



Published in final edited form as:

Addiction. 2022 May ; 117(5): 1284–1294. doi:10.1111/add.15740.

Momentary Associations between Stress and Alcohol Craving in the Naturalistic Environment: Differential Associations for Black and White Young Adults

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Abstract

Background and Aims: Black drinkers compared with White drinkers experience more alcohol-related problems. Examination of social determinants of inequities in alcohol problems is needed. The current study measured 1) associations between acute stress and alcohol craving in the naturalistic environment for self-identified Black and White individuals who drink alcohol and 2) whether a history of Attention Deficit Hyperactivity Disorder (ADHD) moderated these associations.

Design and Setting: Observational study using ecological momentary assessment (EMA) to collect data from participants at 6 semi-random time points throughout the day over a 10-day period. A series of 3-level multilevel models examined between- and within-person associations for stress and alcohol and tested if these associations differed for Black and White adults.

Participants: Participants were 229 adult drinkers (21–35 years old) who completed a larger study examining alcohol response for Black and White adults with and without a history of childhood ADHD.

Measurements: Momentary stress and alcohol craving, ADHD history, and sociodemographic characteristics (i.e., racial identity, sex, age, current education level, household income) were assessed. Participants were required to self-identify as either “African American or Black” or “European American or White.”

Findings: Significant racial identity by stress interactions indicated that associations between stress and craving were stronger for Black compared with White adults across the 10-day period (between-person: $B=.14$, $p=.007$), concurrently within a given EMA timepoint (within-person: $B=.04$, $p=.001$), and prospectively from timepoint to timepoint (within-person: $B=.05$, $p=.001$). Results remained while accounting for income by stress interactions.

Conclusions: Acute stress appears to be more strongly related to alcohol craving in self-identified Black compared with self-identified White individuals. This provides support for policy changes to eliminate structural inequities that increase stress exposure and the development of

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The authors have no conflicts of interest to declare.

just-in-time culturally responsive interventions focused on coping with acute stress for Black individuals.

Black drinkers have elevated rates of morbidity and mortality from alcohol (1), more alcohol-related problems (social, physical, and legal (e.g., (2–4)), and alcohol use disorder (AUD) persistence (5) compared to White drinkers. Despite these pronounced inequities, relatively little research has examined proximal social determinants of risk for Black drinkers. The current study examined near real-time perceived stress and craving in the natural environment to elucidate proximal risk factors for heavy alcohol use that may differentially increase risk for Black Americans.

Stress, Alcohol Use, and Racial Identity

Elevated stress has been shown to relate to elevated alcohol use over time as well as in the moment. In the general population, elevated levels of stress prospectively predict AUD symptoms into adulthood (e.g., (6, 7)). Moreover, higher stress on a given day predicts increased alcohol use the following day in the real world (8). Additionally, experimental research has demonstrated greater alcohol consumption in a quasi-naturalistic (bar lab) setting for participants in the stress task (experimental) condition relative to the control condition (9).

As a result of structural racism (10), Black individuals experience more chronic stress across multiple domains (money, work, family, personal health) than White individuals in the U.S. (11). Indeed, research has shown that such life stressors (e.g., economic disadvantage) partially account for the inequities in alcohol problems experienced by Black drinkers (12). The authors interpret these findings in line with the theoretical review by (13) that suggests Black drinkers may be drinking to cope with higher life stressors. To further test this possibility, examination of how acute stress relates to alcohol risk is needed.

Discrimination experiences are a significant source of stress for Black Americans (14) and predict increased alcohol use (e.g., (15, 16)). Recent findings using daily diary methodology showed both lifetime discrimination and daily negative mood predict alcohol use (17). Although these results indirectly suggest a drinking-to-cope-with-stress pathway to alcohol use for Black drinkers, research examining real-time stress and proximal factors such as alcohol craving is needed.

