

Right Caudate Volume and Parent Ratings of Executive Functions in Pediatric Attention-Deficit/Hyperactivity Disorder (ADHD)

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Introduction

- Attention-deficit/hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder (5-9% prevalence rate).
- Symptoms include inattention or hyperactivity and impulsivity, which increases the risk for lower academic performance, accidents and injury, and additional mental health disorders.
- Children with ADHD also struggle with executive function (EF) deficits related to working memory and inhibition.
- Previous research has shown ADHD-related volume differences in the thalamus, hippocampus, caudate, and putamen, but the potential correlation between subcortical volume and parent ratings of EF skills remains unknown.
- Identifying subcortical brain areas that correlate with EF parent ratings may help identify novel treatment targets for future therapeutic interventions.

Hypothesis

ADHD group will have smaller caudate, and putamen volume compared to typically developing controls (TDC)

Children with ADHD will have increased EF challenges reported by parents

Negative correlation between subcortical volume and EF skills

Methodology

Participants

- 24 children diagnosed with ADHD (mean age = 11.64, SD = 2.54 years; 12 M)
- 25 TDC (mean age = 11.09, SD = 2.49 years; 14 M)

Test Measures

- Parents completed EF ratings scales; BRIEF-2

Magnetic Resonance Imaging Acquisition (MRI)

- T1-weighted anatomical MRI scans (32 channel head coil, 3T GE 750w scanner)
- All children were ADHD medication-free.
- Scans were analyzed in Free Surfer 6.0 for subcortical volumes.

Results

- Executive Function Group Differences
- Parents of children with ADHD reported significantly more executive function challenges on the BRIEF-2 compared to the TDC group, $F(5,43) = 20.89, p < .001$, partial eta square = .71).
- Subcortical Group Differences:
- No significant group difference in volume was observed between children with ADHD and TDC group, $F(4,41) = .79, p > .05$, partial eta square = .07).

Correlations

- Pearson correlations demonstrate negative correlations between right caudate volume and parent ratings of emotion regulation ($r = -.52, p = .009$) in the ADHD group
- No correlations were observed between ADHD symptoms and volumes of subcortical regions
- Linear Regression was completed with BRIEF-2 ERI subscale and right caudate volume
 - Significant amount of the variance in the BRIEF-2 ERI subscale was explained by the right caudate volume ($F(1, 22) = 7.85, p = 0.01, R^2 = 0.263$).

