Alcohol drinking & metabolism in emerging adults

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Rationale

Hazardous drinking patterns are prevalent among young adults and associated with a multitude of negative medico-legal consequences. However, the alcohol metabolizing systems of healthy young adults may be able to adapt, and defend the brain and body against the consequences of hazardous drinking patterns. However, evidence for the existence of drinking-related metabolic adaptations is scant. In the present study, we examined key parameters of the blood alcohol concentration (BAC) time-course after drinking for an effect of individual differences in drinking across the previous last 4-6 years.

Methods

Participants

121 people who gave informed consent for a laboratory study. These were recruited from 744 people who had participated in a longitudinal study on changes in alcohol use and other risky behaviors across emerging adulthood and subsequently consented to provide DNA for a study about the genetic determinants of behavior change. Exclusion criteria included scoring > 16 on the AUDIT and having any medical or other contraindication for alcohol.

Alcohol Administration

Participants were asked to refrain from eating before coming to the laboraroty and given weight-adjusted caloric snack of pretzels upon arrival. Participants were given 2 drinks to consume in 20 min. All drinks prepared in full view of the participants in a simulated bar setting. Beverages were 1 part alcohol 3 parts mixer. Mixer was 5 parts cranberry juice, 4 parts Diet Cherry 7-Up, and 0.5 parts Rose's Lime Juice. Alcohol amounts were determined using Curtin's BAC calculator webtool (dionysus.psych.wisc.edu/WebCMS/baccalc.htm). Sessions were run on Friday and Saturday evenings in mixed-sex groups of 3-4 participants.

Measurements

Blood alcohol concentration (BAC) was approximated by measuring alcohol in exhaled breath (BrAC) using the Alco-Sensor IV breathalyzer (Intoximeters, Inc.) Readings were taken at regular intervals, but sampling times and intervals varied between participants. Peak BrAC was the maximum BrAC achieved after cessation of drinking. Time to peak was defined as minutes elapsed from finishing the last drink to peak BrAC. Time to release was defined as minutes elapsed from peak BrAC to BrAC ≤ 40 mg/dL.

Before entering the bar, Research Assistants helped participants reconstruct their daily drinking across the prior 30 days using a modified Time-Line Follow-Back tool (TLFB). From the TLFB, the following measures were computed: drinks per drinking day, maximum drinks consumed in a single drinking occasion, and times binged (4+ drinks per occasion for women, 5+ for men).

Approximately 1-2 years and 4-6 years before participation in the laboratory study, participants completed on-line surveys via REDCap. The surveys included the Daily Drinking Questionnaire (DDQ), which asks about average drinks for each day of a typical week across the prior 90 days, and from which an average drinks per drinking day was computed. Additional survey items collected information about alcohol use over the past 90 days, including maximum drinks consumed in a single drinking occasion, and times binged (had 4+ drinks per occasion for women, 5+ for men).

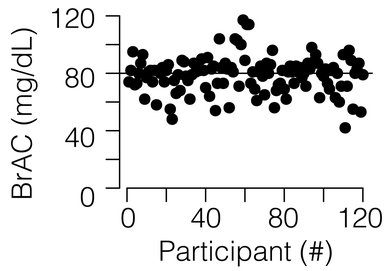
Statistical Analysis

Separate structural regression models of peak BrAC, time to peak, and time to release on age, weight, height, biological sex (dummy variable where 1 indicated female) and drinking pattern were fit in Mplus, Version 7.4 (Múthen & Múthen) using robust max likelihood estimation, which takes advantage of all available information for each case despite incomplete data. For the model of peak BrAC, we included time to peak as an additional covariate. For the model of time to peak and time to release, we included measured peak BrAC as an additional covariate. For each model, drinking pattern was a level-2 factor indexed by level-1 factors corresponding to different drinking measurement periods: past 30 days, 1-2 years ago, 4-6 years ago. Each of the level-1 factors was indexed by measured variables (drinks per drinking day, maximum drinks, times binged).

Table 1. Descriptive Statistics

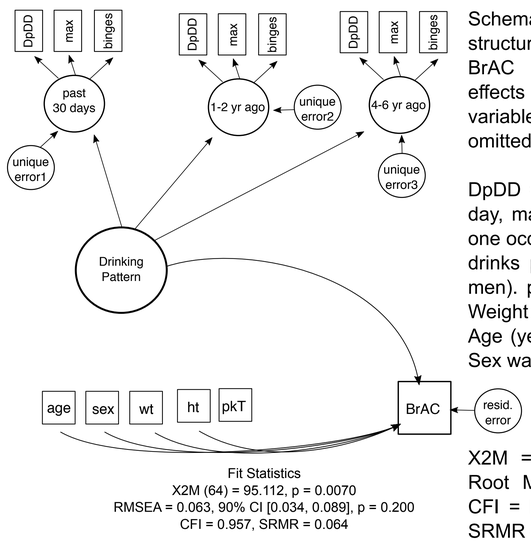
General Demographics	N	(%) Sample		
Male	52	42.98		
White	74	61.16		
Non-Hispanic	102	84.30		
Biological Characteristics	**Mean**	**SD**	**Median**	**Range**
Age (yrs)	28.75	1.21	29.00	27-31
Height (in)	67.79	4.07	67.00	59-79
Weight (lbs)	161.89	37.01	153.00	102-303
Blood Alcohol Measures				
Peak (g/dL)	0.08	0.01	0.08	0.042-0.117
Peak time (min)	49.76	19.14	45.00	22-112
Release (g/dL)	0.04	0.00	0.04	0.017-0.04
Release time (min)	276.70	41.02	280.00	152-375
Drinking in the Past 30 Days				
Drinks per drinking day	2.82	1.46	2.44	1-8
Maximum drinks	6.14	3.83	5.00	1-16
Times binged	2.74	4.03	1.00	0-22
Drinking in the Past 90 Days, 1-2 years ago				
Drinks per drinking day	2.31	1.75	2.00	0-10
Maximum drinks	7.69	4.42	6.50	1-23
Times binged	8.12	12.67	3.00	0-65
Drinking in the Past 90 Days, 4-6 years ago				
Drinks per drinking day	2.43	1.84	2.13	0-9
Maximum drinks	7.05	4.70	6.50	0-22
Times binged	5.98	7.50	3.00	0-34

