.26	.247 [*]	.014, .468
Conduct problems (SDQ) ^d	2.20	1.72	.016	-.217, .236

Note: Information on abbreviated questionnaires is provided in the text. esum score.

^a in years.

^b kg/m².

^c pg/mg, log-transformed.

^d mean score.

* $p < .05$.

with different measures of lifetime trauma exposure. Given recent meta-analytic data, we also predicted HCC attenuation in anxiety disorders (PTSD, anxiety symptoms; Stalder et al., 2017). Finally, given the less consistent evidence on associations with mood disorders (Stalder et al., 2017) and insufficient data on other psychological symptoms (i.e., somatic symptoms, behavioral problems), we raised no specific hypotheses for these variables.

2. Method

2.1. Participants

A total of 142 Arabic and Dari-speaking male URM were contacted in 13 large group homes ($n > 5$ URM) in Leipzig, Germany between June to August 2017. A flow diagram illustrating sample recruitment is provided in Figure S1 of the Supplementary Material. The final sample were 91 male URM, 14–19 years old ($M = 17.40$, $SD = 1.17$) from Afghanistan (58.2%), Syria (36.3%) and other countries (5.5%) (see Table 1 for further characteristics).

2.2. Procedure

After approval by the ethics committee of the Medical Faculty of the University of Leipzig, the study was conducted in residential group homes of the Youth Welfare Office in Leipzig in accordance with the Declaration of Helsinki. Inclusion criteria were comprehension and speaking of Arabic, Dari or German language and the participant's and the legal guardian's written informed consent. Appointments were made with group home caregivers, URM, and interpreters working for the study. URM were fully informed about the study and written consent was obtained. Emphasis was placed on the voluntary nature of participation, the exclusively anonymous processing of data, and the fact that results had no influence on the asylum procedure and residence status. Questionnaires (see below) were available in Arabic, Farsi and German, and were completed with the help of interpreters. Anthropometric measurements of height and weight were conducted and participants' body-mass-index (BMI; kg/m²) was calculated.

2.3. Trauma-related and psychological measures

Lifetime incidence of traumatic events was assessed using the LEC-5 (Weathers et al., 2013a), a 17-item self-report screening instrument recording traumatic events in accordance with the DSM-5 A criterion of PTSD. Of this scale, we derived a score capturing the total number of different trauma types ($n = 13$) as well as a score of the overall number of traumas experienced. A detailed description of this calculation is provided in S2, Supplementary material.

PTSD symptoms were measured using the 20-item *Posttraumatic Stress Disorder Checklist for DSM-5* (PCL-5; Weathers et al., 2013b), which covers the four PTSD symptom clusters rated on a five-point scale. Depression symptoms were measured with the 9-item *Patient Health Questionnaire* (PHQ-9; Kroenke et al., 2001; four-point scale), whereas symptoms of anxiety as well somatic symptoms were assessed using the 7-item *Generalized Anxiety Disorder Scale* (GAD-7; Spitzer et al., 2006; four-point scale) and the 8-item *Somatic Symptoms Scale* (SSS-8; Gierk et al., 2014; five-point scale), respectively. Emotional and conduct problems in the last six months were assessed using the 25-item *Strength and Difficulties Questionnaire* (SDQ; Goodman, 1997; three-point scale). All scales provided sufficient to excellent internal consistencies (α s between .68 and .92). In addition, sociodemographic data (i.e., age, length of the flight, length of stay in Germany, education) were assessed.

2.4. Hair cortisol concentration

Hair strands (~3 mm diameter) were cut as close as possible to the scalp from the posterior vertex region. The proximal 3 cm hair segment was used for analyses. Based on a mean hair growth rate of 1 cm per month, this hair segment contains hair grown over the 3-month period prior to hair sampling. Cortisol concentrations in hair HCC were determined using liquid chromatography tandem mass spectrometry (LC-MS/MS) according to a previously published protocol (Gao et al., 2013). Analyses were conducted at the TU Dresden laboratory, Germany (Clemens Kirschbaum).

