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Subjective alcohol responses in a cross-sectional, field-based study of adolescents and young adults: Effects of age, drinking level, and dependence/consequences

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ABSTRACT

Background: Adolescents are physically, cognitively, socially, and emotionally different than adults in ways that may partially explain why alcohol misuse typically develops during this period. Ample animal-science evidence and nascent ecological evidence points toward developmentally limited differences in sensitivity to alcohol's stimulatory and sedative effects. Field-based research methods were used to test for such age-related differences in a sample of adolescents through young adults. Potential moderating influences of estimated blood alcohol content (eBAC), as well as typical consumption and level of dependence/consequences were explored.
Methods: Subjective alcohol responses were collected from 1,364 participants, aged 17 to 32 years, recruited outside of venues where drinking takes place in a small metropolitan bar district.
Results: Self-reports of stimulatory response to alcohol were age-related, such that younger participants reported increased subjective stimulation at the time of data collection relative to older participants. Age-related differences in stimulatory responses were more pronounced at lower eBACs and among younger participants who typically drank more heavily. Stimulatory responses generally diminished among older than younger participants, although individuals with greater dependence/consequences consistently reported greater stimulation from drinking. Contrastingly, age, typical consumption, and dependence/consequences were not related to sedation in this sample.
Conclusions: This research provides cross-sectional evidence to support age-, consumption-, and dependence/consequences-related differences in stimulatory alcohol responses among adolescents and young adults assessed within a bar-area context. While cross-sectional, the results of this field-based study provide support for the theory that addiction liability is developmentally linked and associated, in part, with age-related differences in subjective alcohol responses.

1. Introduction

Drinking escalates dramatically during adolescence, and alcohol use disorder (AUD) typically emerges prior to the legal drinking age (Behrendt et al., 2009; Hingson et al., 2006; Johnston et al., 2015; Windle et al., 2009). Despite the critical importance of the adolescent years for the development of AUD, subjective responses to alcohol's effects (e.g., stimulation, sedation), which are chief risk factors in contemporary theories of addiction (Kassel et al., 2007; Ray et al., 2010; Sher et al., 2005; Volkow et al., 2016), are rarely directly studied in human adolescents due to restrictions on administration of alcohol to underage drinkers. The present study leveraged field-based data collected in a naturalistic, bar-area setting to test age-related hypotheses regarding alcohol's effects in a sample spanning adolescence through early adulthood. Because adolescence is a key formative period for AUD, bridging this gap is essential for informing developmental models of alcoholism and advancing early interventions.

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1.1. Level of alcohol response

Level of response (LR) to alcohol's effects is one of the most extensively-studied phenotypes reflecting a genetic predisposition to AUD (Schuckit, 1980, 1984; Schuckit and Smith, 1996, 2011, 2013). Reviews of alcohol-challenge studies in humans support a low LR model, where lower responses to alcohol's sedative effects confer risk for AUD (Schuckit, 2014), but also a "differentiator" model that distinguishes between rising and falling BrACs (Morean and Corbin, 2010; Newlin and Renton, 2010; Newlin and Thomson, 1990; Quinn and Fromme, 2011). A recent human laboratory study by King et al., 2014, 2011 supports a "modified differentiator model", finding that heavy drinkers who reported greater stimulatory effects and lower sedative effects at peak BrAC experienced more symptoms of alcohol pathology through 6 years of follow-up. Further, re-examination of subjective alcohol responses in this sample demonstrated that initial differences in alcohol sensitivity among heavy drinkers did not diminish over time as AUD symptoms developed (King et al., 2016), which may mark the early stages of addiction in accordance with an allostatic model of AUD development (Volkow et al., 2016).

Regardless of the specific predictions, all LR theories are founded in the idea that early responses to alcohol mark risk for developing AUD. However, current evidence for LR theories (in humans) is primarily based on retrospective reports of early drinking experiences or alcohol challenge studies with adult drinkers. Yet, retrospection may be biased for drinkers with many years of drinking experience (de Wit and Phillips, 2012). For example, in a recent 25-year longitudinal study of male drinkers, retrospective reports of early alcohol effects were more strongly related to problems as participants aged, suggesting that reporting of early drinking effects may be influenced by life experience (Schuckit and Smith, 2013). Thus, subjective effects of alcohol need to be studied as early in the drinking history as possible (Schuckit, 2014).