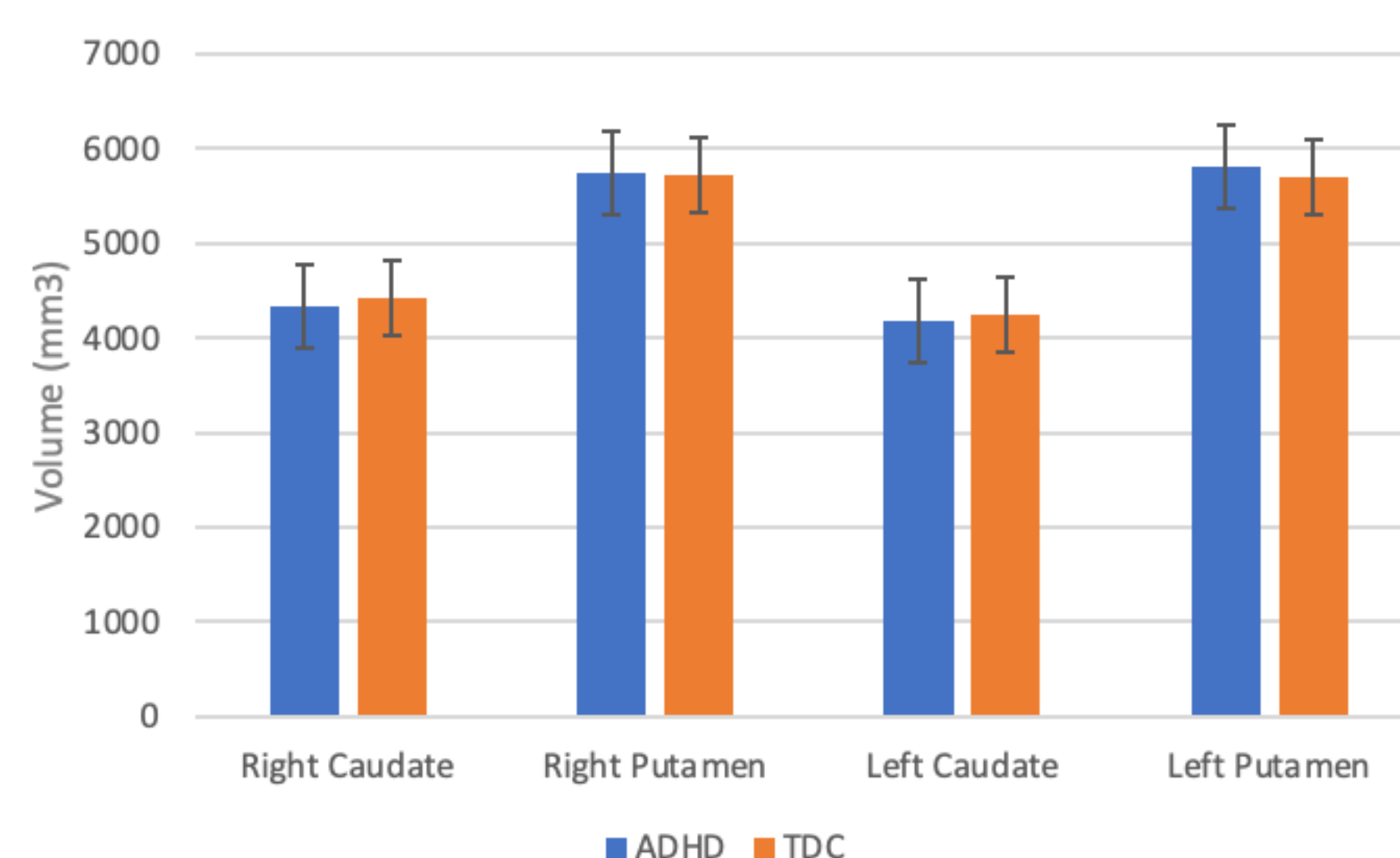


Figure 1: Subcortical Volume Difference between Children with ADHD and the TDC group

