Adverse Childhood Experiences and Salivary Oxytocin in Mothers With a History of Substance Abuse

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Introduction

Oxytocin is a peptide hormone and neuropeptide that is produced by the hypothalamus and released by the pituitary gland. Along with several physiological effects within the body, research has shown oxytocin is involved in regulating various social behaviors, particularly within the maternal-child relationship. These include regulating maternal bonding, parental sensitivity to child distress, the exchange of social cues between a mother and infant, and the facilitation of healthy maternal-child attachment (Feldman et al., 2010; Scatliffe et al., 2019; Szymanska et al., 2017). The role oxytocin plays in pair bonding and attachment has also been shown to reduce the neurophysiological and neurochemical effects trauma has on the brain by facilitating healthy psychological and social attachment, which likely increases resilience to traumatic events. However, research also suggests emotional trauma, particularly early or chronic trauma, may impair oxytocin production later in life, and decreased oxytocin has been associated with experiences of childhood abuse, maltreatment, and dysfunctional parent-infant relationships (Donadon et al., 2018; Szymanska et al., 2017). Recent research suggests the impact trauma has on decreased oxytocin production later in life is likely due to long-term impairments in hypothalamic structures and negative feedback mechanisms within the hypothalamic-pituitary-adrenal (HPA) axis. Specifically, oxytocin plays a role in the negative feedback mechanisms of cortisol and helps ensure a return to baseline cortisol levels after exposure to psychologically stressful stimuli. Under situations of chronic stress especially during early childhood, the functioning of the suprachiasmatic nucleus can become impaired over time, which likely decreases the production and distribution of oxytocin later in life (Donadon et al., 2018).

Despite this growing body of research, the association between salivary oxytocin and early childhood trauma has largely gone unexplored, partly due to past challenges in salivary oxytocin measures and debates over their efficacy. In addition, salivary oxytocin measures have rarely been used in combination with the Adverse Childhood Experiences (ACE) questionnaire, a widely supported questionnaire for measuring childhood maltreatment and household dysfunction (Osofsky et al., 2021). Similarly, there is little research on the association between early childhood trauma and oxytocin production in the high-risk population of mothers of infants with a history of substance use disorders (SUDs). The aim of this preliminary investigation is to examine the association between ACE scores and salivary oxytocin in mothers with a history of SUDs, making use of novel salivary immunoassay techniques recently developed and validated by Salimetrics LLC.

Research Question

Is baseline oxytocin negatively associated with early childhood trauma measured through salivary oxytocin and the ACE questionnaire?

Method

Participants

The sample included 10 mothers participating in a six-week infant parenting program for mothers of newborns. All mothers were recruited from a local residential treatment facility for mothers with a history of SUDs. Participants' age ranged from 22 to 36 years (*M* = 28.38, *SD* = 4.87), excluding two participants who did not report their age.

Procedure

Prior to the start of the program baseline maternal salivary oxytocin was collected using passive drool between 9:30 and 10:30am to control for daytime oxytocin fluctuations. Samples were stored at -80°C until being transported on dry ice to be assayed. At the end of the six-week program participants completed the ACE questionnaire, a 10-item questionnaire commonly used to assess various types childhood abuse, neglect, and exposure to household dysfunction (Felitti et al., 1998). ACE scores range from 0-10, with ACE scores four or higher indicating increased risk of disease, social, and emotional problems. After all data was collected, saliva samples were assayed in triplicate by Salimetrics LLC using a novel electrochemiluminescence method. The relative coefficient of variation for all samples was less than 20-30%. Sample test volume was 25 µL of saliva per determination, with an assay lower limit of sensitivity of 8pg/mL. Two out of the 30 total determinations were below the lower limit of sensitivity.

Results

This preliminary investigation aimed to contribute to previous findings showing an association between early childhood trauma and oxytocin production later in life, using the ACE questionnaire and novel salivary oxytocin measures. See Table 1 for relevant descriptive statistics.

Results of a Spearman's rho correlation found a strong, significant negative correlation between baseline maternal salivary oxytocin and ACE scores **(*r* = -0.81, *p* = 0.004)**. See Table 2 for correlation statistics.

- As participants' ACE scores increased, indicating more adverse childhood experiences, their baseline salivary oxytocin decreased.
- A Spearman's rho correlation was used to analyze the data rather than other correlation methods as two of the total 30 oxytocin assays were left censored (below the lower limit of sensitivity) and it has been argued the rank order method of Spearman's rho is a more accurate analysis in cases of left censored data (Ahmadi et al., 2021).

These results support prior research suggesting early childhood trauma reduces oxytocin production later in life, and this association can be studied using salivary oxytocin and ACE questionnaire measures.

- Results also suggests this association exists in mothers of infants who have a history of SUDs.

