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Different Subjective and Objective Responses to Alcohol Among Heavy and Light Drinkers of Han and Uyghur Nationalities in China

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Abstract

Objective—Given the observed differences in alcohol consumption characteristics between the Han and Uyghur nationalities in clinical reports and in daily life, the subjective and objective responses to alcohol in heavy drinkers (HDs) and light drinkers (LDs) in the Han and Uyghur nationalities in China were compared.

Methods—A within-subject, double-blind, placebo-controlled human laboratory paradigm was performed. Each subject completed three experimental sessions in random order. Biphasic Alcohol Effects Scale and Positive and Negative Affect Schedule scales were administered, and heart rate (HR), blood pressure, and salivary cortisol levels were measured at predrink baseline and 30, 60, 120, and 180 minutes after the initial alcohol beverage consumption.

Results—Compared with LDs, HDs exhibited higher stimulation, positive affect, and lower sedation in both ethnicities. Han drinkers (both HDs and LDs) exhibited higher sedation and lower

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positive affect and stimulation than Uyghur drinkers after consumption of alcohol. Moreover, HDs exhibited more HR increase during the ascending limb of breath alcohol content ($p < .05$) and less cortisol level during the declining limb of breath alcohol content ($p < .05$). Both HDs and LDs exhibited decreased systolic and diastolic pressures for both high- and low-dose beverages ($p < .01$).

Conclusion—Compared with LDs, HDs exhibited more HR increase and lower salivary cortisol level after alcohol consumption. Han drinkers (both HDs and LDs) exhibited higher sedation and lower positive affect and stimulation after consumption of alcohol as compared with Uyghur drinkers. This modality of subjective and physiological responses to alcohol in the Han and Uyghur ethnicities is similar.

Keywords

alcohol use disorder; ethnicity; heavy drinker; subjective response to alcohol

INTRODUCTION

Alcohol has multiple behavioral and neurobiological effects. It is a psychoactive compound and can elicit a spectrum of behavioral effects, which include gregariousness, anxiolysis, aggression, loss of executive functions, and cognitive deficits. Alcohol causes more traffic accidents, crime, violence, and job-related impairments (Cheripitel et al., 2012; Wang et al., 2010; Zeng & Wu, 2010; Zhang et al., 2007). Individuals vary widely in their subjective response to the pharmacological and neurobehavioral effects of alcohol consumption. Some may be sensitive to the stimulant-like effects of alcohol, whereas others may be more sensitive to the sedative and aversive effects. The differences in the subjective experiences of ethanol's effects appear to play a significant role in the predisposition to alcohol abuse and dependence (King, de Wit, McNamara, & Cao, 2011; Newlin & Renton, 2010; Viken, Rose, Morzorati, Christian, & Li, 2003). Previous research has shown that subjective responses to alcohol represent an important endophenotype for alcohol use and misuse (Ray, Mackillop, & Monti, 2010). Aside from the subjective response to alcohol as a risk factor for alcohol use problems, the objective response to alcohol, such as heart rate (HR), may also be an important measure of sensitivity to the stimulant properties of alcohol.

Although alcohol is classified as a central nervous system depressant, it also has psychostimulant properties. Alcohol has dose-dependent and biphasic effects on locomotor activity (Brumback, Cao, & King, 2007; Friedman, Carpenter, Lester, & Randall, 1980), and the locomotor-stimulant effects of alcohol also appear to be mediated (possibly indirectly through opiate mechanisms) by dopaminergic mechanisms (Barrett et al., 2008; Blum, Oscar-Berman, Badgaiyan, Braverman, & Gold, 2014; Diaz, Jotty, Locke, Jones, & Valenzuela, 2014; Moonat, Starkman, Sakharkar, & Pandey, 2010). Activation of the mesolimbic dopamine system results in not only increased motor behavior and autonomic arousal but also increased HR (Brunelle et al., 2004; Schrieke et al., 2014; Ray, McGeary, Marshall, & Hutchison, 2006; Patricia et al., 2001). Increases in resting HR have been shown to be directly proportional to changes in the reinforcing properties of a stimulus, an effect that is independent of the effects of anxiety responses and general motor activity on HR (Conrod, Peterson, & Pihl, 2001; Stewart, Collins, Blackburn, Ellery, & Klein, 2005).