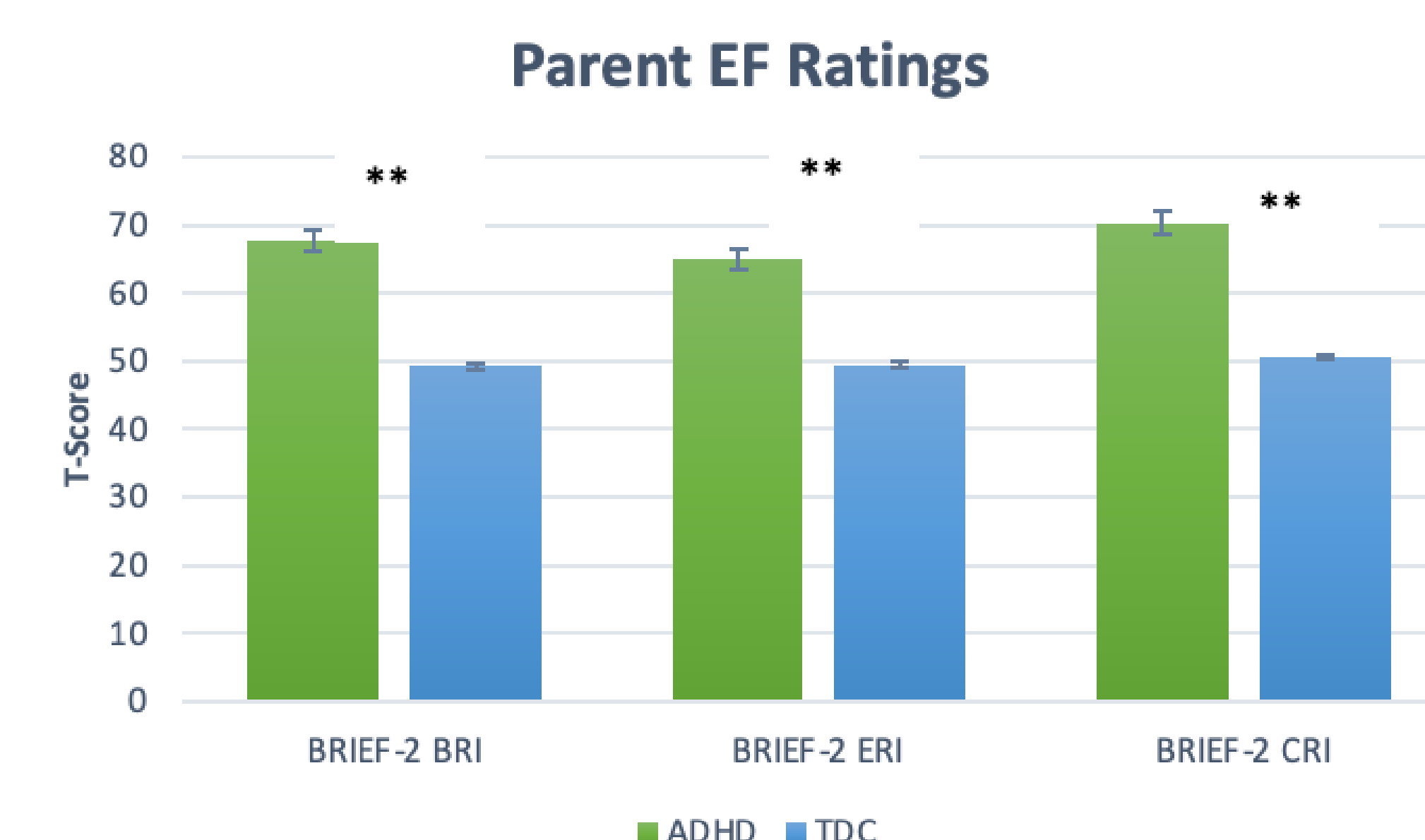


Figure 2: Executive Function Challenges reported on the BRIEF-2 by parents of Children with ADHD and the TDC group

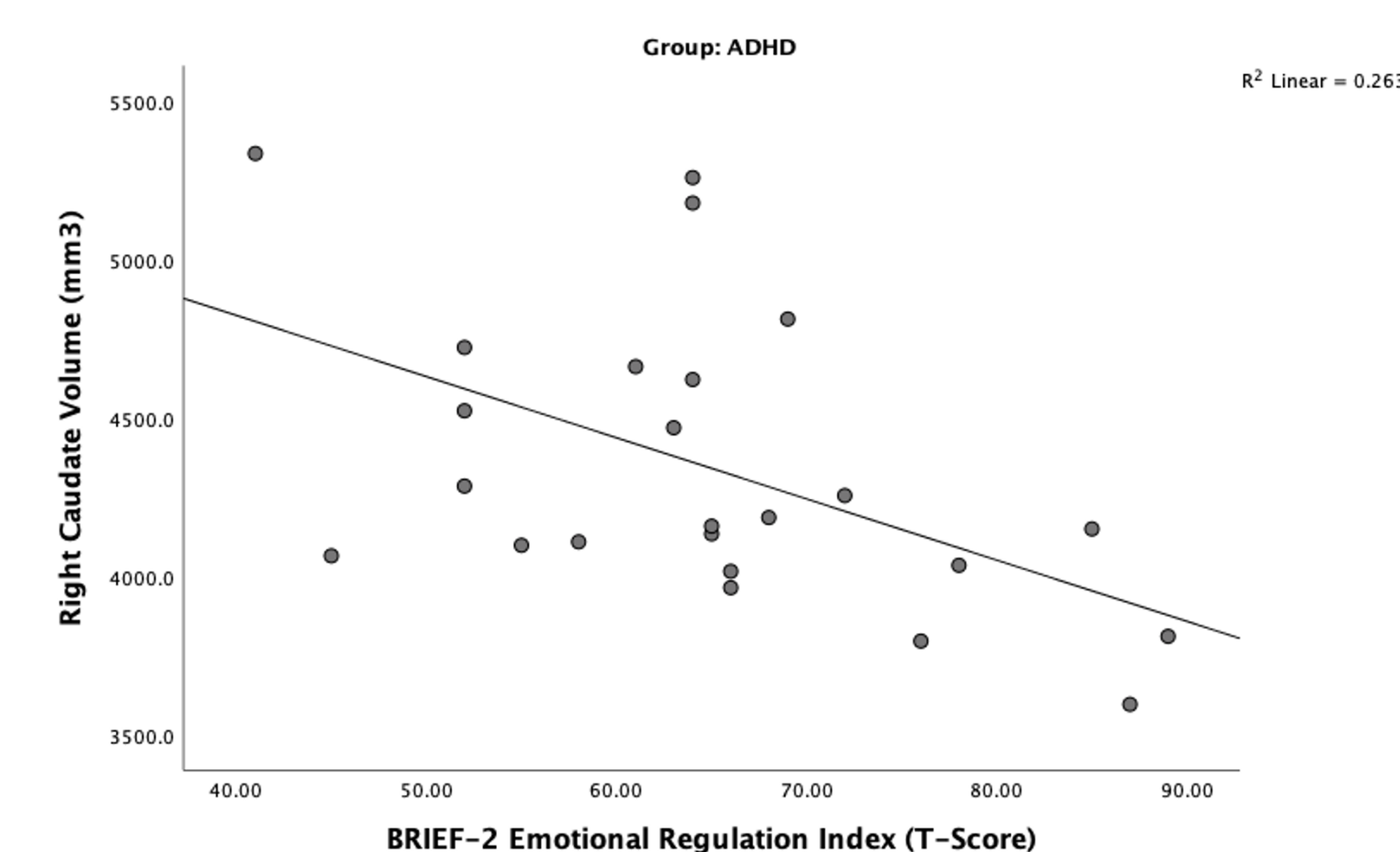


Figure 3: Correlations of BRIEF-2 Emotional Regulation Index score with Subcortical volume of the Right Caudate (Rcaud) across ADHD group

