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Social problems and brain structure trajectories following pediatric mild traumatic brain injury

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Introduction

Pediatric traumatic brain injury (pTBI), even mild (mTBI), is associated with risk of developing social problems, including aggressive behaviors and social cognitive deficits, which may profoundly impact the child's quality of life [Zamani et al., 2019]. The maturation of the neural bases of social behaviors and cognition, sometimes referred to as "the social brain", is protracted, continuing throughout childhood and adolescence, and correlates with increasing capacity for social information processing [Blakemore, 2012]. Therefore, pTBI may disrupt the expected developmental trajectory of the social brain structure that could manifest as development of social problems. However, limited sample sizes and cross-sectional designs generally used in the neuroimaging study of pTBI so far [Zamani et al., 2019], prevented from exploring developmental trajectories following pTBI. The present study aims to examine the longitudinal development of social problems and cortical thickness in social brain regions following pediatric mTBI using data from the large population-based cohort study Adolescent Brain Cognitive Development (ABCD) [Casey et al., 2018]).

Methods

Baseline and 2-year follow-up data from the ABCD 3.0 curated data release were used. Childhood history of mTBI was retrospectively assessed using the Parent Ohio State TBI Screen-Short Modified report [Bogner et al., 2017]. Age-corrected t-scores from the social problem subscale on the Child Behavior Checklist [Achenbach and Rescorla, 2000] were used to measure social problems. Cortical thickness was computed from T1-weighted images by the ABCD group using FreeSurfer 5.3 [Fischl, 2012]. Analyses focused on the following bilateral Desikan cortical regions of interest (ROIs) [Desikan et al., 2006] corresponding to core regions of the social brain [Blakemore, 2012]: medial orbitofrontal, temporal pole, inferior parietal, and bank of the superior temporal sulcus. Scanner (n=26) effects were removed before analyses using longitudinal ComBat [Beer et al., 2020]. Multigroup latent change score models were constructed with the lavaan 0.6-8 package [Rosseel, 2012] in R 4.1.0 to estimate latent difference scores between baseline and follow-up for social problems and social brain cortical thickness. Group differences in 4 parameters of interest (mean of the baseline score, rate of change over time, and variances of the baseline and of the change) were tested using chi-square tests [Kievit et al., 2018]. Child sex and parental education were included as covariates.

Results

The final sample included 5,736 controls (i.e., no history of TBI; 52% males, 9.97 ± 0.62 years at baseline) and 224 mTBI (i.e., history of mTBI with loss of consciousness ≤ 30 min or memory loss; 59% males, 9.99 ± 0.64 years at baseline). Group differences were observed in both means and variances of the baseline values and rate of change in social problems (all $p \leq .002$). MTBI showed higher problems at baseline than the controls, and a decrease over time, but remained higher than the controls ($p = .03$), where problem scores stayed stable. Variances at baseline and in change were greater in mTBI than in controls. For all ROIs, no group differences were observed in either means or variances of the baseline values or rate of change in social brain cortical thickness (all $p \geq .17$). For all ROIs but the temporal pole, cortical thickness significantly decreased over the two years of the study in the two groups.

Conclusion

This longitudinal retrospective study revealed different developmental trajectories of social problems between adolescents with and without history of mTBI, but no difference in the trajectory of the social brain cortical thickness. Social problems decreased over time but remained high in mTBI, while stayed stable in controls. Cortical thickness decreased between age 10 and 12 years in both groups. Future studies should explore if changes in social brain function or other brain structure metrics may underly the changes in social problems after pTBI.

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