Available online at www.sciencedirect.com
SCIENCE DIRECT
International Journal of Psychophysiology 59 (2006) 203 – 209
INTERNATIONAL JOURNAL OF PSYCHOPHYSIOLOGY
www.elsevier.com/locate/ijpsycho

Attenuated cortisol response to alcohol in heavy social drinkers☆

Andrea King *, Geetha Munisamy, Harriet de Wit, Shang Lin

University of Chicago, Pritzker School of Medicine, Department of Psychiatry, Chicago, IL, USA

Received 13 October 2005; received in revised form 15 October 2005; accepted 20 October 2005
Available online 15 December 2005

Abstract

Individual differences in response to stress may play a role in the development and maintenance of addictive behaviors. While there is evidence that people with a biological family history for alcoholism have a blunted cortisol response to alcohol, data are lacking in other at-risk subgroups, such as heavy social drinkers. The present study examined salivary cortisol response to administration of 0.0, 0.4 (2 drink equivalent), and 0.8 g/kg (4 drink equivalent) alcohol in two groups of social drinkers: heavy drinkers ($n=32$) and light social drinkers ($n=23$). The study was conducted double-blind and drink-order was counterbalanced between groups. Salivary cortisol and subjective measures were obtained at predrink baseline, and 15, 45, 105, and 165 min after beverage consumption. Results showed a significant group × dose × time interaction ($p<0.005$), with alcohol (0.8 g/kg) producing an attenuated cortisol response in heavy drinkers compared to the light drinkers during the declining phase of the BAC. This outcome remained even after controlling for the effects of smoking status, family history of alcoholism, sex, and negative affect ratings during the session. Neither placebo nor the lower dose of alcohol significantly increased cortisol levels. In sum, a relatively high dose of alcohol produced a smaller increase in cortisol in heavy drinkers compared to light drinkers. The reduced cortisol reactivity in the heavier drinkers is consistent with reports that individuals at risk for alcoholism are hyporesponsive to physical and psychological stress. Further research may help determine whether alteration in cortisol response to alcohol is a biological marker of the propensity to abuse alcohol.

Keywords: Cortisol; HPA axis; Alcohol; Heavy social drinker; Binge drinker; Risk for alcoholism

1. Introduction

Variations in responsivity to stress may play a role in the development and maintenance of alcohol use disorders. Heavy alcohol consumption and rapid increases in blood alcohol levels reliably increase cortisol or corticosterone in humans and nonhumans (Kalant, 1975; Mendelson and Stein, 1966; Merry and Marks, 1969; Valimaki et al., 1984). Both acute alcohol intoxication (Cobb and van Thiel, 1982; Elias et al., 1982; Rivier et al., 1984) and withdrawal (Adinoff et al., 1991; Iranmanesh et al., 1989; Risher-Flowers et al., 1988) increase levels of hypothalamic–pituitary–adrenal (HPA) axis derived stress hormones. Further, diurnal cortisol secretion is dysregulated in alcoholics, although levels return to normal within approximately one week of abstinence (Adinoff et al., 1991). While alcohol-related effects on the HPA axis have been determined in persons with alcohol dependence, the role of stress hormones in the etiology, development, and maintenance of alcohol use disorders remains unclear.

Several lines of evidence suggest that the HPA axis may be important in the development of alcohol dependence. Individuals with a positive family history of alcoholism (FH+) have abnormal stress responses compared to those without family history of alcoholism (FH−). Early studies showed that compared to FH− males, FH+ males exhibited a reduced cortisol response after consuming a moderate to high dose of alcohol (Schuckit, 1984a; Schuckit et al., 1987). In addition to attenuated cortisol reactivity, FH+ individuals also experienced diminished subjective response including reduced sedative effects and less psychomotor impairment as measured by body sway (Schuckit, 1984b, 1985, Schuckit et al., 1996; Schuckit and Gold, 1988). Moreover, in other studies, prepubertal sons of alcoholics had attenuated salivary cortisol responses to antic-

☆ Supported by #R01-AA013746 and M01-RR00055.
* Corresponding author. University of Chicago, Dept. of Psychiatry, 5841 S. Maryland Avenue, Chicago, IL 60637, USA. Tel.: +1 773 702 6181; fax: +1 773 702 6454.
E-mail address: aking@yoda.bsd.uchicago.edu (A. King).

0167-8760/$ - see front matter © 2005 Elsevier B.V. All rights reserved.
doi:10.1016/j.ijpsycho.2005.10.008

ipatory stress (Moss et al., 1995), and FH+ adults with antisocial tendencies had reduced cortisol responses to a speech stressor (Sorocco et al., this issue). Administration of opioid antagonists (which remove tonic opioid inhibition of the HPA axis) have also been shown to produce a differential pattern of results as a function of family history of alcoholism, with FH+ subjects exhibiting greater plasma cortisol and adrenocortical hormone (ACTH) response compared to their FH-counterparts (King et al., 2002a; Wand et al., 1999). Taken together, these data indicate that FH+ and FH− individuals differ in HPA stress responsivity to several psychological as well as pharmacological laboratory challenges.