Some studies indicate that the alcohol-induced HR increase reflects a specific sensitivity to the psychomotor-stimulant properties of alcohol. These studies also report that genetic predisposition to alcoholism is partially mediated by a specific sensitivity to this very addictive property of alcohol (Conrod et al., 2001; Patricia et al., 2001).

Heavy alcohol consumption and rapid increases in blood alcohol levels increase cortisol or corticosterone levels in humans and nonhumans (Välimäki, Härkönen, Eriksson, & Ylikahri, 1984). Both acute alcohol intoxication (Cobb & Van Thiel, 1982; King, Schluger, et al., 2002; Rivier, Bruhn, & Vale, 1984) and withdrawal (Adinoff et al., 1991; Iranmanesh, Veldhuis, Johnson, & Lizarralde, 1989; Risher-Flowers et al., 1988) increase levels of hypothalamic–pituitary–adrenal axis-derived stress hormones. However, people with a biological family history (FH) of alcoholism exhibit a blunted cortisol response to alcohol (Schuckit, 1984; Schuckit, Gold, & Risch, 1987). Reduced cortisol reactivity was also found in social heavy drinkers (HDs) compared with light drinkers (LDs) in the American population (King et al., 2011; King, Munisamy, de Wit, & Lin, 2006).

Some studies have investigated the subjective and objective responses to alcohol in different populations, such as at-risk participants with alcoholic FH and heavy social drinkers. Most of these studies were performed in western populations; similar studies in East-Asian populations, such as in China, are limited. The few available studies on objective responses to alcohol in Chinese people investigated HR or blood pressure, degree of facial flushing, and prolactin hormone levels. To our knowledge, this is the first study to focus on the subjective and objective responses to alcohol after consumption of different doses of alcohol in social drinkers in the Uyghur and Han ethnicities in China. Breath alcohol content (BrAC), HR, blood pressure, and saliva cortisol level were selected as objective responses to alcohol. To identify the objective response to alcohol that exerts an influence on alcohol use and alcohol dependence, differences between HDs and LDs in response to a challenge dose of alcohol were investigated.

This study employed a within-subject, double-blind, placebo-controlled, dose-ranging alcohol challenge procedure in young adult HDs and LDs of the Han and Uyghur nationalities in China. The Uyghur nationality is one of the ethnic minorities in China and accounts for almost half of the total population in Xinjiang, whereas the Han nationality accounts for 40% (National Bureau of Statistics of the People's Republic of China, 2012). In routine clinical practice, we observed many Uyghur individuals with alcohol dependence or alcohol-related problems. They may, on an average, ingest a larger volume of alcohol per drinking occasion or a higher drinking frequency than the Han nationality. However, no data are available on the state or prevalence of alcohol consumption and alcohol-related problems in the Uyghur population.

Some studies have shown that the Uyghur population was formed by a two-way admixture, with 60% European ancestry and 40% East Asian ancestry, and these studies estimated that the admixture event occurred about 2520 years ago (Li, Cho, Kidd, & Kidd, 2009; Xu, Huang, Qian, & Jin, 2008). Some research indicated that the frequency of the *ADH1B2**2 allele in the Uyghur population was 15%, which was lower than that of the Han population or other ethnicities living in the east or west region in China (Li et al., 2008), which may

affect the metabolism and distribution of alcohol in vivo. The subjective and objective responses to alcohol may also differ between the two ethnicities.

In this study, we aim to ascertain the drinking habits and subjective and objective responses to alcohol in the Han and Uyghur ethnicities and to discuss the potential reasons that affect their subjective responses to alcohol. It is additionally important to note that, in Chinese culture, women are discouraged from drinking alcohol and from using illicit substances. The male-to-female ratio of alcohol dependence is approximately 33:1 (Hao et al., 2004). Therefore, female participants were not included in this study.

