
ALCOHOL ALERT

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Alcohol and Stress

The term "stress" often is used to describe the subjective feeling of pressure or tension. However, when scientists refer to stress, they mean the many objective physiological processes that are initiated in response to a stressor. As this *Alcohol Alert* explains, the stress response is a complex process; the association between drinking and stress is more complicated still. Because both drinking behavior and an individual's response to stress are determined by multiple genetic and environmental factors (1-3), studying the link between alcohol consumption and stress may further our understanding of drinking behavior.

The Stress Response

The maintenance of the body's relatively steady internal state, or homeostasis, is essential for survival. The body's delicate balance of biochemical and physiological function is constantly challenged by a wide variety of stressors, including illness, injury, and exposure to extreme temperatures; by psychological factors, such as depression and fear; and by sexual activity and some forms of novelty-seeking. In response to stress, or even perceived stress, the body mobilizes an extensive array of physiological and behavioral changes in a process of continual adaptation, with the goal of maintaining homeostasis and coping with the stress (4).

The stress response is a highly complex, integrated network involving the central nervous system, the adrenal system, and the cardiovascular system. When homeostasis is threatened, the hypothalamus gland, at the base of the brain, initiates the stress response by secreting corticotropin releasing factor (CRF). CRF coordinates the stress response by triggering an integrated series of physiological and behavioral reactions. CRF is transported in blood within the brain and in seconds triggers the pituitary gland to release adrenocorticotropin hormone (ACTH), also referred to as corticotropin. ACTH then triggers secretion of glucocorticoid hormones (i.e., "steroids") by the adrenal glands, located at the top of the kidneys. Glucocorticoid hormones play a key role in the stress response and its termination (4).

Activation of the stress response affects smooth muscle, fat, the gastrointestinal tract, the kidneys, and many other organs and the body functions that they control (4). The stress response affects the body's regulation of temperature; appetite and satiety; arousal, vigilance, and attention; mood; and more (4).

Physical adaptation to stress allows the body to redirect oxygen and nutrients to the stressed body site, where they are needed most (4).

Both the perception of what is stressful and the physiological response to stress vary considerably among individuals. These differences are based on genetic factors and environmental influences that can be traced back to infancy (5).

Stress is usually thought of as harmful; but when the stress response is acute and transient, homeostasis is maintained and no adverse effects result. Under chronic stress, however, when the body either fails to compensate or when it overcompensates, damage can occur (4). Such damage may include suppression of growth, immune system dysfunction, and cell damage resulting in impaired learning and memory (4,6).

Does Stress Influence Drinking?

Human research to clarify the connection between alcohol and stress usually has been conducted using either population surveys based on subject self-reports or experimental studies. In many but not all of these studies, individuals report that they drink in response to stress and do so for a variety of reasons. Studies indicate that people drink as a means of coping with economic stress, job stress, and marital problems, often in the absence of social support, and that the more severe and chronic the stressor, the greater the alcohol consumption (7). However, whether an individual will drink in response to stress appears to depend on many factors, including possible genetic determinants of drinking in response to stress, an individual's usual drinking behavior, one's expectations regarding the effect of alcohol on stress, the intensity and type of stressor, the individual's sense of control over the stressor, the range of one's responses to cope with the perceived stress, and the availability of social support to buffer the effects of stress (1,2,7,8). Some researchers have found that high levels of stress may influence drinking when alternative resources are lacking, when alcohol is accessible, and when the individual believes that alcohol will help to reduce the stress (1,8).

Numerous studies have found that stress increases alcohol consumption in animals (9) and that individual animals may differ in the amount of alcohol they consume in response to stress (10). Such differences may be related in part to an animal's experiencing chronic stress early in life: Prolonged stress in infancy may permanently alter the hormonal stress response and subsequent reactions to new stressors, including alcohol consumption (10,11). For example, monkeys who were reared by peers, a circumstance regarded as a stressor compared to mother-rearing, consumed twice as much alcohol as monkeys who were mother-reared (10). According to Viau and colleagues (11), adult rats handled for the first 3 weeks of life demonstrate markedly reduced hormonal responses to a variety of stressors compared with rats not handled during this time (11). In humans, Cloninger reported an association between certain types of alcoholism and adverse early childhood experiences (12).

Animal studies reporting a positive correlation between stress and alcohol consumption suggest that drinking may take place in response to chronic stress perceived as unavoidable (2,13). For instance, rats chronically exposed to unavoidable shock learn to be helpless or passive when faced with any new stressor--including shock that is avoidable--and to demonstrate increased alcohol preference compared with rats that received only avoidable shock (2). The rats

exposed to unavoidable shock exhibit the hormonal changes indicative of the stress response, including increased levels of corticosteroid hormones (2).