Craving, Racial Identity, and Alcohol Use

Craving is a symptom of AUD in *DSM-5* (18) and has significant implications for alcohol risk (19) and AUD treatment outcomes (e.g., (20, 21)). Additionally, in samples with a range of alcohol use behaviors (e.g., weekly drinkers), alcohol craving is a proximal risk factor that predicts subsequent alcohol use later the same day (22, 23) and prospectively predicts binge drinking over a 2.5-year period (24). Epidemiological research has shown that Black relative to White drinkers are less likely to endorse the craving symptom of AUD (25); however, research has not examined racial differences in momentary alcohol craving. Importantly, compared to global, retrospective report, ecological momentary assessment (EMA) research allows for fine-grained examination of the dynamic and temporal

associations between constructs (e.g., (26), decreases recall bias, and may be particularly important for assessing momentary states that fluctuate across time and environments (e.g., (27)). Given the importance of craving in the development of heavy alcohol use and AUD, more research on this construct in Black individuals is critical to informing treatments that may decrease inequities in alcohol problems in this population.

Stress and Craving

Alcohol craving is one mechanism by which stress increases risk for heavy alcohol use. For example, in social and heavy drinking samples, subjective craving increases following laboratory-based stress exposure (e.g., (28, 29). In line with this, a recent meta-analysis, utilizing samples with varying levels of alcohol use and problems (e.g., AUD, social drinking samples), found small-to-medium effects for lab-based stress/negative mood induction on increased craving (30). A future direction put forth in this paper was for EMA research to extend these lab-based findings.

Current Study

The current study examined associations between stress and alcohol craving across a 10-day naturalistic assessment period and if these associations differed between Black and White drinkers. Our first hypothesis was that Black drinkers would endorse higher levels of stress across the 10-day period than White drinkers. Based on literature demonstrating that Black drinkers may be more likely to drink to cope with negative mood/stress (e.g., (31), our second hypothesis was that the association between stress and alcohol craving would be stronger for Black compared to White drinkers across the 10-day period, concurrently at each EMA survey, and prospectively, from one EMA survey to the next.

By design we recruited ~50% of our sample to have a history of childhood Attention Deficit Hyperactivity Disorder (ADHD). The larger study goals were interested in examining impulsivity and alcohol response across racial identities, and recruiting individuals with a history of ADHD who have higher levels of both impulsivity and alcohol problems (e.g., (32)) increased the variability in these constructs. Research has demonstrated that EMA is a valid and reliable assessment method for individuals with ADHD (33, 34) and that adults with ADHD may be more vulnerable to stressors than adults without ADHD (35). Given the lack of research on momentary stress or craving for individuals with ADHD, we secondarily examined the differential association between stress and alcohol craving as function of childhood ADHD and explored the interaction between racial identity and ADHD history.

Materials and Methods

Study procedures were approved by the University of Pittsburgh's Institutional Review Board. Variable selection and analyses were planned prior to data collection. However, the analyses were not formally pre-registered, and therefore results should be considered exploratory.

Participants

Participants were 229 current drinkers (51% with childhood ADHD). The sample was 75% male ($M_{age}=28.08$; range: 21–35 years). Participants were recruited either from the community (posted fliers, Craigslist advertisements; 65 ADHD, 76 without ADHD) or from the Pittsburgh ADHD Longitudinal Study (AA011873, co-author Molina; PI; 52 ADHD, 36 without ADHD), in which ADHD (*DSM-III-R* or *DSM-IV* criteria; revisions between *DSM-III-R*, *DSM-IV*, and *DSM-5* have not resulted in significant differences in rates of diagnosis (36), presence/absence was established in childhood ($M_{age}=9.4$) using standardized parent and teacher rating scales (37). Participants recruited from the community completed a phone screen of *DSM-IV* ADHD symptoms from childhood, and a parallel informant report (e.g., parents) was obtained by phone to verify presence/absence of childhood ADHD. Participants with childhood ADHD were required to endorse at least 6 out of 18 symptoms prior to age 12. Informant and participant report both had to endorse childhood ADHD to be eligible for enrollment. Given the focus on differences between Black and White individuals, all participants were required to self-identify as either “African American or Black” or “European American or White.” The majority of participants identified as White/European American (67%) and 33% identified as Black/African American. Of the Black participants, 46% had a history of ADHD and of the White participants, 53% had a history of ADHD. Participants were required to be between 21–36 years old. Due to the larger study design containing an alcohol administration component, all participants were required to have drunk alcohol in the last month and consumed the equivalent amount of alcohol in the past 6 months as would be administered in the laboratory. Participants were excluded if they were currently abstaining from alcohol, had previously received treatment for AUD, had significant medical or psychiatric illness (e.g., psychotic disorders, past head injury with loss of consciousness >5 minutes), or were currently taking medication for which use of alcohol is contraindicated.

