Relations Between Gestational Age and ADHD Symptoms: The Mediating Role of Executive and Socioemotional Functioning

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Introduction

- Preterm birth (gestational age <37 weeks) is the leading cause of short-term and long-term neurodevelopmental disorders in children. *(Fraiman et al., 2023)*
- Attention-Deficit Hyperactivity Disorder (ADHD) is the most common neurodevelopmental disorder among children born preterm. *(Fraiman et al., 2023)*
- ADHD is characterized by a cluster of symptoms related to inattention, impulsivity, and hyperactivity with symptom onset typically during early childhood. *(APA, 2013)*
- There is a lack of literature examining the neurocognitive underpinnings of ADHD, which is crucial for informing prevention and intervention strategies.
- The ***objective*** of this study was to investigate the relation between gestational age and ADHD symptoms in preschool-aged children, with a focus on the mediating role of executive and socioemotional functioning as measured by standardized tests.

Methods

- Preterm and term-born preschool-aged children were consented to the study (IRB #201808846).
- Participants were recruited via UIOWA mass emailing system and word of mouth between June 2019 and March 2020.
- During the three-hour study visit, parents completed online questionnaires and children completed a battery of neurocognitive testing with a trained research team member:
  - Child behavioral and mental health symptoms were measured via a parent-completed, standardized questionnaire, the Child Behavior Checklist (CBCL) *(Achenbach & Rescorla, 2001)*
    - ***Pervasive Developmental Problems***
      - E.g., disturbed by change, avoids eye contact, unresponsive to affection, etc.
    - ***Attention Deficit/Hyperactivity Problems***
      - E.g., can't sit still, can't concentrate, demands must be met, etc.
  - Child executive and socioemotional functioning were measured via the following standardized tests:
    - Wechsler Preschool & Primary Scale of Intelligence, Fourth Edition (WPPSI-IV) *(Weschler, 2012)*
      - ***Picture Memory*** (Working memory)
      - ***Bug Search*** (Processing speed)
    - A Developmental Neuropsychological Assessment, Second Edition (NEPSY-III) *(Brooks et al., 2009)*
      - ***Statue*** (Attention and executive functioning)
      - ***Affect Recognition*** (Social perception)
      - ***Theory of Mind*** (Social perception)
- Basic path analyses were computed in the R package *lavaan*.

Results

Table 1. Demographic Characteristics of Participants (N=104)

	M (SD) or n (%)
Child Age (years)	4.58 (0.62)
Child Gender (female)	51 (50%)
Gestational Age (weeks)	36.28 (5.22)
Birth Weight (lbs, oz)	6.21 (2.44)
Caregiver Age at Delivery (years)	31.50 (5.57)
Primary Caregiver Education	
High School Graduate	3 (3%)
Some College Credit	6 (6%)
Associate's Degree	14 (13%)
Bachelor's Degree	43 (41%)
Professional Degree	38 (37%)

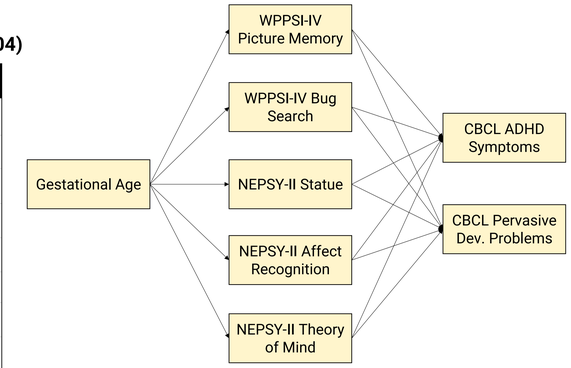

Figure 1. Conceptual model incorporating all variables. Does executive and socioemotional functioning mediate the association between gestational age and ADHD symptoms and pervasive developmental problems?

Table 2. Executive and Socioemotional Functioning and CBCL Domains for Three- to Five-Year-Old Preterm- and Term-born Children (N=104)

	Gestational Age		
	Preterm (n=36)	**Term (n=68)**	***p***
Executive and Socioemotional Functioning			
WPPSI-IV Bug Search	**8.59 ± 2.6**	**10.41 ± 2.80**	**< .01**
WPPSI-IV Picture Memory	10.16 ± 3.0	10.88 ± 2.59	0.251
NEPSY-II Affect Recognition	9.84 ± 2.84	10.58 ± 3.09	0.252
NEPSY-II Statue	10.27 ± 2.86	10.84 ± 3.24	0.426
NEPSY-II Theory of Mind	9.48 ± 3.25	10.42 ± 2.84	0.234
Child Outcomes			
Attention Deficit Hyperactivity Symptoms	3.61 ± 2.72	3.13 ± 2.81	0.401
Pervasive Developmental Problems	3.31 ± 3.40	2.43 ± 2.65	0.182

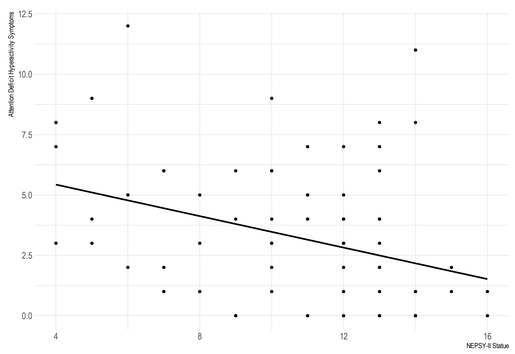

Figure 2. Scatterplot examining the negative association between attention and executive functioning, as measured by NEPSY-II Statue, on ADHD symptoms.

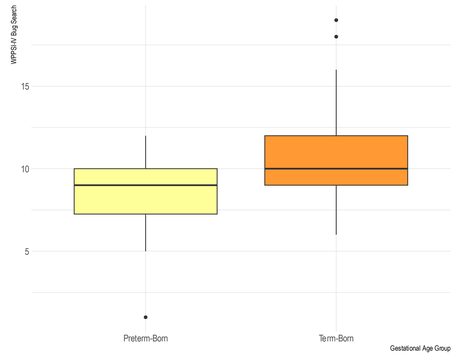

Figure 3. Comparison of preterm-born versus term-born children on processing speed, as measured by WPPSI-IV Bug Search.

Conclusion

- Unexpectedly, executive and socioemotional functioning did not mediate the relations between gestational age and ADHD/developmental disorder symptoms.
  - A direct association emerged between attention and executive functioning (NEPSY-II Statue) and ADHD symptoms (Figure 2).
- Preterm- and term-born children did not differ on parent-report measures of ADHD and developmental disorder symptoms in the study cohort (Table 2).
- Additionally, preterm- and term-born children did not differ on measures of working memory, behavioral inhibition, theory of mind, or affect recognition (Table 2).
- Notably, preterm- and term born infants did differ on a measure of processing speed (WPPSI-IV Bug Search), in which preterm infants scored lower (Figure 3).

Limitations & Future Directions

- The current sample was predominately term-born children, compared to preterm-born children, respectively.
- The preterm-born children had an average gestational age in the moderately preterm range, which may not capture the infants at highest risk for ADHD or other neurodevelopmental disorders.
- The sample size was limited due to COVID-19 restrictions that impeded in-person assessments for a large portion of the study period.
- Future research should continue to examine cognitive components as mediators of the association between preterm birth and ADHD symptoms, especially in older children to determine if cognitive differences emerge after preschool.

Acknowledgements

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