Decelerated Development of Rostral Anterior Cingulate Cortex Linked to Childhood Trauma

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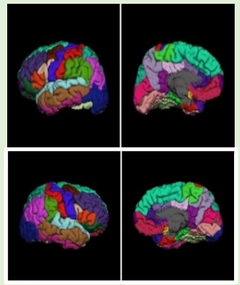
DETROIT TRAUMA PROJECT

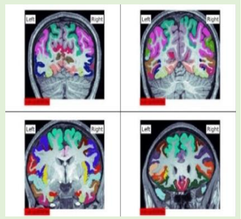
BACKGROUND

- Childhood trauma exposure is a major risk factor for subsequent stress-related psychopathology including generalized anxiety (GAD), major depression (MDD) and post-traumatic stress disorder (PTSD).
- Alterations in prefrontal cortical (PFC) development during childhood may affect emotion regulation and executive functioning underlying psychiatric illness. The amygdala is a critical brain structure that detects threat and initiates sympathetic arousal. The medial PFC regulates and dampens amygdala reactivity to stress.
- **We hypothesized that higher trauma severity will be related to decelerated development of the prefrontal cortical regions during age 9-11, hence moderating future psychopathology risk.**

METHODS

Participants: 58 children (35 F) were scanned at age 9 y/o, and 41 of those children were scanned again at age 11 y/o, with 36 (20 F) having usable MRI data.
Procedures: T1 weighted structural images were acquired using 3T scanner. Trauma exposure scores using VEXR[1] and PTSD scores using the UCLA-RI[2] were collected at both visits.
Data analysis: MRI data were analyzed and visualized using Freesurfer[3] software. ENIGMA structural protocols were used to quality check cortical parcellations. Median split was done to separate children into higher and lower trauma group.
Regions of Interest: Rostral anterior cingulate cortex (rACC), medial orbitofrontal cortex (mOFC), frontopolar cortex (FPC), amygdala, hippocampus, gray matter volume, and total cortical volume.





RESULTS

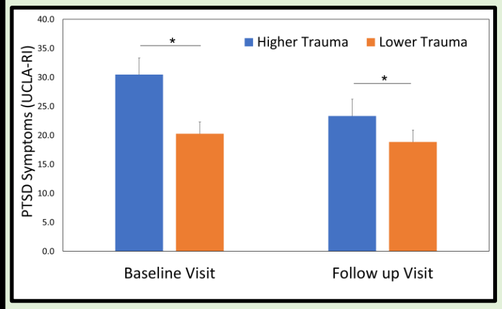


Figure 1: Children with higher trauma have greater PTSD symptoms at both visits compared to children with lower trauma.
V1: F= 7.95, p= 0.008
V2: F= 5.38, p= 0.026

Group Differences between Higher and Lower Trauma	F	p
Change in Amygdala Volume	0.1968	0.660
Change in Hippocampal Volume	0.0314	0.860
Change in rACC Volume	**7.4938**	**0.010**
Change in mOFC Volume	0.9861	0.330
Change in FPC Volume	0.8363	0.367
Change in Gray Matter Volume	0.8617	0.360
Change in Total Cortical Volume	0.0105	0.919
Change in rACC Thickness	**5.1269**	**0.033**
Change in mOFC Thickness	0.6763	0.417
Change in FPC Thickness	0.3258	0.572
Change in Cortical Thickness	0.8520	0.362

Table 1: Corticolimbic changes during age 9-11 between higher and lower trauma group.

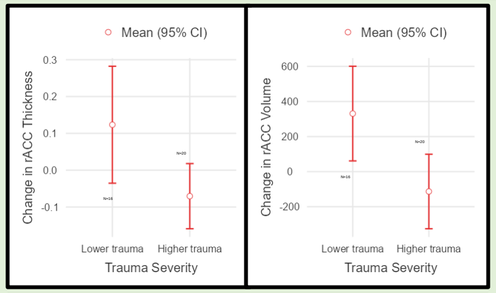
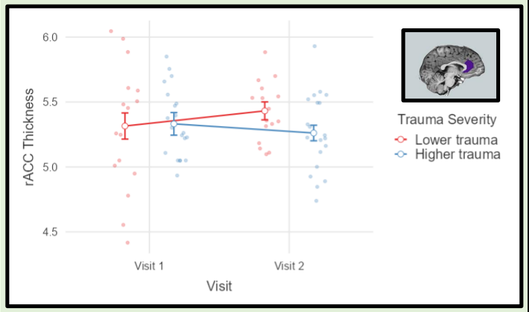


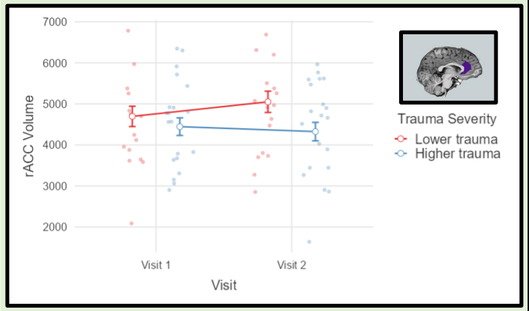
Figure 2: Change score (V2 – V1) in rACC thickness and volume was lower in higher trauma group.
Thickness: F= 5.13, p= 0.03
Volume: F= 7.49, p= 0.01

RESULTS



Main Effects and Interactions	F	p
Visit	1.048	0.314
Trauma Severity	0.5108	0.480
SEX	0.0651	0.800
Difference_ICV	1.3249	0.258
Visit ✻ Trauma Severity	**4.796**	**0.036**
Visit ✻ SEX	0.389	0.537
Visit ✻ Difference_ICV	0.769	0.387

Figure 3: Trauma severity interacts with visit between scans to predict change in rACC thickness.
(F= 4.80, p=0.036)



Main Effects and Interactions	F	p
Visit	0.0433	0.836
Trauma Severity	2.20	0.148
SEX	**12.06**	**0.001**
Difference_ICV	3.02	0.092
Visit ✻ Trauma Severity	**7.8250**	**0.009**
Visit ✻ SEX	0.5005	0.484
Visit ✻ Difference_ICV	0.0324	0.858

Figure 4: Trauma severity interacts with visit between scans to predict change in rACC volume.
(F= 7.83, p=0.009)

CONCLUSIONS

A subregion of the prefrontal cortex, rostral anterior cingulate cortex (rACC), shows decelerated growth of thickness and volume between age 9 and 11 in children with higher trauma exposure

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