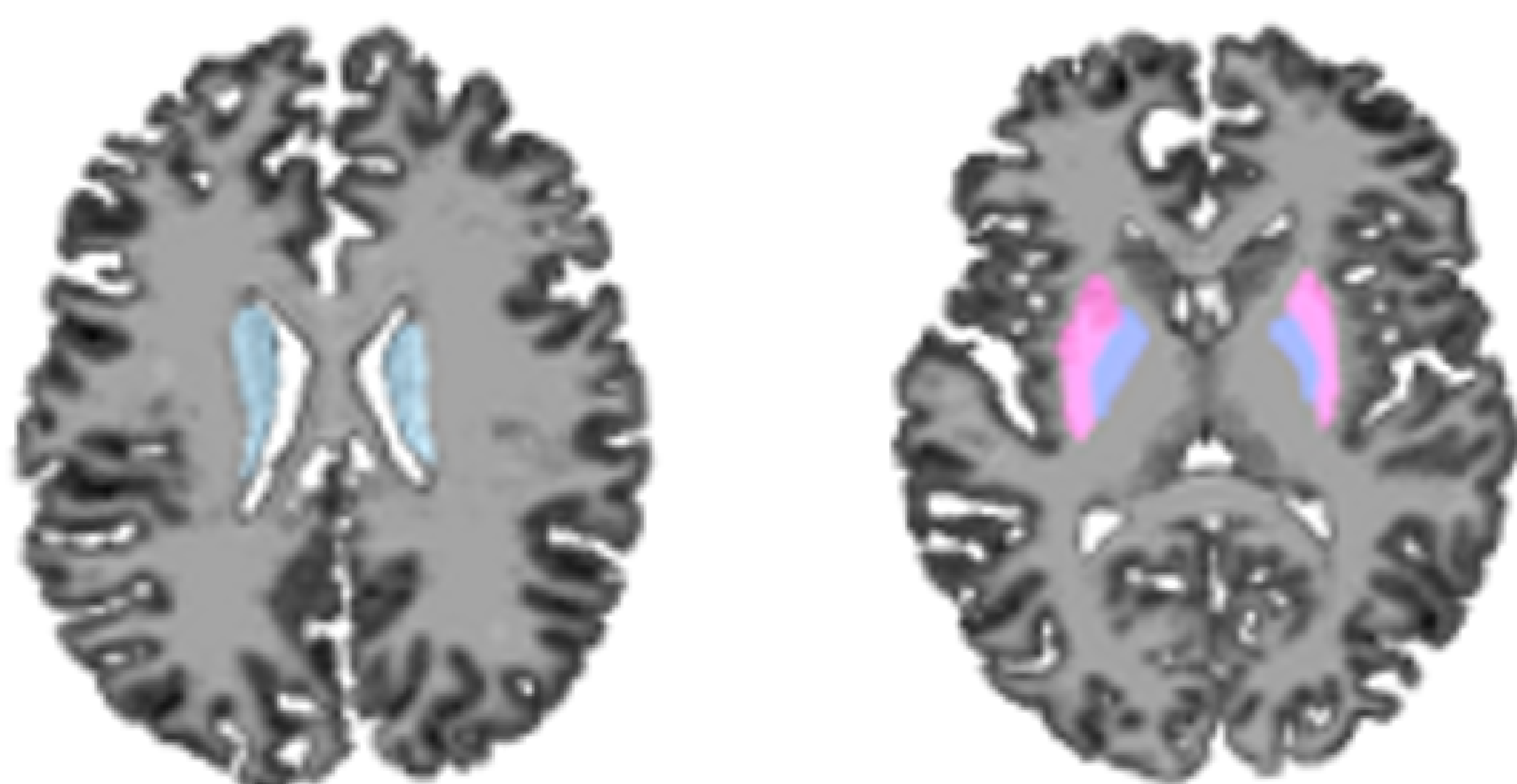


Figure 4:
 A) Axial view of the caudate in blue; B) Axial view of the putamen in pink.

Conclusion

- Our study showed significant executive function difficulties based on parent ratings, with parents of children with ADHD reporting increased EF difficulties compared to peers.
- No significant volumetric difference was observed in the caudate or the putamen.
 - Likely due to the heterogeneous presentation of children with ADHD both in neuroanatomical and behavioural findings.
- Potential association between right caudate volume and parent ratings of executive function in pediatric ADHD participants was observed
 - Specifically, the Emotional Regulation Index was significantly correlated with the right caudate volume and predicted 26.3 % of the variability.
- Implication: Given the current findings, there is an increased need to target interventions specifically to manage emotional regulation challenges in the identified subgroup of children.