Whether humans drink in response to uncontrollable stress is less clear, according to Pohorecky (7). In a review investigating the connection between alcohol consumption and stress, Pohorecky notes several studies in which researchers sampled individuals from areas affected by natural disaster. One study found that alcohol consumption increased by 30 percent in the 2 years following a flood at Buffalo Creek, West Virginia. Similarly, there was evidence of increased drinking in the towns surrounding Mount St. Helens following eruption of the volcano (7). Following the nuclear plant accident at Three Mile Island, however, alcohol consumption was infrequently used by those sampled as a means of coping with the resulting stress (14).

In both humans and animals, drinking appears to follow stress (2,3,7,13). Some human research, however, shows that drinking may take place in anticipation of or during times of stress (15).

Does Drinking Reduce or Induce Stress?

Some studies have reported that acute exposure to low doses of alcohol may reduce the response to a stressor in animals and humans. For example, low doses of alcohol reduced the stress response in rats subjected to strenuous activity in a running wheel (3). In humans, a low dose of alcohol improved performance of a complex mental problem-solving task under stressful conditions (3). However, in some individuals, at certain doses, alcohol may induce rather than reduce the body's stress response (16).

Much research demonstrates that alcohol actually induces the stress response by stimulating hormone release by the hypothalamus, pituitary, and adrenal glands (4,6,17,18). This finding has been demonstrated in animal studies. In one study with rats, the administration of alcohol initiated the physiological stress response, measured by increased levels of corticosterone (19). In addition to stimulating the hormonal stress response, chronic exposure to alcohol also results in an increase in adrenaline (20).

Stress, Alcoholism, and Relapse

Stress may be linked to social drinking, and the physiological response to stress is different in actively drinking alcoholics compared with nonalcoholics (17). Researchers have found that animals preferring alcohol over water have a different physiological response to stress than animals that do not prefer alcohol (21). Nonetheless, a clear association between stress, drinking behavior, and the *development* of alcoholism in humans has yet to be established.

There may, however, in the *already established* alcoholic, be a clearer connection between stress and relapse: Among abstinent alcoholics, personally threatening, severe, and chronic life stressors may lead to alcohol relapse (15,22). Brown and colleagues (15) studied a group of men who completed inpatient alcoholism treatment and later experienced severe and prolonged psychosocial stress prior to and independent of any alcohol use. The researchers found that subjects who relapsed experienced twice as much severe and prolonged stress before their return to drinking as those who remained abstinent. In this study, severe psychosocial stress was related to relapse in alcoholic

males who expected alcohol to reduce their stress. Those most vulnerable to stress-related relapse scored low on measures of coping skills, self-efficacy, and social support. Stress-related relapse was greatest among those who had less confidence in their ability to resist drinking and among those who relied on drinkers for social support. Although many factors can influence a return to drinking, Brown and colleagues note that stress may exert its greatest influence on the initial consumption of alcohol after a period of abstinence (15).

***Drinking and Stress--A Commentary by
NIAAA Director Enoch Gordis, M.D.***

Stress is commonly believed to be a factor in the development of alcoholism (alcohol dependence). However, current science is more informative about the relationship between drinking and stress than about the relationship between stress and alcohol dependence.

Drinking alcohol produces physiological stress, that is, some of the body's responses to alcohol are similar to its responses to other stressors. Yet, individuals also drink to *relieve* stress. Why people should engage in an activity that produces effects similar to those they are trying to relieve is a paradox that we do not yet understand. One hypothesis is that stress responses are not exclusively unpleasant; the arousal associated with stress itself may be rewarding. This might explain, for example, compulsive gambling or repeated participation in "thrill-seeking" activities. Current studies may illuminate genetic variations in the physiological response to stress that are important in drinking or other activities with the potential to become addictive.

Training clinical staff to accurately appraise patients' drink-provoking stressors may help staff to identify individuals at risk for relapse. One route to relapse prevention is the teaching of coping skills where patients learn how to deal with these stressors without drinking. How this treatment approach compares with others remains of special interest.

References

(1) **Sadava, S.W.**, & Pak A.W. Stress-related problem drinking and alcohol problems: A longitudinal study and extension of Marlatt's model. *Canadian Journal of Behavioral Science* 25(3):446-464, 1993. (2) **Volpicelli, J.R.** Uncontrollable events and alcohol drinking. *British Journal of Addiction* 82(4): 381-392, 1987. (3) **Kalant, H.** Stress-related effects of ethanol in mammals. *Critical Reviews in Biotechnology* 9(4):265-272, 1990. (4) **Tsigos, C.**, & Chrousos, G.P. The neuroendocrinology of the stress response. In: Hunt, W., & Zakhari, S., eds. *Stress, Gender, and Alcohol-Seeking Behavior*. National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 29. Bethesda, MD: the Institute, 1995. (5) **Meany, M.J.**; Diorio, J.; O'Donnell, D.; Smythe, J.W.; Parent, A.; & Sharma, S. Serotonin as a mediator of the effects of environmental events on the development of the hypothalamic-pituitary-adrenal axis. In: Hunt, W., & Zakhari, S., eds. *Stress, Gender, and Alcohol-Seeking Behavior*. National Institute of Alcohol Abuse and Alcoholism Research Monograph No 29. Bethesda, MD: the Institute, 1995. (6) **Eskay, R.L.**; Chautard,

