Cumulative Adversity Predicts Toddler Hair Cortisol through Mother’s Hair Cortisol

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INTRODUCTION

Cumulative adverse experiences have long-term consequences on children. Cumulative adversity (from relationships, physical environment, nutrition; may affect child development via biological chronic stress embedding during sensitive, early development (Figure 1)

![Figure 1. Ecobiodevelopmental Framework](image)

Although often measured by salivary cortisol reactivity, chronic stress in children may be better reflected through hair cortisol concentration (HCC). Very high or very low levels of HCC reflect physiologic chronic stress, very low levels suggest blunted stress reactivity.

AIM

Prior research examined relationship between adversity and adult HCC; research in early childhood is lacking. The aims here are to examine:

a) The relationship between early adversity and toddler chronic stress (via HCC)

b) If this relationship is indirectly linked through mother’s chronic stress (via HCC)

METHODS

Participants

Subsample of low-income mothers and children from a Midwestern metropolis who were participating in a longitudinal birth cohort study (n = 142)

Prolonged Stress Measure

Four cm of hair proximal to the posterior vertex of the scalp (> 4 months of average cortisol secretion) was ground, processed, and analyzed for HCC via immunoassay using Salimetrics® cortisol kit. HCC calculated in pg/mg, aided by MyAssays®, In-transformed for normalization.

Adversity Measure

Sum of adversities theorized on the ecobiodevelopmental framework (possible range 0-8):

1. Home Observation for Measurement of the Environment added to Supplemental HOME for Impoverished Families: ≤ 25th percentile of sample (20-24 mos)

2. Chaos, Hubbub, and Order Scale short form

3. 200% poverty level or below

4. ≤ high school education for mothers

5. Parent Stress Index Short Form 85th percentile or above

6. Center for Epidemiological Studies-Depression score 6 or above

7. Not married or living with partner

8. Food insecurity (score ≥ 2) (15-19 mos)

Controls

Mother race Black (vs. other), weeks pregnant at HCC sampling, father support to dyad, toddler physical environment

Statistical Analyses

SPSS version 25 and PROCESS for mediation analysis

RESULTS

Table 1. Participant characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD) or N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at HCC (months)</td>
<td>22.6 (1.3)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male 54, Female 98</td>
</tr>
<tr>
<td>Race</td>
<td>Black 60, White 62</td>
</tr>
<tr>
<td>Education</td>
<td>≤ High School 88, &gt; High School 32</td>
</tr>
<tr>
<td>Income</td>
<td>Low Income 84, High Income 16</td>
</tr>
<tr>
<td>Maternal HCC (pg/mg)</td>
<td>26.6 (5.2)</td>
</tr>
<tr>
<td>Paternal HCC (pg/mg)</td>
<td>22.7 (1.6)</td>
</tr>
<tr>
<td>Toddler HCC (pg/mg)</td>
<td>23.3 (1.3)</td>
</tr>
<tr>
<td>Mother race Black vs. Other</td>
<td>Black 60, Other 62</td>
</tr>
<tr>
<td>Mother weeks pregnant at HCC</td>
<td>22.6 (1.3)</td>
</tr>
</tbody>
</table>

Note: n = 54 dyads participated in hair cortisol collection. Mother-child dyad HCC values were excluded if the mother did not provide hair. Flow: 2, (1) The HCC was an overall outlier in the distribution of HCC values for the whole cohort. These outliers, 30% reported corticosteroid use, which can alter cortisol levels. Adversity scores reported without missing values.

CONCLUSIONS

Cumulative adversity is associated with a blunted stress response, or “biological burn out”, in the mother, which in turn is associated with increasing levels of biologic chronic stress in the child. This is one of the first studies that demonstrates how early adversity and maternal chronic stress affects the chronic stress in children, measured via HCC.

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