Study Design

Participants who met eligibility criteria based on the phone screen then completed two counterbalanced laboratory beverage administration sessions approximately 1 week apart (non-alcohol/alcohol; target peak BrAC = .08%; see (38) for additional information). On the following Friday, participants started the EMA protocol. Participants used their personal smartphone or a study smartphone. All participants were provided in-person instruction on how to complete the prompts (e.g., wait until done driving). During this training session participants were asked their typical wake and bedtimes to serve as anchors for the first and last EMA prompts of each day. The first assessment was sent 15 minutes after self-reported typical wake time ($M=9:18$ am) and the last assessment was sent 15 minutes before typical bedtime ($M=10:47$ pm). During each morning report, participants were also asked when they actually went to bed the night prior ($M=12:36$ am on weeknights; $M=12:52$ am on weekends). An additional 4 assessments were sent throughout the day (binned into 4 equal windows spanning from the 2 hours after the individual’s self-reported typical morning wake time to 2 hours before the individual’s self-reported typical bedtime). Participants had 10 minutes to complete the assessment and received a reminder text 5 minutes after the prompt was sent. All prompts were sent via text message containing a direct link to a password-protected web-based questionnaire. Participants could earn up to \$110.00 for

completing at least 80% of the EMA prompts. If participants completed fewer than 80% of prompts across the 10 days, they received proportional compensation (60% of prompts = \$66.00).

Measures

Sociodemographics—Participants reported their sex, age, current education level (range from “no high school diploma or GED” through “post college education: grad school/med school”), and estimated annual household income (range from “under \$10,000” through “greater than \$100,000”). These demographic variables were included as covariates in analyses. Additionally, participants self-identified their race (racial identity).

Stress—Stress level was examined with 1 item at each of the 6 daily prompts. Participants were asked to report, “Since the last assessment how much has stress weighed on you?” from 0 (not at all) to 6 (extremely).

Craving—Alcohol craving was assessed with a 5-item modified Brief Questionnaire of Smoking Urges (39) that was adjusted to query alcohol (e.g., “I have a desire for an alcoholic drink right now;” “An alcoholic drink would taste good now”). Participants were asked to rate their craving in the last 15 minutes (0: not at all to 3: very much). The average of these 5 items was computed for each assessment during the 10-day period.

Plan of Analysis

A series of 3-level multilevel models examined whether fluctuations in momentary stress were associated with concurrent and prospective fluctuations in momentary alcohol craving (3-level models; (40)). We also examined interactions between stress and racial identity, stress and ADHD history, and the 3-way interaction between stress, racial identity, and ADHD. Models accounted for age, sex, racial identity, ADHD history, highest educational attainment, annual income, number of days in the study (numbered 0–9), time of day of assessment (numbered 0–5), and whether the assessment day was a weekend (Friday, Saturday, Sunday) or weekday (Monday–Thursday). Based on visual inspection of craving across days and time of day showing linear patterns over time and prior findings showing alcohol craving increases linearly throughout the day (41, 42), we assumed time effects to be linear in all models. Because of the multilevel nature of the model, we separated the primary predictor, perceived stress, into between-person effects (i.e., person-specific average stress during the study period, centered on the grand mean) and within-person effects (i.e., EMA deviations in stress, centered on the person-specific mean). Models included random intercepts by both person and day, as well as a random slope of day number over the EMA period (0–9). Analyses were conducted in Stata 13.1 using the Xtmixed procedure with maximum likelihood estimation, which used all available data to estimate model parameters. We statistically adjusted for the unique clustering of the data (non-independence; momentary assessments nested within day, which were nested within individuals).