T.; Torda, T.; & Hwang, D. The effects of alcohol on selected regulatory aspects of the stress axis. In: Zakhari, S., ed. *Alcohol and the Endocrine System*. National Institute on Alcohol Abuse and Alcoholism Research Monograph No. 23. Bethesda, MD: the Institute, 1993. (7) **Pohorecky, L.A.** Stress and alcohol interaction: An update of human research. *Alcoholism: Clinical and Experimental Research* 15(3):438-459, 1991. (8) **Jennison, K.M.** The impact of stressful life events and social support on drinking among older adults: A general population survey. *International Journal of Aging and Human Development* 35(2):99-123, 1992. (9) **Hilakivi-Clarke, L.**, & Lister, R.G. Social status and voluntary alcohol consumption in mice: Interaction with stress. *Psychopharmacology* 108(3):276-282, 1992. (10) **Higley, J.D.**; Hasert, M.F.; Suomi, S.J.; & Linnoila, M. Nonhuman primate model of alcohol abuse: Effects of early experience, personality, and stress on alcohol consumption. *Proceedings of the National Academy of Sciences U.S.A.* 88:7261-7265, 1991. (11) **Viau, V.**; Sharma, S.; Plotsky, P.M.; & Meaney, M.J. Increased plasma ACTH responses to stress in nonhandled compared with handled rats require basal levels of corticosterone and are associated with increased levels of ACTH secretagogues in the median eminence. *The Journal of Neuroscience* 13(3):1097-1105, 1993. (12) **Cloninger, C.R.** Neurogenetic adaptive mechanisms in alcoholism. *Science* 236:410-416, 1987. (13) **Nash, J.F.**, & Maickel, R.P. The role of the hypothalamic-pituitary-adrenocortical axis in post-stress induced ethanol consumption by rats. *Progress in Neuro-psychopharmacology and Biological Psychiatry* 12:653-671, 1988. (14) **Kasl, S.V.**; Chisholm, R.F.; & Eskenazi, B. The impact of the accident at the Three Mile Island on the behavior and well-being of nuclear workers. Part II: Job tension, psychophysiological symptoms, and indices of distress. *American Journal of Public Health* 71(5):484-495, 1981. (15) **Brown, S.A.**; Vik, P.W.; Patterson, T.L.; Grant, I.; & Schuckit, M.A. Stress, vulnerability, and adult alcohol relapse. *Journal of Studies on Alcohol* 56(5):538-545, 1995. (16) **Waltman, C.**; Blevins, Jr., L.S.; Boyd, G.; & Wand, G.S. The effects of mild ethanol intoxication on the hypothalamic-pituitary-adrenal axis in nonalcoholic men. *Journal of Clinical Endocrinology and Metabolism* 77(2):518-522, 1993. (17) **Wand, G.S.**, & Dobs, A.S. Alterations in the hypothalamic-pituitary-adrenal axis in actively drinking alcoholics. *Journal of Clinical Endocrinology and Metabolism* 72(6):1290-1295, 1991. (18) **Krishnan, S.**; Nash, Jr., J.F.; & Maickel, R.P. Free-choice ethanol consumption of rats: Effects of ACTH4-10. *Alcohol* 8(5):401-404, 1991. (19) **Spencer, R.L.**, & McEwen, B.S. Adaptation of the hypothalamic-pituitary-adrenal axis to chronic ethanol stress. *Neuroendocrinology* 52(5):481-489, 1990. (20) **Rivier, C.**; Imaki, T.; & Vale, W. Prolonged exposure to alcohol: Effect on CRF mRNA levels, and CRF- and stress-induced ACTH secretion in the rat. *Brain Research* 520: 1-5, 1990. (21) **Ehlers, C.L.** Stress, gender, and alcoholism risk: Findings in humans and animal models. In: Hunt, W., & Zakhari, S., eds. *Stress, Gender, and Alcohol-Seeking Behavior*. National Institute on Alcohol Abuse and Alcoholism Research Monograph No 29. Bethesda, MD: the Institute, 1995. (22) **Brown, S.A.**; Vik, P.W.; McQuaid, J.R.; Patterson, T.L.; Irwin, M.R.; & Grant, I. Severity of psychosocial stress and outcome of alcoholism treatment. *Journal of Abnormal Psychology* 99(4):344-348, 1990.

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