1.2. Adolescent alcohol responses

Adolescents' responses to alcohol may differ from adults in ways that contribute to the prototypical heavy drinking during this developmental period (Crabbe et al., 2010; de Wit and Phillips, 2012; Schramm-Sapyta et al., 2009; Spear, 2011a). Animal analogues have shown that adolescent rats and mice from outbred strains not only typically drink 2–3 times more alcohol than do adult rats, but are less sensitive to the aversive, sedative and, and motor impairing effects of alcohol while showing greater sensitivity to alcohol's stimulatory and social-facilitating effects than adults (Quoilin et al., 2010; Spear, 2011b). These alcohol sensitivities often persist into adulthood after chronic alcohol exposure during adolescence in rodents (see Spear and Swartzwelder, 2014; for review), perhaps contributing to the greater propensity for high levels of alcohol use in adulthood after adolescent alcohol exposure (Spear and Varlinskaya, 2010; Windle et al., 2009).

Few studies have directly examined alcohol's effects in human adolescents. The first and only human laboratory study, published nearly 35 years ago, evaluated risk biomarkers following a moderate dose of alcohol that produced blood alcohol concentrations (BAC) of approximately 0.04 mg/ml among 22 alcohol-naïve boys aged eight to 15 years. These youth reached peak breath alcohol levels at a faster rate than is typical of adults administered a similar alcohol dose, while also showing smaller behavioral changes than anticipated given their BAC (Behar et al., 1983). A recent ecological study assessed dose-related changes in subjective ratings of stimulation and sedation on the ascending limb of intoxication using handheld wireless devices among a small sample of 29 adolescents aged 15 to 19 (Miranda et al., 2014). Youth were instructed to record subjective stimulatory and sedative states just before beginning to drink as well as their subjective responses following each of the first three standard drinks of a drinking episode, which produced an average estimated BAC (eBAC) equivalent to the Behar study (.04 mg/ml). Responses for this adolescent sample were compared to an additional sample of 36 adult drinkers (aged 24 to 64 years) from a separate study implementing a similar protocol. Although adolescents experienced decreases in stimulation as eBAC increased, overall their stimulatory response was greater than that of their adult counterparts at low to moderate eBACs.

1.3. Field-based investigations of alcohol use

Field-based research methods have historically tested the ecological validity of findings from experimental studies of acute intoxication, and examined phenomena that cannot easily be reproduced in laboratory settings (Clapp et al., 2007; Johnson et al., 2006). For example, field-based alcohol research has provided new insights on individual and environmental predictors of drinking (e.g., Clapp et al., 2008a,b; Thombs et al., 2009) and on the effects of alcohol use on cognitive performance among underage drinkers (i.e., age 18–20; Day et al., 2013). Although studies conducted in the natural environment sacrifice some experimental control, this limitation is mitigated by the unique opportunity to observe acute alcohol consumption at levels well above what is permissible in laboratory administration paradigms and, perhaps more importantly, to observe this phenomenon during a pivotal window in the development of AUD among underage drinkers.

1.4. Hypotheses

The present field-based study provides a cross-sectional test of age differences in subjective responses to alcohol, namely stimulatory and sedative effects. We expected that younger age would be associated with greater self-reported stimulation and lesser sedation among adolescents and young adults recruited in an ecologically valid setting and in the context of a natural drinking episode. Previous ecological momentary assessment (EMA) research found that adolescents experience greater stimulation while drinking in the natural environment, relative to adults, but this effect diminished at higher estimated eBACs (Miranda et al., 2014). Therefore, we also tested for interactive effects of age and eBAC, and expected that the relation of age to stimulatory responses to alcohol would be attenuated at higher eBACs. Given the theoretical link between the development of drinking problems and AUD to enhanced stimulatory and blunted sedative subjective responses, we also expected that greater typical alcohol consumption and a higher degree of alcohol dependence/consequences would be associated with greater self-reported stimulatory alcohol responses and lesser sedative responses. We also tested for interactive effects of typical alcohol consumption and alcohol dependence symptoms/consequences with eBAC. Interactive effects of typical alcohol consumption and dependence/consequences with age and gender were also explored.

2. Materials and methods

2.1. Setting and participants

Data were collected outside of venues where alcohol is served within the downtown bar district in Binghamton, NY, which is a small metropolitan city in the southern tier of New York State. Specifically, this area comprises eight bars within a city block (see Fig. 1). Prior studies report on a subset of the current sample for which neuropsychological testing (Celio et al., 2014) and additional online survey data (Usala et al., 2015) were available. The present report utilizes the complete survey sample ($N = 1904$). Sixty-one