Another risk factor for alcoholism is heavy drinking at a young age (Hingson et al., 2000). Not only is early-onset heavy alcohol drinking in itself a potentially hazardous behavior, it is also a risk factor for lifetime alcohol problems (Chou and Pickering, 1992). While some college-aged binge drinkers may "mature out" of their problematic drinking habits, for others, alcohol misuse persists or progresses in severity over time (Gruenewald et al., 2002; Hasin et al., 1990; Schulenberg et al., 1996). Recent investigations by our group suggest physiological differences in response to alcohol at the level of the HPA axis in young adult heavy drinkers (defined as consuming 5+ drinks/occasion for males or 4 for females) versus light drinker controls (Holdstock et al., 2000; King et al., 2002b). While our first study with a small sample size did not show alterations in plasma ACTH after alcohol consumption as a function of habitual alcohol consumption (Holdstock et al., 2000), another study with a priori selection of subjects for heavy ($n=20$) and light drinkers ($n=14$) showed that heavy drinkers had lower salivary cortisol responses after drinking (King et al., 2002b). This finding in non-alcohol dependent young binge drinkers is consistent with the previously mentioned findings from Schuckit and colleagues in their high risk subjects, i.e., FH+ men.

The present study was designed to examine cortisol response to two doses of alcohol or placebo in light and heavy social drinkers. Salivary cortisol levels were obtained before beverage consumption, and during both the rising and falling portions of the blood alcohol curve. It was hypothesized that heavy drinkers, compared to lighter drinkers, would show a reduced cortisol response to alcohol, especially at the higher alcohol dose. Secondary analyses using multivariate models were used to assess the role of drinking history independently of family history of alcoholism, smoking status, sex, and negative affect. It was predicted that the effect of drinking status would remain after controlling for family history of alcoholism and other potential confounding factors.

2. Methods

Subjects ($n=55$) were recruited through newspaper and Internet advertisements, word-of-mouth referrals, and local flyers. Candidates were first interviewed over the phone and if eligible, they attended an in-person screening. Subjects were accepted if they were aged 21–35 years, had a body mass index between 18.5 and 30, and qualified as either light drinkers (LD) or heavy drinkers (HD). To qualify for the LD group, subjects had to be lifetime social drinkers with typical alcohol consumption of 1–3 drinks up to several times weekly and with rare consumption of five or more drinks on one occasion (4 for females) totaling to less than 4 times a year. The HD group included regular heavy social drinkers (i.e., predominant pattern for at least the past two years) with a minimum of 10 or more alcoholic drinks per week, and regular weekly binge drinking (5 or more drinks for men and 4 or more drinks for women in one occasion) 1 to 4 times each week. Moderate drinkers with an intermediate amount of alcohol consumption or drinkers with an inconsistent pattern of drinking were not eligible. The drinking inclusion criteria were based on laboratory, epidemiological, and clinical studies of "binge" drinking as 5 or more drinks consumed in an occasion (4 for females) which departs from normative social drinking and may indicate aspects of loss of control (Dawson, 2000; Dufour, 1999). Such binge drinking is also frequently associated with adverse consequences (Dawson, 1999; Single, 1996).

2.1. In-person screening

At the in-person screening, participants were first required to read and sign the consent form, which stated that the purpose of the study was to assess responses to commonly used substances. To control for alcohol expectancies, participants were informed that they might be receiving a stimulant, sedative, alcohol, placebo or a combination of substances. The participants filled out several questionnaires including a demographic information form, the Beck depression inventory (BDI; Beck et al., 1961), the Spielberger Trait Anxiety Inventory (STAI; Spielberger et al., 1970), the Short Michigan Alcoholism Screening Test (SMAST; Selzer et al., 1975), the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 1992), and a quantity–frequency index scale (QFI; Cahalan et al., 1969).

After completing the questionnaires, the participants underwent a modified Structured Clinical Interview for DSM-IV (SCID-P; First et al., 1995) conducted by a trained Master's level clinician. Selected SCID Modules for lifetime mood disorders, alcohol and substance use disorders, and nicotine dependence (where applicable) were also administered. On the questionnaires and interview, standard cut-off thresholds were used to exclude subjects with significant major current or past psychiatric symptomatology (i.e., lifetime history of psychotic disorder, alcohol and other substance dependence, or a past year history of other Axis I disorders). Subjects were not excluded if they met criteria for past or current Alcohol Abuse.

Participants also filled out a family history tree identifying both primary and secondary biological relatives with alcohol use disorders. Parental history of alcohol use disorders was coded positive only if either one or both parents were identified by the subject as having an alcohol use disorder. A less stringent family history criteria was also examined and coded positive if one or more primary relatives, or two or more secondary relatives, were identified with alcohol use disorders.