

The Role of ACEs, and Sex in Brain Development During Adolescence: Insights from the ABCD Study

Adverse Childhood Experiences (ACEs) are well-established risk factors for various physical and mental health outcomes. While research has identified sex differences in both ACE exposure and long-term effects in adults, few studies have examined how ACEs shape brain development during adolescence—a critical period of neurobiological change. Additionally, most studies treat ACEs as a single construct, overlooking the differential impact of specific ACE subtypes (e.g., sexual abuse, physical neglect) on brain structure and function. Whether certain ACE subtypes exert a greater influence on adolescent brain development and whether these effects vary by sex remain underexplored. This study addresses these gaps by investigating how ACE subtypes and their interaction with sex influence adolescent brain development.

Using data from the Adolescent Brain Cognitive Development (ABCD) Study—a longitudinal study tracking nearly 12,000 youth (ages 9–10 at baseline) across 21 U.S. sites—this study examines the effects of five ACE subtypes (e.g., sexual abuse, household mental illness) on brain structures (e.g., hippocampal and amygdala volumes) and resting-state functional connectivity (e.g., Default Mode Network [DMN] within-network connectivity, Salience Network–Fronto-Parietal Network [FPN] between-network connectivity). The ABCD dataset provides extensive neuroimaging, cognitive, emotional, and environmental measures, allowing for a comprehensive analysis of adolescent brain development.

Using mixed-effects models with False Discovery Rate (FDR) correction, we identified significant interactions between ACE subtypes and sex. Preliminary findings indicate that the interaction between sexual abuse and sex significantly predicts hippocampal volume, while household mental illness interacts with sex to influence amygdala volume. Specifically, boys exposed to sexual abuse exhibit greater reductions in hippocampal volume than girls, while boys experiencing household mental illness show greater amygdala volume reductions than their female counterparts.

Unlike previous studies that aggregate ACE scores into broad categories (e.g., none [0], moderate [1–3], high [4+]), this study focuses on the distinct impact of individual ACE subtypes on adolescent brain development. These findings underscore the importance of assessing specific ACE subtypes in clinical and educational settings. By recognizing the differential vulnerability of boys and girls to specific ACEs, practitioners, educators, and policymakers can develop more targeted intervention and treatment strategies tailored to individual developmental needs.