EMA Prompt Completion

On average, participants completed 67% of the 60 EMA prompts, above commonly accepted thresholds (43). EMA prompt completion rate did not significantly differ between individuals with ADHD (65.3%) compared to those without ADHD (69.5%), $t=1.385(227)$, $p=.167$. Over 42% of the full sample completed at least 80% of the EMA prompts. Participants had an average of 9.36 days with valid data ($SD = 1.64$ days), and 77% of participants recorded data at least once every day.

Results

Descriptive Results

Table 1 displays descriptive statistics for sociodemographic variables and ADHD history by racial identity. Black individuals in this sample were less likely to be male and reported lower levels of educational attainment and annual household income compared to White individuals. Results of an unconditional multilevel regression analysis (random intercepts by person and day number and random slope by day number) showed that stress across the 10-day period did not significantly differ between Black and White participants ($B=-.18$, $SE=.17$, $p=.290$).

Concurrent Between- and Within-Person Associations for Stress and Craving

Main Effect of Stress on Craving—Higher average stress throughout the study period was associated with higher average alcohol craving (between-person effect; $B=.12$, $p<.001$). Additionally, when participants experienced increased momentary stress, they reported higher momentary alcohol craving at the same time point (within-person effect; $B=.03$, $p<.001$) (see Table 2, Model 1).

Sociodemographic Variables and Contextual Covariates—Alcohol craving increased throughout the day ($B=.08$, $p<.001$), decreased across the 10-day period ($B=-.02$, $p<.001$), and was higher on weekends than weekdays ($B=.10$, $p<.001$; Table 2, Model 1). Racial identity, sex, ADHD history, income, education, and age were not associated with momentary alcohol craving in the fully adjusted model ($Bs=.003-.11$, $ps=.128-.967$).

Stress by Racial Identity Associations with Craving—Both of the stress by racial identity interactions were significant (Table 2, Model 2; between-person: $B=.14$, $p=.007$; within-person: $B=.04$, $p=.001$). Higher average stress across the 10-days was associated with higher alcohol craving for Black ($B=.21$, $p<.001$) but not for White drinkers ($B=.06$, $p=.062$). Within-person associations between momentary stress and alcohol craving were also significantly stronger for Black ($B=.06$, $p<.001$) compared to White drinkers ($B=.02$, $p=.005$).

Stress by ADHD Associations with Craving—The between-person interaction with stress and ADHD was not significant ($B=.03$, $p=.587$), suggesting that higher average stress was associated with higher average alcohol craving regardless of ADHD history ($B_{ADHD}=.13$, $p<.001$; $B_{nonADHD}=.10$, $p=.050$). However, the within-person stress by ADHD history interaction was significant ($B=.04$, $p=.001$). Momentary increases in stress were

associated with momentary increases in alcohol craving for individuals with ADHD ($B=.05$, $p<.001$) but not individuals without ADHD ($B=.01$, $p=.174$; Table 2, Model 3).

Stress by Racial Identity by ADHD Associations with Craving—The 3-way interaction with between-person stress, racial identity, and ADHD history was not significant ($B=.06$, $p=.654$; Table 3) but the 3-way interaction with within-person stress was significant ($B=.07$, $p=.004$). Probing of this interaction suggested that for Black participants, momentary increases in stress were associated with higher momentary alcohol craving, regardless of ADHD history ($Bs=.06$, $ps<.001$; Table 3, Model 4). However, for White participants, increases in momentary stress were only associated with higher momentary alcohol craving for those with a history of ADHD ($B_{ADHD}=.05$, $p<.001$; $B_{nonADHD}=-.01$, $p=.196$; Table 3, Model 5).

Prospective Within-Person Associations Between Momentary Stress and Subsequent Craving at the Next Assessment Prompt

While the prospective within-person main effect of stress on craving at the next time point was not significant ($B=.01$, $p=.295$; Table 4, Model 1), the within-person stress by racial identity interaction was significant ($B=.05$, $p=.001$; Table 4, Model 2). Specifically, momentary increases in stress predicted subsequent increases in alcohol craving at the next assessment among Black ($B=.04$, $p=.001$) but not White drinkers ($B=-.01$, $p=.304$). The within-person stress by ADHD interaction was not significant ($B=-.01$, $p=.419$; Table 4, Model 3) and the 3-way interaction with racial identity, ADHD history, and within-person stress was not significant ($B=.04$, $p=.146$; Table 5).