2.5. Statistical analysis

Cortisol data were log-transformed to normalize the distribution and extreme values ($> 2SD$ from the mean; pre-log HCC > 90 pg/mg). Preparatory analysis investigated associations with sociodemographic and anthropometric variables using correlation analyses. Subsequently, continuous associations between HCC, trauma-related and psychological symptoms were conducted using Pearson correlations including calculations of 95% confidence intervals (CI) based on 1,000 bootstrap samples. Statistical analyses were performed using IBM SPSS version 24 with a two-tailed alpha level of .05.

3. Results

Table 1 presents descriptive data as well as the results of associations with HCC including estimates of 95% CI. Preparatory analyses revealed no significant associations of HCC with sociodemographic characteristics or BMI (all $ps > .05$). Detailed additional information on inter-correlations between sociodemographic characteristics, BMI and individual psychological variables are provided in Table S3, Supplementary material.

The main analyses revealed inverse associations of HCC with the total number of lifetime traumatic experiences (LTE; $r = -.25$, $p = .022$) and with the number of different trauma types ($r = -.27$, $p = .013$). Moreover, HCC were found to be positively associated with SDQ emotional problems ($r = .25$, $p = .026$). Fig. 1, shows scatter plots displaying these correlations. No significant associations between HCC and other psychological variables were found. This overall pattern of results remained the same when controlling for age or

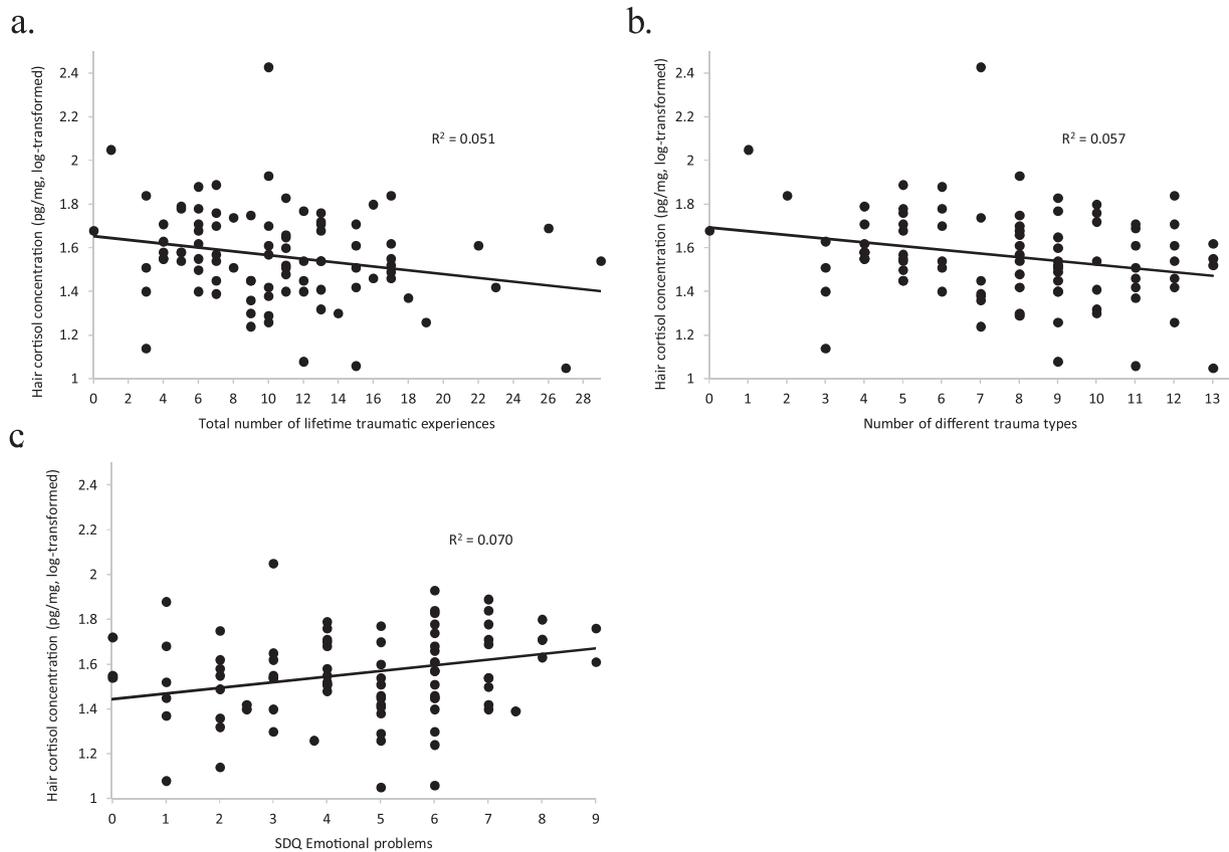


Fig. 1. Scatterplots illustrating associations of hair cortisol concentration (pg/mg, log-transformed) with (a) the total number of lifetime traumas, (b) number of different trauma types, and (c) SDQ emotional problems in URM.

sociodemographic variables in partial correlation analyses (data not shown).