MATERIALS AND METHODS

Participants

The consent form indicated that the study aimed to assess the subjective and objective responses to some common substances. The categories of substances included stimulants, sedatives, alcohol, or a placebo. The recruited participants were men, aged 21–35 years, and weighed 50–95 kg. The participants presented in good general health without current or past physical or psychiatric disorders or alcohol or substance dependence disorders and with a regular lifestyle for at least 2 years. Exclusion criteria included a history of alcohol or substance dependence or regular heavy use of drugs other than alcohol. The participants were 70 healthy Han and 70 healthy Uyghur men recruited from word-of-mouth referrals and local flyers. The participants were screened through telephone interviews to determine whether they met the criteria of HD or LD. The criteria for the HD group were as follows: (a) consuming at least 10 but not more than 40 standard alcoholic drinks per week and (b) engaging in regular binge drinking, defined as consumption of five or more drinks on an occasion, one to five times per week, on average (King et al., 2011). The criteria for the LD group were as follows: (a) consuming at least one but not more than five standard alcoholic drinks per week and (b) not engaging in binge drinking. The two nationalities contained 35 HDs and 35 LDs. This study was conducted in accordance with the Declaration of Helsinki. This study was conducted with approval from the ethics committee of Central South University. Written informed consent was obtained from all participants.

Experimental Procedures

The participants deemed eligible in the telephone interview received an in-person screening. The screening included a survey of quantity and frequency of alcohol consumption, which we designed, and a structured clinical interview for DSM-IV Axis 1 disorders. The clinical interview consisted of a screening module and specific modules for mood episodes and substance use disorders as well as a brief physical examination. The participants also completed the symptom checklist, Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) and a two-generation FH tree for alcohol use disorders. The term “FH positive” was defined as having at least one primary biological relative or two or more secondary biological relatives with an alcohol use disorder. “FH negative” was defined as having no biological relatives in the past two generations with an alcohol use disorder.

This study used a within-subject, double-blind, placebo-controlled design. Each subject participated in three experimental sessions separately with low-dose alcohol (0.4 g/kg), high-dose alcohol (0.8 g/kg), or placebo administered in a random sequence. Each session was separated by at least 48 hours. The alcoholic beverage consisted of 8% by volume 52-proof alcohol (0.4 g/kg) and 16% by volume alcohol (0.8 g/kg) mixed with ice-red tea (a kind of beverage with no caffeine or alcohol and low sugar content). The placebo beverage contained 1% alcohol as a taste mask to reduce expectancy effects. During each session, neither the subject nor the experimenter was aware of the contents of the beverages.

The participants arrived in the afternoon for each session. The participants completed the demographic and baseline questionnaires requiring subjective responses and the objective indices, which measured test and pulse performance, blood pressure level, breathalyzer test, and saliva sample. After half an hour, the participants consumed the beverages in the experimenter's presence. The beverages were divided into two equal parts, and the participants were asked to finish the beverages within 15 minutes. Some of the first part was to be consumed in the first 5 minutes, and the rest was to be consumed in an additional 5 minutes; the second part was to be consumed in the last 5 minutes. After the beverages were finished, the participants were allowed to perform an activity, such as playing card games or other simple mobile games in the experiment room. Then, the participants completed the subjective questionnaires (Biphasic Alcohol Effects Scale [BAES] and Positive and Negative Affect Schedule [PANAS]), and their objective indices (HR, blood pressure, saliva cortisol, and BrAC) were measured 30, 60, 120, and 180 minutes after finishing the beverages. After the session was completed, the participants were sent home.

Subjective Measure

BAES—The BAES has been used as a questionnaire with good reliability and validity and sensitivity to responses to stimulant and sedative effects of alcohol. It consists of two subscales, namely, stimulation and sedation, which correspond to alcohol effects often observed on the ascending and descending limbs of BrAC, respectively (Martin, Earleywine, Musty, Perrine, & Swift, 1993). The questionnaire consists of 14 items with 14 adjective words. Each item is rated using an 11-point scale ranging from not at all (0) to extremely (11). The stimulation subscale is the summation of scores for the adjectives elated, energized, excited, stimulated, talkative, up, and vigorous. The sedation subscale score is the summation of the descriptors down, heavy head, difficulty concentrating, inactive, sedated, slow thoughts, and sluggish. The instructions were modified to read "Please rate the extent to which these words describe your feelings at the present time."

PANAS—The PANAS is a 20-item adjective rating scale that assesses the participants' current affective state (Watson, Clark, & Tellegen, 1988). The positive affect (PA) scale reflects the degree to which a person feels joyful, active, elated, or strong, and the negative affect (NA) scale reflects the degree to which a person experiences negative arousal, such as distress, hostility, anger, or anxiety. Each item is rated from not at all (0) to extremely (Viken et al., 2003).