Figure 1. Example of variability in BAC



Peak breath alcohol shown for each participant after drinking equivalent doses. Horizontal line indicates peak BrAC target. Similar variability was observed in time to peak and time to leave.

Figure 3. Structural Model of BAC



Schematic representation of the structural regression model of peak BrAC (mg/dL) showing regression effects of covariates and the latent variable of drinking pattern. Covariances omitted.

DpDD = number of drinks per drinking day, max = maximum number drinks in one occasion, binges = times binged (+4 drinks per occasion for women, +5 for men). pkT = Time to Peak (min), Wt = Weight (lbs), Height = Ht (in).
Age (years), Wt, and Ht were centered. Sex was coded as 0=Men, 1=Women.

X2M = Model Chi-Square, RMSEA = Root Mean Square of Approximation, CFI = Bentler's Comparative Fit Index, SRMR = Root Mean Square Residual.

Table 2. Effects of Covariates

Parameter	Estimate	SE	z	p
Age ➔ pkB	2.472	0.744	3.322	0.001
Age ➔ pkT	2.443	1.186	2.059	0.039
Age ➔ relT	-3.417	2.967	-1.152	0.249
Sex ➔ pkB	-7.785	2.783	-2.797	0.005
Sex ➔ pkT	2.092	4.478	0.467	0.640
Sex ➔ relT	6.714	11.184	0.600	0.548
Wt ➔ pkB	-0.067	0.032	-2.103	0.036
Wt ➔ pkT	0.123	0.049	2.515	0.012
Wt ➔ relT	-0.064	0.122	-0.522	0.602
Ht ➔ pkB	0.339	0.334	1.1014	0.310
Ht ➔ pkT	0.164	0.522	0.315	0.753
Ht ➔ relT	0.196	1.304	0.150	0.881
pkT ➔ pkB	-0.340	0.050	-6.773	<0.001
pkB ➔ pkT	-0.826	0.122	-6.787	<0.001
pkB ➔ relT	1.397	0.305	4.586	<0.001

Maximum likelihood estimates of covariates in separate structural regression models of peak BAC, time to peak, and time to release. pkB = Peak BrAC (mg/dL), pkT = Time to Peak (min), relT = Time to Release (min), Wt = Weight (lbs), Height = Ht (in). Age, Wt, and Ht were centered. Sex was coded as 0=Male, 1=Female.

Table 3. Effects of Drinking Pattern

Parameter	Estimate	SE	z	p
Drinking ➔ pkB	-2.338	1.098	-2.129	0.033
Drinking ➔ pkT	-3.031	1.757	-1.725	0.084
Drinking ➔ relT	6.153	4.396	1.400	0.162

Maximum likelihood estimates of key paths in separate structural regression models of peak BAC, time to peak, and time to release. pkB = Peak BrAC (mg/dL), pkT = Time to Peak (min), relT = Time to Release (min).

Table 4. Variances

Variance	Estimate	SE	z	p
Peak BAC	166.818	21.537	7.746	<0.001
Peak BAC Residual	88.618	11.623	7.624	<0.001
Peak Time	363.200	46.889	7.746	<0.001
Peak Time Residual	215.202	28.154	7.644	<0.001
Release Time	166.439	216.298	7.714	<0.001
Release Time Residual	1339.978	175.322	7.643	<0.001
Drinking Meas. Period 1	0.664	0.179	3.699	<0.001
Drinking Meas. Period 2	0.113	0.168	0.676	0.499
Drinking Meas. Period 3	1.309	0.305	4.292	<0.001

Maximum likelihood estimates of observed and residual variances of interest. Drinking Meas. Period 1 refers to the level-1 latent variable that draws on the drinking measurements covering the past 30 days. Drinking Meas. Period 2 refers to the level-1 latent variable covering 1-2 years ago. Drinking Meas. Period 3 refers to the level-1 latent variable covering 4-6 years ago.

Findings & Implications

A hazardous drinking pattern across emerging adulthood may induce alcohol metabolizing systems in the stomach, but not the liver, of otherwise healthy people. Thus, there was some evidence for protective, drinking-related adapations in alcohol metabolism in otherwise healthy young people. However, the form of metabolic tolerance (lower peak BAC) provides limited protection against alcohol toxicity and it is easy overcome within drinking episodes, leaving hazardously drinking young adults at risk for medical consequences.

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