Magnetic resonance spectroscopy in the brain of adolescent binge drinkers

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Introduction

Binge consumption of alcohol in adolescents has been shown in animal models to impact development and cognition but little data in humans exists. Frontal lobe myelination and development occurs mostly in adolescence so an understanding of the impact of alcohol on this process is crucial to informing alcohol licensing and public health advice. Here, we present preliminary data from a cross-sectional study of 16-17 yo boys and girls who binge drink compared with alcohol naïve controls.

Methods We studied 22 adolescents (13 male (7 Binge, 6 controls); 9 female (3 binge, 6 controls) using ^{1}H MRS, questionnaires and cognitive testing. All MRS was acquired at 3T (Achieva X) using an 8 channel SENSE coil from a 2 cm^3 VOI positioned in the white matter underlying the dorsolateral prefrontal cortex (DLFPC Fig. 1) using single voxel PRESS (TE = 31 ms, TR = 2s; Fig. 2). Spectra were processed using AMARES (jMRUI v 3) to fit up to 14 resonances [1] and metabolites are expressed relative to the reference water signal. We also tested measures of frontal lobe function (Stroop), emotional face recognition (UNSW Face Emotion Task) and depression/anxiety (DASS). Cortical thickness measurements for 32 regions were computed for males using Freesurfer.

Fig. 1 VOI placement

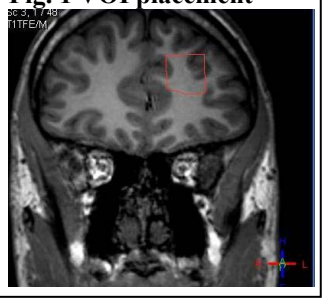
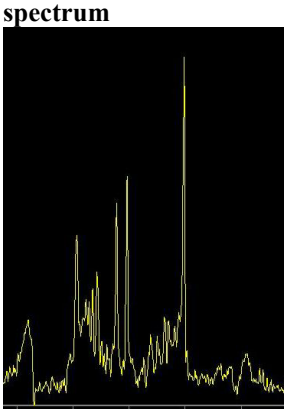
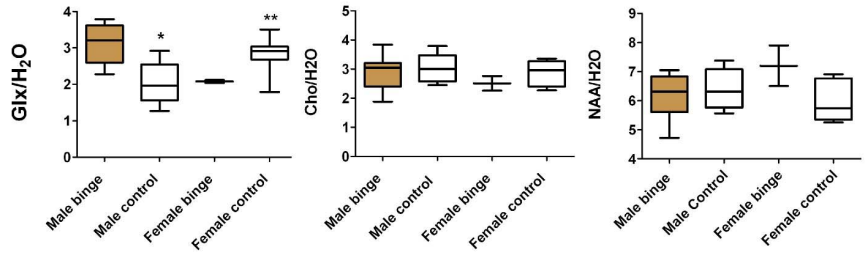


Fig. 2. Sample ^{1}H spectrum



Results Biomarkers of cellular density and integrity (NAA, Cho, Cre, mIno) were not significantly different in binge drinkers cf controls (e.g. Fig. 3 for mIno) but Glx was found to be elevated in male binge drinkers compared to male controls (P = 0.014; Fig. 3). FWM Glx was also significantly higher in female controls than male (P = 0.035). Binge drinkers showed impaired neuro-cognitive function with significantly slower responses and greater errors on the tests of inhibition (males; Stroop, P < 0.03), and poorer face recognition (FACES, angry/afraid P <0.05) compared to non drinkers. These neuro-cognitive changes were positively correlated with binge drinking episodes and alcohol consumption. DASS scores were higher in male binge drinkers than controls and in both cases correlated with frontal white matter glutamate levels (r^2 = 0.7, (P = 0.05) and 0.91 (P = 0.001)) respectively.

Fig 3. ^{1}H MRS ratios showing left frontal white matter Glx, Choline & NAA (box & whisker) according to gender and binge status.



Discussion We found no effect of bingeing on cellular markers, although more severe bingeing was associated with lower NAA, Cre and Cho levels. Alcohol is known to act at the NMDA receptor and to alter brain metabolism, with chronic alcohol use resulting in altered receptor populations [2]. This may contribute to the elevated Glx seen in male bingers.

References [1]. Singh S et al. *Gastroenterology* 2009; **136**, 417-24. [2] Liang J. et al. *Alcoholism Clin Exp Res* 2010; **34**, 56A