Objective Measure

BrAC was obtained by an alcohol breath concentration detector (CA2000; South Korea). Several studies show that the rising and declining limbs of the blood alcohol curve occur 30 and 120 minutes, respectively, after alcohol consumption (Brumback et al., 2007; Brunelle, Barrett, & Pihl, 2007; Fillmore, Marczinski, & Bowman, 2005; King, Houle, deWit, Holdstock, & Schuster, 2002). The concentration of blood alcohol was measured 30 minutes before beverage consumption and 30, 60, 120, and 180 minutes after drinking.

HR and blood pressure—An automated monitor (Omron; Dalian Infinite Company, China) was used to measure HR (in beats per minute) and blood pressure (in mmHg) at each time point, and the data were recorded by the experimenter.

Cortisol level—Each participant chewed plain cotton (Salivettes; Sarstedt, Newton, NC) 30 minutes before consumption and 30, 60, 120, and 180 minutes after consumption. Because of the budget of the study, saliva samples of only Han drinkers, and not of Uyghur drinkers, could be collected. All saliva samples were stored in a -70°C freezer until analysis using an enzyme immunoassay (Diagnostics Biochem Canada, Inc., Dorchester, Ontario, Canada). The assay method was standardized and validated at the Center Laboratory of the First Affiliated Hospital of Xinjiang Medical University.

Statistical Analysis

Demographic and drinking characteristics for the HDs and LDs were examined by t tests and χ^2 tests. The main dependent variables were BAES and PANAS scores, salivary cortisol, HR, and blood pressure. These data were analyzed with repeated-measures analysis of variance with group (HDs and LDs) as a between-subject factor and dose (placebo, 0.4 and 0.8 g/kg) and time (baseline and 30, 60, 120, and 180 minutes) as within-subject factors.

In all analyses, F values were considered significant at $p < .05$. To protect against the violations of sphericity, Greenhouse–Geisser corrections were used to adjust the degrees of freedom of the F test.

RESULTS

Background Characteristics

Table 1 displays the general demographic and alcohol drinking characteristics of HDs and LDs in the two ethnic groups. No significant differences in mean age, years of education, and weight were observed between the two nationality groups (Han or Uyghur). For the alcohol drinking characteristics, the mean age of first-time drinkers in the Han nationality was identical between the HDs and LDs, but it was earlier in HDs than in LDs in Uyghur nationality ($p < .001$). Significant differences were found in the Alcohol Use Disorders Identification Test scores and the drink per occasion, occasions per week, and binge times per week variables between the HDs and LDs in both nationalities (all p s $< .001$). The HDs presented more alcoholic drinks per drinking occasion and greater frequency of binge drinking than the LDs. There was also a higher proportion of FH of alcoholics among the HDs.

Outcome of BrAC

BrAC increased significantly in the early period after alcohol consumption and decreased slowly after the peak of alcohol concentration. The extent of the increase in BrAC level was consistent with alcohol dose. The following were found for the Han nationality: dose, $F(2, 102) = 75.821$; time, $F(4, 99) = 66.93$, $p < .001$; and Dose $\times$ Time, $F(8, 198) = 26.293$, $p < .001$. The following were found for the Uyghur nationality: dose, $F(2, 102) = 526.218$; time, $F(4, 99) = 6.895$, $p < .001$; and Dose $\times$ Time, $F(8, 198) = 1.634$, $p < .001$ (see Figure 1). The HD and LD groups exhibited a similar curve.

Subjective Effects

HDs versus LDs—Alcohol produced higher stimulation (Han: Group $\times$ Dose $\times$ Time, $F(1, 68) = 100.52$, $p < .01$; Uyghur: Group $\times$ Dose $\times$ Time, $F(1, 68) = 40.38$, $p < .01$; see Figure 2) and increased the PA on PANAS (Han: Group $\times$ Dose $\times$ Time, $F(2, 102) = 0.20$, $p = .045$; Uyghur: Group $\times$ Dose $\times$ Time, $F(2, 102) = 11.20$, $p < .001$; see Figure 3) in HD compared with LD at high and low doses in both the Han and Uyghur ethnic groups. Alcohol increased the sedative effect both in HDs and LDs (Dose $\times$ Time: $F_s(1, 102) < 29.83$, $p_s < .01$) in high and low doses, both in the Han and Uyghur ethnic groups. Similarly, alcohol also increased the NA on PANAS both in HDs and LDs in the Han and Uyghur ethnic groups (Dose $\times$ Time: $F_s(1, 102) > 6.42$, $p_s < .01$).