Post-Hoc Analyses Accounting for Stress by Income Interactions

Given prior research showing economic disadvantage partially accounting for racial inequities in alcohol problems (12), we conducted post-hoc sensitivity analyses to examine if our primary results remain after adjusting for stress by income interactions (Model 2). In these models, the stress by racial identity interactions remained significant for both concurrent (between-person: $B=.15$, $p=.004$; within-person: $B=.03$, $p=.011$) and prospective (within-person: $B=.05$, $p=.001$) analyses. The between-person stress by income interactions were not significant ($Bs=.01$, $ps=.338-.411$). The within-person stress by income interaction was significant both concurrently ($B=-.01$, $p<.001$) and prospectively ($B=-.01$, $p=.001$), indicating that momentary increases in stress were more strongly related to momentary increases craving for individuals with lower compared to higher income levels.

Discussion

Examination of social determinants of racial inequities in alcohol problems is sorely needed. The current study examined the association between stress and craving to test a component of the proposed drinking-to-cope pathway that may be increasing risk for Black drinkers (44). Our results showed that associations between perceived stress and craving were stronger for Black than White drinkers across a 10-day period, concurrently at a given EMA prompt, and prospectively at the following prompt. These results remained while accounting for stress by income effects, as well as sex, age, and highest educational attainment.

These findings provide important information about the deleterious effects of stress related to alcohol risk in Black Americans. While mean level differences across racial identities in acute stress were not significant in this study, it is possible that differences in chronic, cumulative stress as a function of systemic racism are contributing to the tightening of the association between acute stress and craving for Black drinkers. A recent integrative review (45) highlights this possibility: early life stress increases stress sensitivity, and stress-related hormones may induce craving. Further, a recent EMA study in a predominantly White sample (46) found that negative affect was more strongly related to alcohol craving for individuals high in coping motives. Given higher mean levels of coping motives in Black compared to White drinkers (e.g., (31, 47)), a greater tendency toward drinking to cope may be partially accounting for the stronger association between stress and craving for Black drinkers. Treatments utilizing mobile-health (mHealth) technologies targeting craving and coping (e.g., (48) for a review) hold promise for reducing AUD. Our findings suggest that developing a culturally tailored mHealth intervention to address in-the-moment craving and enhance coping skills within the Black community may be particularly impactful in reducing alcohol risk. In particular, the finding that heightened stress in a given moment predicts subsequent increases in craving for Black individuals highlights the potential for just-in-time interventions to deploy stress reducing strategies to prevent alcohol craving and ultimately alcohol use. Additional research integrating chronic stress exposure, naturalistic and/or lab-based alcohol cue exposure, and acute drinking motives is needed to understand what may be driving the stress-craving associations.

We also found that while ADHD history did not moderate the association between stress and craving for Black participants, it did for White drinkers. Stress and craving were related concurrently for White individuals with but not without a history of ADHD. While we did not find this association prospectively or between-person, results point to the potential for extending this line of research to elucidate treatment targets that could inform just-in-time interventions for individuals with ADHD during periods of increased stress.

While the current study has significant strengths, there are several limitations that warrant discussion. First, perceived stress was assessed with one item that did not examine specific domains (e.g., work, interpersonal) or occurrence of stressful events. Additional research is needed to understand if there are specific aspects of an individual's life that are driving the stress-craving associations. We also did not specifically examine discrimination experiences in relation to craving because endorsement at any given time point within the 10-day window was very low and made within-person analyses underpowered. Additionally, research is needed on other minoritized groups (e.g., Latine populations, LGBTQ+ populations) to understand whether the tightened associations between stress and craving are specific to inequities affecting Black Americans or reflect a more general process that is occurring across minoritized individuals. We were also underpowered to examine intersectionality (e.g., gender \times racial identity). Lastly, by design our sample was matched across racial identity on recent drinking behavior and excluded individuals who had received treatment for an AUD. While this design facilitates understanding of processes without the confound of differences in alcohol use across racial identities, it limits examination of alcohol use as an outcome. Additionally, since the current study did not enroll participants

based on AUD diagnosis or assess AUD symptoms, extending this research to a population with AUD is needed.

