

ADHD Subtypes and Internalizing Symptoms Modulate Region-Specific Brain Lateralization

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Background/Rationale

Inattentive ADHD

Symptoms: Inattention, slow thinking, trouble staying alert

Associated Regions: Frontal and Executive

Combined ADHD

Symptoms: Impulsivity, trouble with planning, focus, and self-control

Associated Regions: Visual and spatial processing

What is Unknown

- Brain studies rarely examine symptom traits across conditions, often focusing on diagnostic labels.
- Anxiety and depression, affect brain asymmetry, but are rarely modeled alongside ADHD or ASD.

Do differences in asymmetry and volume across ADHD subtypes relate to attention and emotion networks, and are they shaped by anxiety and depression symptoms?

Research Question

Methods and Analyses

Participants & Measures

- 356 youth (ages 10–18) from the POND study
- ADHD symptoms scored using SWAN
- Anxiety + depression scores assessed using RCADS

MRI Data and Preprocessing

- MRI used to extract brain volumes from 79 regions
- Calculated asymmetry index for each region
- Left and right hemisphere volumes analyzed separately

Models on Asymmetry Index

Predictors: Subtype, anxiety & depression, interaction

Covariates: age, sex, diagnosis

Post hoc & Marginal Effects

Pairwise comparisons between subtypes

Slopes for anxiety & depression within each subtype

Models on L/R Hemisphere Volumes

Predictors and covariates matched to AI models

Post hoc & Slope Estimates

Group comparisons

Volume change associated with anxiety/depression

Anxiety and depression shape brain asymmetry differently across ADHD subtypes, helping explain challenges with focus, emotion, and behavior.



Results and Key Findings

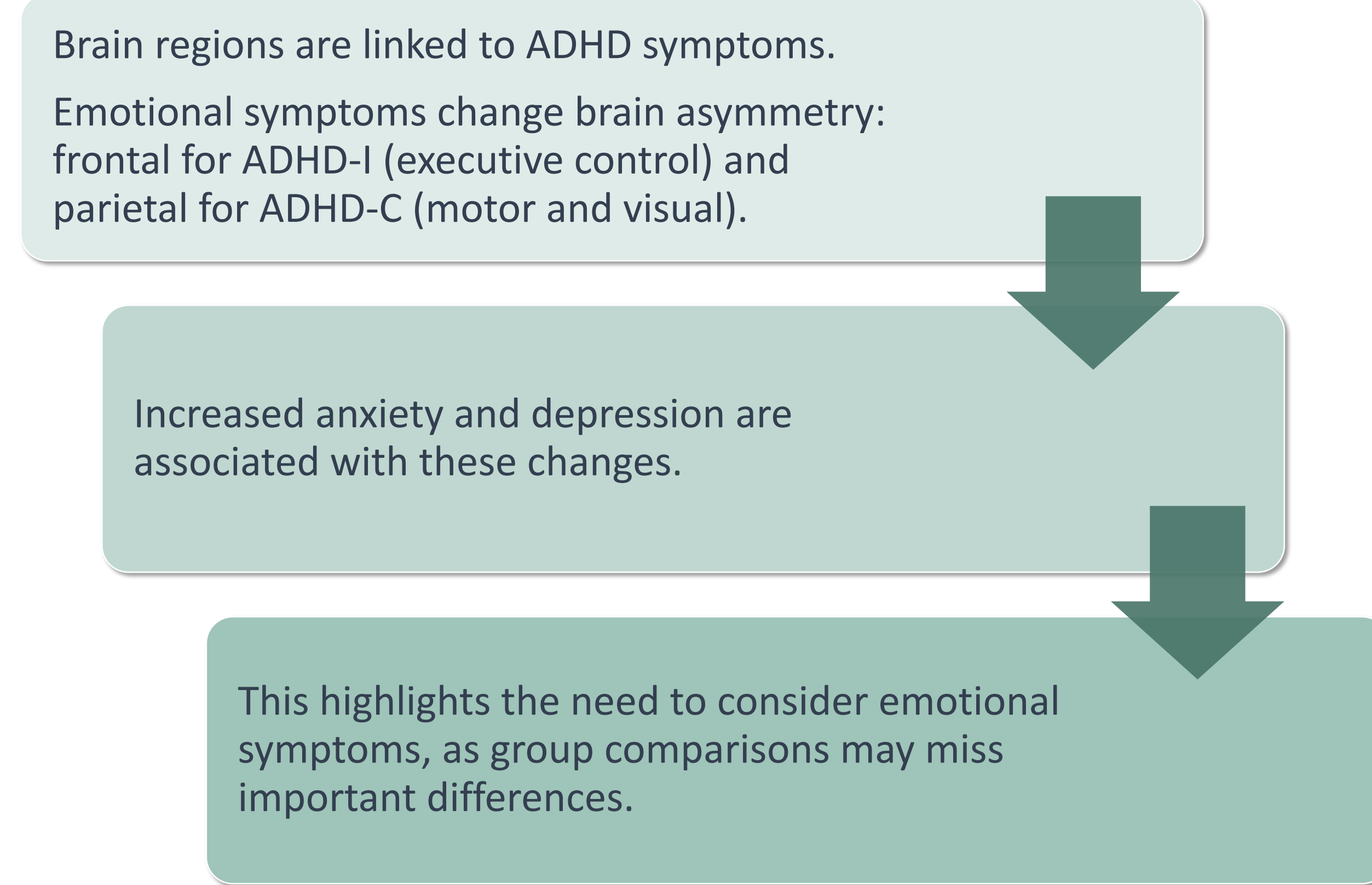
Regional asymmetry and volume differed by ADHD subtype and were modulated by anxiety and depression.

1. Asymmetry:

- Differences in asymmetry appeared when anxiety and depression were considered
- Leftward shift in frontal (Inattentive) & parietal (Combined) were associated with anxiety/depression

2. Volume:

- Visual cortex decreased with anxiety/depression in all groups
- Combined shows larger parietal & visual regions than Inattentive



Conclusion and Next Steps

Emotional symptoms shape patterns of brain asymmetry in ADHD in a dynamic, subtype-specific way, with differences in regions tied to each group’s core cognitive symptoms, showing patterns that may influence how brain structure develops.

- 1. Examine how emotional symptoms and asymmetry change over time.
- 2. Explore links between asymmetry and other symptoms.
- 3. Apply symptom-based approaches in larger, more diverse samples.

Relevance to Holland Bloorview

Emotional symptoms may shape brain development in ADHD, helping explain challenges with focus, emotion regulation, and behavior.

Findings highlight the need to look beyond diagnoses and consider each child’s unique symptom profile for more personalized care.

Linking brain differences to symptoms may guide future screening, monitoring, and tailored support for children with ADHD and emotional difficulties.