Comparison between Han and Uyghur—For Han versus Uyghur HDs, alcohol produced higher sedation (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 26.28$, $p < .01$) and lower PA (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 28.55$, $p < .001$), but no differences in stimulation (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 3.36$, $p = .07$) and NA (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 2.43$, $p = .13$) were observed. For Han versus Uyghur LDs, alcohol produced higher sedation (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 7.58$, $p < .01$), lower stimulation (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 0.23$, $p = .03$), and PA (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 5.42$, $p = .02$), but no difference in NA (Ethnicity $\times$ Dose $\times$ Time: $F(1, 68) = 0.08$, $p = .78$).

Objective Effects

Comparison of cortisol levels in Han drinkers—Alcohol increased cortisol levels in the LD group, but not in the HD group, in the Han ethnicity (Group $\times$ Dose: $F(1, 68) = 240.93$, $p < .001$; see Figure 4). The enzyme immunoassay was carried out using the collected saliva samples of the Han ethnic group, whereas no samples were collected and analyzed for the Uyghur ethnic group. The increase in cortisol level in the LD group occurred mainly during the declining limb of the BrAC curve (time: $F(1, 68) = 4.853$, $p = .031$). The LDs exhibited increased cortisol levels both at high and low doses, but the HDs exhibited no response compared with LDs (Group $\times$ Dose: $F_s(1, 68) > 24.56$, $p < .001$). However, the LDs and HDs showed similar responses to the placebo beverage (Group $\times$ Dose: $F(1, 68) = 1.58$, $p = .21$).

Comparison of HR in HD and LD—Both Han and Uyghur HDs exhibited higher HR increase than the LD groups (Han: Time $\times$ Dose, $F(2, 102) = 4.674$, $p = .011$; Uyghur: Time $\times$ Dose, $F(2, 102) = 18.081$, $p < .001$; see Figure 5) during the ascending limb of the BrAC. Moreover, regardless of the consumed beverage, the Uyghur HD group's HR at baseline or

throughout the test was higher than that of the LD groups (group: $F(1, 68) = 21.898, p < .001$). For Han nationality participants, although the difference in HR at baseline between the HD and LD groups was not significant, the HD group's HR was slightly higher than that of the LD group (group: $F(1, 68) = .814, p = .37$). No group difference in HR increase was observed between Han and Uyghur HDs after the high-dose beverage (Group $\times$ Time $\times$ Dose: $F(1, 68) = 3.64, p = .06$).

Comparison of blood pressure in HD and LD—Both systolic and diastolic pressures decreased during ascending BrAC both in HDs and LDs in the Han ethnicity (time: $F(1, 68) > 12.64, ps < .01$; see Figure 6), and no group difference existed between HDs and LDs (Group $\times$ Dose: $F(1, 68) > 0.77, ps > .19$). Both systolic and diastolic pressures also decreased during BrAC both in HDs and LDs in the Uyghur ethnicity (time: $F(1, 68) > 40.71, ps < .01$), and no group difference was observed between HDs and LDs (Group $\times$ Dose: $F(1, 68) > 0.01, ps > .77$). Han HDs exhibited higher diastolic pressure in the high-dose condition compared with the Uyghur group (Group $\times$ Dose: $F(1, 68) = 14.87, p < .001$), but no difference in systolic pressure was found between the two groups (Group $\times$ Dose: $F(1, 68) = .2, p = .66$).

Relationships Between Main Measures

Both BAES and PANAS were designed to assess the subjective response to alcohol, and correlations between the two measures were also found in this study. BAES stimulation was positively correlated with PANAS PA both during ascending BrAC and declining BrAC ($r > .5, p < .002$). BAES sedation was positively associated with PANAS NA during both rising and declining BrAC ($r > .388, p < .021$). BAES stimulation was also positively correlated with increased HR and negatively correlated with the cortisol response to alcohol ($r > .371, p < .002$).

DISCUSSION

The current study investigated the subjective and physiological responses to alcohol in HDs and LDs both in the Han and Uyghur groups. We observed that the HDs exhibited higher excitation in response to alcohol during the rising limb of the BrAC and less sedative effects in response to alcohol during the declining limb of the BrAC than LDs in both ethnic groups. The placebo beverage could not induce these effects, which is similar to the results from American participants of mixed ethnicity and gender. The stimulant-like effects in the Han and Uyghur nationalities were similar in BAES scores. Moreover, Han HDs exhibited lower PA and stimulation and higher sedation, compared with Uyghur HDs.