4. Discussion

The present study investigated associations between long-term hair cortisol levels, lifetime traumatic experiences and psychological symptoms in a sample of unaccompanied refugee minors (URM). Our main results reveal HCC to be negatively related to two different measures of lifetime traumatic experiences, the total number of traumas and the number of different trauma types. These findings are consistent with our hypothesis and with previous evidence suggesting that, after an initial phase of hypercortisolism, trauma exposure eventually results in a dose-dependent attenuation of long-term cortisol output (review: Steudte-Schmiedgen et al., 2016). The present data corroborate the principal notion of an attenuation of long-term cortisol output with trauma exposure. Our data also partly correspond with a recent study using HCC assessments in asylum seekers, reporting a hypercortisolemic pattern in asylum seekers still suffering from under insecure living conditions but relative hypocortisolism in permanently settled asylum seekers (Mewes et al., 2017). Unfortunately, we did not collect data on the temporal characteristics of trauma exposure and/or settlement status and thus could not investigate whether such a diverging pattern was also present in the current sample. Still, it has been proposed that the transition from initial hypercortisolism to a hypocortisolemic pattern, amongst other things, might occur when individuals leave the unsafe, trauma-related environment and enter a state of relative safety (Steudte-Schmiedgen et al., 2016). Given that refugees in the present study were examined at a time when they had already been living for 19 months in sheltered accommodation in Germany, it could be speculated that most individuals might have already transitioned into the hypocortisolemic phase; an interpretation matching our

principal findings.

Besides negative associations with trauma exposure, we observed evidence showing HCC to be positively related to self-reported emotional problems, but not with any of the other symptoms (PTSD, depression, anxiety, somatic symptoms, conduct problems). Given the lack of a clear *a priori* hypothesis concerning the association with emotional problems, this finding needs to be viewed as tentative and should be further investigated in future research. Even more so, the observed positive association with emotional symptoms is generally at variance with recent data from a larger child and adolescent sample, reporting negative associations of HCC with internalizing symptoms in adolescents (White et al., 2017). However, this study observed also consistent negative associations with externalizing symptoms, which was also not matched by the present results for conduct problems. Finally, the lack of consistent HCC associations with depression symptoms, although surprising on a theoretical basis, matches recent HCC meta-analytic data revealing no consistent associations with mood disorders or self-reported depressiveness (Stalder et al., 2017). One factor that may have contributed to the weak associations of HCC with symptom scales is that symptom levels on all scales were in the lower range – a finding that is unexpected for a sample of URM (Witt et al., 2015). It has been suggested that consistent psychoendocrine covariance may particularly arise in groups characterized by very severe adversity (Stalder et al., 2017), meaning that the relatively low symptom range may have made it more difficult to detect consistent associations with HCC in the present study. However, the SDQ emotional problems scale includes various symptoms (somatic problems, feelings of worries, sadness and anxiety), and thus represent a comorbid symptom scale, with higher scores indicating a higher comorbidity of (emotional) symptoms, and a more severe symptom load. Another noteworthy fact relates to the different time frames of psychological measures: anxiety and depression ratings covered only the last two

weeks whereas emotional and behavioral problems were assessed over the last six months. The latter may correspond more closely to HCC, which also captures integrated cortisol secretion over a three-month period. This could have further contributed to the observed HCC association with emotional problems.

Limitations of the current study involve the exclusive focus on male participants. This was due to practical reasons of URM in Germany being predominantly male and limits the generalizability of the present findings to females. Furthermore, it is important to state that not causal inferences should be made from the present cross-sectional findings and that future research providing more detailed longitudinal analyses and insights into HCC trajectories will be needed in this context.

Conflict of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.psyneuen.2019.03.003>.

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