Despite these limitations, our study substantively adds to existing research by extending laboratory-based findings to the naturalistic environment and is the first to examine real-time craving and stress-craving associations in Black individuals. Our results add to a growing body of research demonstrating the importance of examining social determinants of health inequities for minoritized racial groups. This line of research can ultimately inform public policy reforms to address racial inequities as well as improve the development of culturally-tailored mHealth interventions for AUD.

Funding:

Funding for this study was provided by the National Institute on Alcohol Abuse and Alcoholism (NIAAA): K01AA021135, R37AA011873, K21AA000202; the National Institute on Drug Abuse (NIDA) R01 DA012414 and the ABMRF/The Foundation for Alcohol Research.

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Table 1

Descriptive Statistics by Racial Identity

Variable	Black	White	Group Comparisons	
	<i>n</i> (%)		χ^2 (<i>df</i>)	<i>p</i>
	76 (33.2%)	153 (66.8%)		
Sex			12.94 (1)	< .001
Female	30 (39.5%)	27 (17.6%)		
Male	46 (60.5%)	126 (82.4%)		
ADHD History	35 (46.1%)	81 (52.9%)	96 (1)	.326
Education			27.16 (3)	< .001
High school or less	27 (35.5%)	16 (10.5%)		
Some college	28 (36.8%)	49 (32.0%)		
College graduate	14 (18.4%)	52 (34.0%)		
Post college	7 (9.2%)	36 (23.5%)		
			<i>t</i> (<i>df</i>)	<i>p</i>
Income ^a			4.56 (194.27)	< .001
< \$10,000	18 (23.7%)	22 (14.4%)		
\$10,000 – \$24,000	23 (30.3%)	30 (19.6%)		
\$25,000 – \$39,000	18 (23.7%)	30 (19.6%)		
\$40,000 – \$54,000	8 (10.5%)	17 (11.1%)		
\$55,000 – \$75,000	5 (6.6%)	23 (15.0%)		
\$76,000 – \$100,000	4 (5.3%)	16 (10.5%)		
> \$100,000	0 (0%)	15 (9.8%)		
	<i>M</i> (<i>SD</i>)			
Age	28.24 (4.20)	28.00 (3.99)	-.42 (227)	.678

Note: *N*=229.

^aIncome is coded from 1 = < \$10,000 to 7 = > \$100,000.

Table 2
Associations Between Stress and Concurrent Alcohol Craving by Racial Identity and ADHD History

	<u>Model 1</u>			<u>Model 2</u>			<u>Model 3</u>																	
	Main effect			Stress X Race			Black			White			Stress X ADHD			ADHD			No ADHD					
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p
Stress (BETWEEN-person)	.12	.03	<.001	.14	.05	.007	.21	.04	<.001	.06	.03	.062	.03	.06	.587	.13	.03	<.001	.10	.05	.050	.10	.05	.050
Stress (WITHIN-person)	.03	.01	<.001	.04	.01	.001	.06	.01	<.001	.02	.01	.005	.04	.01	.001	.05	.01	<.001	.01	.01	.174	.01	.01	.174
Assessment time of day	.08	.003	<.001																					
Number of days in study	-.02	.003	<.001																					
Weekend	.10	.02	<.001																					
Race (1=Black)	.11	.07	.128																					
Sex (1=Male)	.003	.07	.967																					
ADHD history (1=ADHD)	-.04	.06	.501																					
Income	-.02	.02	.169																					
Education	.01	.03	.740																					
Age	.01	.01	.396																					

Notes. Three-level multilevel models (clustered on study ID and study day; random slope for number of days in study) estimated with maximum likelihood estimation. Interactions probed by rotating the reference group for racial identity/ADHD in Model 1. Racial identity is abbreviated to race in the table. Bolded entries are statistically significant. *N* = 229.