For objective responses, the results indicated that alcohol induced higher HR after high- or low-dose alcoholic beverages in HDs compared with LDs. HDs exhibited higher HR at baseline than LDs, both in the Han and Uyghur ethnicity groups. No group difference in HR increase was found between the Han and Uyghur HDs. Moreover, systolic and diastolic pressures decreased immediately after alcohol consumption both in HDs and LDs, and no group difference was observed between them. Although systolic and diastolic pressures increased slightly during the declining BrAC limb in all drinkers with high- or low-dose alcoholic beverages, the baseline blood pressure could not be recovered. Salivary cortisol

level increased during declining BrAC in response to both high- and low-dose alcoholic beverages in Han LDs, but not in Han HDs.

The HDs were more sensitive to the stimulation effect and exhibited less sedation both after high- and low-dose alcoholic beverages than LDs. The HDs also reported more drinking occasions and drinks. More stimulation, PA, and less sedation after alcohol consumption may partly explain why HDs consume alcohol more and frequently binge drink more often than LDs.

An interesting result was observed in this study. The HDs in both ethnic groups showed some similar responses to alcohol, but some differences in BAES and PANAS scores were found between the two ethnicities. Uyghur HDs exhibited lower sedation and higher PA than Han HDs, but no difference in stimulation was observed between them. On the basis of these results, we can postulate that the Uyghur population has more HDs than the Han population. To date, there has been no epidemiological investigation about the prevalence of alcohol use disorders or dependence in the Uyghur and Han ethnicities in Xinjiang province. However, in clinical practice, more Uyghur patients with alcohol use disorders were observed.

Some studies suggest that some objective responses, such as HR, may affect people's subjective experience by increasing the excited feeling after alcohol consumption (Patricia et al., 2001). In this study, the HDs exhibited higher HR both at baseline and during the ascending BrAC limb, compared with LDs. Whether higher HR at baseline in HDs was a predisposition or an outcome of binge drinking is unknown. Conrod, Peterson, Pihl, and Mankowski (1997) found a positive relationship between HR increase and self-reported stimulation during the rising limb of the BrAC. Another study indicates that sensitivity to alcohol-induced HR increase during the ascending limb of the blood alcohol curve may be a useful and informative marker for understanding susceptibility to alcoholism (Patricia et al., 2001). This study found that HDs had higher HRs than LDs, and the stimulation and positive affect were positively correlated with increased HR.

Several studies suggest that the hypothalamic–pituitary–adrenal axis may be important in the development of alcohol dependence. Individuals with a positive FH of alcoholism have blunt stress responses compared with those without FH of alcoholism (Schuckit, 1984; Schuckit et al., 1987). Other populations at risk for alcohol use disorders, such as heavy social drinkers, exhibited a similar cortisol response after alcohol consumption compared with LDs (King et al., 2006). The results of this study duplicated the previous outcomes and provided support for a physiological difference between HDs and LDs. Both Han and Uyghur HDs exhibited a higher HR increase than LD groups, but there was no significant difference in HR increase and blood pressure change between Han and Uyghur HDs. Thus, HR may be a stable indicator for the stimulant effect of alcohol in HDs.

The reasons underlying the differences in alcohol consumption between HDs and LDs may relate to the differences in subjective responses and rewarding effects after drinking. Moreover, genetics, which is beyond the scope of this study, can also be an important attributing factor in the different subjective responses to alcohol in different populations and ethnicities. Significant differences in alcohol metabolic enzyme between the Asian and

European populations are observed. Most studies focus on the *ADH1B*2* and *ALDH2*2* alleles, which influence the speed of alcohol metabolism. Some studies show that the frequency of the *ADH1B*2* allele in the Uyghur and Kazak populations is 15%, which is lower than that of the Han population or other ethnic groups living in the east, west, or south region in China (Li et al., 2008). Allele frequency may be another factor causing different rewarding effects and BAES responses in the Uyghur and Han ethnicities.