Results Continued

Table 1

Descriptive Statistics for Baseline Salivary Oxytocin and Mean ACE Score

Variable	N	M	SD	Min.	Max.	Skewness
Baseline Oxytocin	10	20.96	10.09	1.56	32.20	-0.74
ACE Score	10	6.80	2.62	3	10	-0.19

Table 2

Correlation Matrix for Baseline Salivary Oxytocin and Mean ACE Score

		Baseline Oxytocin	ACE Score
Baseline Oxytocin	Spearman's rho	—	
	p-value	—	
ACE Score	Spearman's rho	-0.81**	—
	p-value	0.004	—

Note. *p < .05, **p < .01, ***p < .001

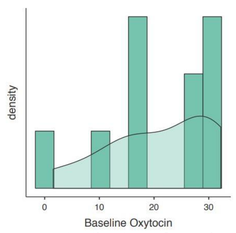


Figure 1. Distribution of Baseline Oxytocin

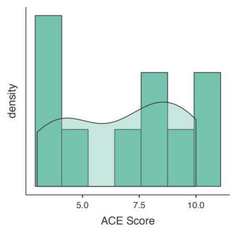


Figure 2. Distribution of ACE Scores

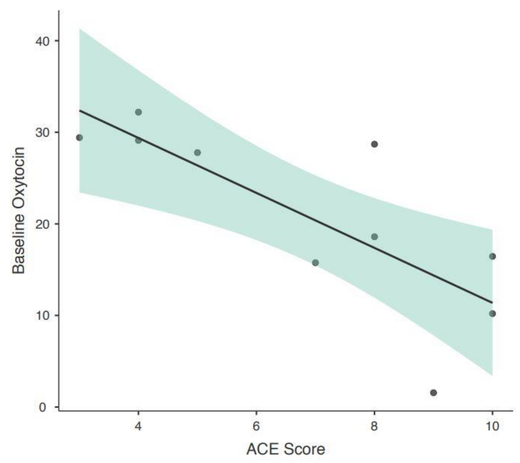


Figure 3. Correlation between salivary oxytocin at baseline and ACE score

Conclusions and Implications

Findings

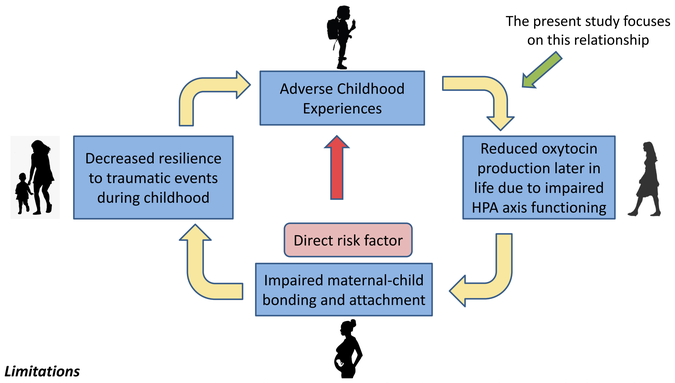
This pilot study supports previous findings showing a negative correlation between early childhood trauma and adult oxytocin production. Results expand previous work by demonstrating this association between salivary oxytocin measures and the ACE questionnaire. Specifically, as ACE scores increased baseline maternal salivary oxytocin decreased, and these variables were highly correlated. This study uses a unique combination of measures that have rarely been used to explore this association, as well as a novel salivary oxytocin immunoassay. Findings of the present study also suggest this correlation can be seen in the much less studied population of mothers of infants with a history of SUDs.

Implications

Given previous research on the role of oxytocin in maternal-child bonding and attachment, these findings suggest oxytocin may be one way in which the intergenerational impacts of early childhood trauma can be understood. Specifically:

- Impaired oxytocin production may be a pathway in which the effects of early childhood adversity can be transmitted to future generations.
- Exposure to early childhood adversity likely impairs HPA axis functioning, decreasing oxytocin production later in life.
- Decreased oxytocin has been linked to impaired maternal-child bonding and attachment, which acts both as a direct risk factor for adverse childhood experiences and reduces resilience to traumatic events during childhood.
- This decreased oxytocin production may increase the likelihood of adverse childhood experiences as well as making the neurophysiological effects of trauma more severe in children of mothers with a history of trauma.
- This may encourage the continuation of this cycle in new mothers as they progress through life and pass these risk factors on to new generations, with oxytocin acting as a pathway through which this may occur. See Figure 4.

Figure 4. Oxytocin and Adverse Childhood Experiences: A Potential Pathway for the Intergenerational Impacts of Maternal Childhood Trauma



Limitations

As a preliminary investigation, the small sample size significantly reduces the generalizability of these findings. Additionally, baseline oxytocin was based on a single sample for each participant to avoid confounding effects of an intervention the participants later took part of. However, interactions between hormones and trauma are complex and multifaceted, and there may be other confound variables influencing this relationship. Finally, while the results support previous findings on the effect of trauma on oxytocin production in general, research suggests peripheral oxytocin should not be used to estimate specific oxytocin levels within the brain (Valstad et al., 2017).

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