Table 3
 Three-way Interactions Among Stress, Racial Identity, and ADHD History in Relation to Concurrent Alcohol Craving

	Model 4						Model 5														
	Black			White			No ADHD			ADHD											
	B	SE	p	B	SE	p	B	SE	p	B	SE	p									
Stress (BETWEEN-person)	.06	.12	.654	-.04	.12	.736	.21	.06	<.001	.24	.10	.015	.04	.06	.476	.07	.04	.051	.03	.05	.645
Stress (WITHIN-person)	.07	.02	.004	-.01	.02	.750	.06	.01	<.001	.06	.02	<.001	.06	.01	<.001	.05	.01	<.001	-.01	.01	.196

Notes. Three-level multilevel models (clustered on study ID and study day; random slope for number of days in study) estimated with maximum likelihood estimation. Models included all covariates. Interactions probed by first running models separately for Black and White drinkers and then rotating the reference group for ADHD. Racial identity is abbreviated to race in the table. Bolded entries are statistically significant. *N* = 229.

Table 4
Associations Between Stress and Alcohol Craving at the Subsequent EMA Time Point by Racial Identity and ADHD History

	Model 1			Model 2			Model 3			Model 4															
	Main effect			Stress X Race			Black			White			Stress X ADHD			ADHD			No ADHD						
	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p	
Stress (BETWEEN-person)	.12	.03	<.001	.13	.06	.021	.20	.05	<.001	.07	.04	.058	.02	.06	.762	.13	.03	<.001	.11	.05	.044	.01	.01	.192	
Stress (WITHIN-person)	.01	.01	.295	.05	.02	.001	.04	.01	.001	-.01	.01	.304	-.01	.01	.419	.002	.01	.821	.01	.01	.01	.01	.01	.192	
Assessment time of day	.08	.005	<.001																						
Number of days in study	-.02	.003	<.001																						
Weekend	.11	.02	<.001																						
Race (1=Black)	.08	.08	.295																						
Sex (1=Male)	-.05	.08	.566																						
ADHD history (1=ADHD)	-.02	.07	.755																						
Income	-.04	.02	.072																						
Education	.01	.03	.681																						
Age	.01	.01	.156																						

Notes. Three-level multilevel models (clustered on study ID and study day; random slope for number of days in study) estimated with maximum likelihood estimation. Interactions probed by rotating the reference group for racial identity/ADHD in Model 1. Racial identity is abbreviated to race in the table. Bolded entries are statistically significant. *N* = 225 (reduced from full *N* of 229 because 4 individuals did not have valid data for both stress and craving at the subsequent EMA time point).

Table 5
 Three-way Interactions Among Lagged Stress, Racial Identity, and ADHD History in Relation to Subsequent Alcohol Craving

	Model 4						Model 5														
	Black			White			Black			White											
	Stress X Race X ADHD	Stress X ADHD	ADHD	Stress X ADHD	No ADHD	ADHD	Stress X ADHD	No ADHD	ADHD	Stress X ADHD	No ADHD	ADHD									
B	SE	p	B	SE	p	B	SE	p	B	SE	p	B	SE	p							
Stress (BETWEEN-person)	.02	.13	.872	-.02	.13	.900	.21	.06	.001	.22	.11	.040	.03	.07	.656	.07	.04	.089	.04	.06	.544
Stress (WITHIN-person)	.04	.03	.146	-.04	.02	.141	.02	.02	.172	.06	.02	.001	.01	.02	.736	-.01	.01	.633	-.01	.01	.382

Notes. Three-level multilevel models (clustered on study ID and study day; random slope for number of days in study) estimated with maximum likelihood estimation. Models included all covariates. Interactions probed by first running models separately for Black and White drinkers and then rotating the reference group for ADHD history. Racial identity is abbreviated to race in the table. Bolded entries are statistically significant. *N* = 225 (reduced from full *N* of 229 because 4 individuals did not have valid data for both stress and craving at the subsequent EMA time point).