Special alcohol culture, such as interpersonal pressure during drinking, is another potential factor that induces people to drink excessively in China. People like drinking collectively and typically drink at mealtimes. Drinking alone is not advocated in Chinese culture (Wei, Derson, Xiao, Li, & Zhang, 1994). During collective drinking, people are often forced to drink under the interpersonal pressure from superior leaders or older adults and peers (Zhou, Zhang, Hu, Fan, & Hao, 2013). This phenomenon is more common and frequent in the Han than in the Uyghur ethnic groups. Therefore, some people will drink excessively under interpersonal pressure and fall into the HD group but get no pleasure or rewarding effect from drinking.

This study had several limitations. First, all the participants were men. Considering that women are not agreeable to drinking on social occasions and the proportion of female HDs is by far lower than male HDs in China, only male participants were recruited for this study. We were unable to compare men with women, so whether they exhibit a similar subjective response to alcohol after consumption remains unknown. Second, the longitudinal information about all the data was not provided. Therefore, the conclusions of our study are still speculative until further prospective study is performed.

CONCLUSION

In summary, early onset of drinking and habitual heavy drinking strongly predicted the development of alcohol use disorders, but the mechanisms responsible for heavy drinking are not well known. This study showed that HDs exhibited higher stimulation, PA, and increased HR and reported more drinking occasions and drinks but had lower sedation and cortisol level, when compared with LDs. Therefore, subjective responses to alcohol and increased HR may be a good indicator for heavy drinking or alcohol use disorders in the future. On average, the Han and Uyghur populations exhibited different BAES scores and PA. Han HDs exhibited lower PA and stimulation and higher sedation compared with Uyghur HDs. The potential factors underlying the different subjective and objective responses between HDs and LDs in different ethnic groups may result from not only biological factors, such as alcohol pharmacokinetics and pharmacodynamics, but also cultural factors, especially alcohol culture. In future studies, we will divide HDs into two groups: HDs who like drinking and those who do not like drinking. We will also investigate each group's genetic polymorphism related to alcohol pharmacokinetics and pharmacodynamics. Thus, the relationship between the subjective response to alcohol and the environment and genes will be analyzed further.

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Figure 1.
BrAC in Uyghur vs. Han heavy and light social drinkers.

Figure 2. Subjective alcohol response (BAES) in Uyghur vs. Han heavy and light social drinkers.

Figure 3.
Subjective alcohol response (PANAS) in Uyghur vs. Han heavy social drinkers.

Figure 4.
Objective alcohol response (saliva cortisol level) in Han heavy and light social drinkers.

Figure 5. Objective alcohol response (heart rate) in Uyghur vs. Han heavy and light social drinkers.

Figure 6. Objective alcohol response (blood pressure) in Uyghur vs. Han heavy and light social drinkers.

TABLE 1

The General Demographic Characteristics of the HD and LD Groups

Variables	Han Nationality		p/χ^2	Uyghur Nationality		p/χ^2
	HD	LD		HD	LD	
Demographic characteristics						
Age	25.6 (3.99)	23.74 (4.0)	.06	26.63 (3.83)	25.06 (3.44)	.08
Educational years	15.11 (2.95)	14.89 (2.61)	.73	14.06 (2.46)	14.41 (2.54)	.54
Weight	73.09 (11.62)	70.06 (10.37)	.26	75.11 (8.56)	73 (8.64)	.31
Alcohol-related variables						
Age at first drink	16.14 (2.67)	16.03 (2.54)	.86	15.63 (1.61)	17.03 (1.49)	.00
AUDIT scores	9.83 (2.19)	3.17 (0.66)	.00	9.74 (1.60)	2.94 (0.42)	.00
Drinking days/month ^a	13.03 (2.89)	6.54 (1.99)	.00	14.63 (2.65)	6.51 (1.96)	.00
Binge days/month ^b	9.49 (3.00)	0	.00	11.14 (1.94)	0	.00
Drinks/drinking day ^c	8.71 (2.06)	3.37 (0.85)	.00	8.46 (1.48)	3.23 (0.53)	.00
Positive family history ^d (%)	40	5.7	.00	37.1	2.9	.00

Note. Data are mean (*SEM*) or *n* (%). AUDIT = Alcohol Use Disorders Identification Test.

^aDrink was defined as standard drink: one drink = 10-g pure ethanol.

^bBinge criteria were 5 drinks per occasion for men and 4 drinks for women.

^cThe number of drinks during a day.

^dPositive family history: having at least one primary biological relative or two or more secondary biological relatives with an alcohol use disorder.