Research Week 2020

Predicting Adolescent Binge Drinking from Brain Networks at Rest

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Keywords

adolescence, alcohol, resting-state fMRI, graph theory

Abstract

Patterns of alcohol consumption during adolescence differ from those observed during adulthood; namely, adolescents are more likely to consume alcohol less frequently, but in larger quantities per occasion, when compared to adults. Importantly, this binge-pattern of drinking carries substantial risks for adverse outcomes, including involvement in motor vehicle accidents, alcohol poisoning, and sexual victimization. Although prior work has examined neural correlates of emergent alcohol use among adolescent populations, the present study takes a novel, data-driven approach by incorporating graph theory metrics of resting-state functional connectivity with predictive modeling via machine learning. To identify risk factors for future binge drinking, a subset of participants were selected from an ongoing prospective longitudinal study (National Consortium on Alcohol and Neurodevelopment in Adolescence). All participants were alcohol-naïve at baseline (n=150), but 51% (n=77) emerged into binge drinking over the course of four years of follow-up assessments (transitioners), while the rest remained abstinent from alcohol use (controls). Resting-state fMRI data were pre-processed and parcellated using a functional atlas to construct weighted, undirected adjacency matrices, then thresholded to retain the top 15% of edge weights. Graph analyses were performed using the Brain Connectivity Toolbox implemented in MATLAB (Rubinov & Sporns, 2010). Network parameters of interest were entered into a supervised random forest (RF) algorithm to distinguish the two groups of participants, as well as to identify the most important input features for classification. The RF model had an overall accuracy of 60%, with 70% sensitivity and 50% specificity. Notably, several characteristics of the frontoparietal network were important for this classification task, including average clustering coefficient, characteristic path length, and betweenness centrality. These metrics help to establish functional "hubs" in the network, and suggest that differential functioning of brain regions relevant for executive control may underlie a predisposition for future binge drinking.