Available online at www.sciencedirect.com
ScienceDirect
Neuroscience and Biobehavioral Reviews 31 (2007) 246–253
NEUROSCIENCE AND BIOBEHAVIORAL REVIEWS
www.elsevier.com/locate/neubiorev

Review

Woman, alcohol and environment: Emerging risks for health

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Abstract

Alcohol drinking is one of the most relevant problems in Western Countries but the negative effects of alcohol misuse are often neglected or underestimated with serious consequences for public health. Over the last few years a rapid growth in the number of drinking females and the decrease of their age of first use, have increased the health risk for women and their offspring. Moreover, modern environments facilitate pollutants exposure, further escalating the health risks due to lifestyle habits. This review takes into account the peculiarities of alcohol effects on female health and the risks of teratogenic effects. The possible interaction between alcohol and pollutants exposure is also discussed. The role of biomarkers against alcohol-related damage is presented as an invaluable clinical tool, including early intervention, treatment monitoring and, above all, prevention of prenatal non-reversible damage. Recent alcohol studies show the greater severity of alcohol damage in female subjects and the need of gender-targeted intervention.

Keywords: Alcohol; Woman; Environment; Biological markers; Prenatal exposure; Fetal alcohol spectrum disorders (FASD)

Contents

1. Introduction

Alcohol problems are due to several factors, like the availability of alcoholic beverages, social acceptance and traditional usages of alcohol in a culture. These factors complicate the perception of risk due to alcohol misuse. At present, the concept of excessive drinking is still controversial and this brings difficulties in the approach to alcohol problems (Meyerhoff et al., 2005). Modern lifestyle promotes at-risk behavior such as alcohol, tobacco and drugs misuse. Furthermore, many people are also exposed to environmental xenobiotics such as pesticides, heavy metals, and pollutants. The simultaneous exposure to alcohol misuse and environmental toxics may have an amplifying effect on health and a synergistic mechanism of interaction has been postulated. In recent years, gender's influence on drinking patterns and alcohol-related problems has attracted considerable scientific research with implications for a more gender-specific alcohol policy. Several studies support the hypothesis that women are more vulnerable to ethanol effects, because of their

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doi:10.1016/j.neubiorev.2006.06.017

physiological, metabolic, hormonal peculiarities (Mancinelli and Guiducci, 2004; National Institute on Alcohol and Alcohol Abuse (NIAAA), 1990). The increase in the number of drinking females is an emerging problem. This has been demonstrated by US epidemiological studies that revealed a rapid progression of the rate of risky drinking among females (Kessler et al., 1994; Substance Abuse and Mental Health Services Administration, 2000). In Europe, 2004 epidemiological data confirm that the percentage of at-risk female drinkers was increasing more quickly than men's and that the rate among female teenagers was quite similar to male ones (European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), 2005). Further epidemiological data support a raising concern not only for female health but also for the offsprings. In fact, the consequences on the offsprings of maternal alcohol intake during the pregnancy may be dramatic because the fetus is not tolerant to alcohol (Warren and Foudin, 2001).

To evaluate drinking habits and the type of alcoholic beverages used, self-report questionnaires are largely used. But their reliability is questionable since most alcoholics, and especially women, are quite reticent about their drinking patterns and alcohol consumption. To ascertain and evaluate at-risk drinking patterns and to identify alcohol hazard mostly for pregnant women, the role of specific biomarkers is relevant, such as blood alcohol concentration (BAC), transaminases (AST and ALT), mean corpuscular volume (MCV), gamma-glutamil-transferase (GGT), together with clinical examination, instrumental data and psychometric tests as Michigan Alcoholism Screening Test (MAST), Munich Alcoholism Test (MALT), Severity of Alcohol Dependence Questionnaire (SADQ), Alcohol Use Disorders Identification Test (AUDIT) (Sasso et al., 2004).

This paper focuses on some aspects of alcohol-related problem in women, peculiarities of female drinking and possible interactions between alcohol and environmental toxics. The role of biomarkers and specifically the recent advances in the study of alcohol biomarkers will be considered.

2. Alcohol metabolism: gender differences

The effects of ethanol are directly correlated to its BAC. BAC depends on the amount of alcohol ingested and absorbed by the gastrointestinal tract, on its distribution in the body and on the elimination rate. Most tissues of the body contain enzymes involved in the oxidation of ethanol or in its non-oxidative metabolism. As significant activity occurs only in the liver and, to a lesser extent, in the stomach, alcohol-related physical complications are predominant in these organs. In the liver, ethanol oxidation generates an excess of reducing equivalents, mainly NADH, inducing hepato-toxicity. A major cause of this is an additional system, containing cytochromes P-450 2E1(CYP2E1) inducible by chronic alcohol intake, and demonstrated in liver microsomes (Lieber, 2005). CYP2E1 is also induced in Kupffer cells, promoting their activation and the release of inflammatory cytokines, including the tumor necrosis factor (TNF)-α. (Lieber, 2004).

During the first-pass metabolism (FPM) in the stomach, a variable amount of ethanol is metabolized by the gastric isoenzyme of alcohol dehydrogenase (ADH), and the remaining by hepatic ADH.

Many hypotheses have been proposed to explain the more rapid progression of alcohol damage in females. Their enhanced vulnerability may be due to higher blood alcohol levels after drinking, but the mechanisms are debated. BAC is strongly related to body mass index (BMI) and water content in the body. Female BMI and total body water are lower than in males, leading to lowered ethanol diffusion and resulting in higher BAC. If BAC value is normalized according to content of total body water, gender differences are flattened (Ely et al., 1999; Goist and Sutker, 1985). Several years ago it was also demonstrated that the activity of gastric ADH is significantly lower in females than in males and is close to zero in heavy drinking females (Frezza et al., 1990). Thus, in females a larger amount of alcohol ingested will reach the liver, promoting a more rapid progression of liver damage. A recent experimental study showed that the gender differences were concentration-dependent, since women have a gastric metabolism lower than men's, when given 10% or 40% but not 5% alcohol solutions (Baraona et al., 2001).

ADH activity was also demonstrated to be age-dependent (Parlesak et al., 2002). In social drinking males, gastric ADH activity is at the maximum level at 20–40 yr and decreases with age until, at 61–80 yr, it becomes approximately half of the maximum. On the contrary, female gastric ADH activity is minimum at 20–40 yr, reaches the top at 41–60 yr and decreases at 61–80 yr in a manner similar to males. The critical point is at young age (20–40 yr), when the gender difference is maximum and females are more exposed to alcohol's toxic effects. Furthermore, this is the age of fertility and the risk of fetal exposure and damage is increased. BAC levels are related to an impairment of cognitive and psychomotor performance (Maruff et al., 2005). Alcohol may affect female more than male psychological health during adolescence with possible consequences in the behavior later on in life (Wagner, 1993; Ge et al., 1994; Grant, 1998; Markwiese et al., 1998; De Bellis et al., 2000; Vik and Brown, 1998). Brain imaging studies demonstrated specific alterations in the brain of alcoholic women that were not found in nonalcoholic women, such as smaller corpus callosum (Hommer et al., 1996) and larger intracranial spaces (Hommer et al., 2001). On the contrary, male alcoholics do not differ from nonalcoholic males on these measures. Other measures of alcohol-related brain damage, such as ventricle-to-brain volume ratio (Jacobson, 1986), show similar deficits in male and female alcoholics even if females have less severe drinking patterns than males. This evidence supports the hypothesis that female brain is more vulnerable to alcohol toxicity (Sohrabi, 2003). Even