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by [Juntunen J](#)

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Alcohol, work and the nervous system¹

by Juhani Juntunen, MD²

JUNTUNEN J. Alcohol, work and the nervous system. *Scand J Work Environ Health* 10 (1984) 461–465. From the clinical point of view, the nervous system effects of alcohol are the most important when work-related problems are considered. Alcohol is a primary, descending, central nervous system depressant that causes a familiar dose-dependent progression of acute intoxication from euphoria to ataxia, stupor, and ultimately coma. Chronic effects of alcohol on the nervous system are more difficult to diagnose. Particularly an insidiously developing alcoholic psychoorganic syndrome is a very difficult problem in occupational health. The interactions of low-level, chronic exposure to solvents and heavy drinking are interesting but, unfortunately, poorly understood. Withdrawal phenomena ranging from common hangover to tremulousness, cerebral convulsions, and delirium can also severely disturb normal worklife. The multitude of factors which regulate drinking behavior among the working population provides a challenge for investigators in the field of occupational health. More research should be focused on alcohol diseases and their effects on work, the effects of work on alcohol consumption, and the interactions of alcohol and compounds present in the work environment. The first step towards these problems is the development of valid methods for the early detection of heavy drinkers among the working population.

Key terms: alcohol diseases, alcoholism, heavy drinking, occupation.

Alcohol abuse is a major public health concern (11), and it can well be equated with the problems arising in the domain of major illnesses of mankind, such as cancer, cardiovascular disorders, and mental illness. Alcohol is perhaps the most common single toxic substance causing problems in industrial countries, and alcohol abuse is also a major concern in the field of occupational health.

When the interrelations of alcohol drinking and work are discussed, three major issues should be considered. The first and best understood issue is the effect of alcohol drinking on work. The adverse effect on work performance is mediated directly or indirectly through the effects of alcohol on the nervous system. During the past few years, particular attention has been paid to the second relationship, the effects of work and occupation on drinking behavior. [See, eg, the reports of Whitehead (43) and Olkinuora (31).] The third and perhaps least understood issue is the wide range of interactions between alcohol and compounds existing in the workplace. In light of data on the drinking habits of the working population and on the elimination of alcohol by human metabolism, it is clear that these interactions occur on a large scale (19). In this paper, some general aspects of alcohol-induced disorders, particularly nervous system disorders, are described. The main emphasis is on those

factors which connect alcohol abuse to work-related disorders, although such associations are certainly difficult to assess.

General considerations of the effects of alcohol on the nervous system

Alcohol diseases in general constitute a large group of somatic diseases (table 1). In the development of any disease, particularly somatic alcohol diseases, there is a spectrum of symptoms and signs which may range from no observable effects to frank clinical signs. In occupational health care stations, for obvious reasons, severe alcohol diseases are uncommon.

The nervous system is the most important target for the effects of alcohol (2). In fact, individuals drink alcohol because of its effects on the central nervous system. These effects are also the most important in the development of alcoholism and also regarding problems at work. Therefore the neurological complications of alcohol abuse and its nervous system effects are considered in more detail.

Before going any further, it is important to clarify some concepts regarding alcohol abuse. The following three terms, not necessarily mutually exclusive, are frequently encountered in the literature:

An alcoholic is a person with physical alcohol dependence; a concept which will be described briefly later.

A problem drinker is a person whose alcohol drinking leads to social or medical problems.

A heavy drinker is a person with a steady chronic alcohol consumption exceeding 80 g of absolute alcohol per day or 30 l per year.

¹ This paper is not meant to constitute an all-inclusive review of the literature in this area. The readers are kindly requested to look at the most recent reviews referred to in the text.

² Clinical Neurosciences, Institute of Occupational Health, Helsinki, Finland.

Table 1. Nonneurological alcohol-related diseases and the effects of alcohol on various organ systems.

Organ system	Alcohol-related diseases or effect	Reference
Gastrointestinal	Gastritis, fatty liver, alcoholic hepatitis, cirrhosis of the liver, intrahepatic cholestasis, chronic active hepatitis, cancers of the gastrointestinal tract	Alpers & Isselbacher (1), Breeden (4), Conn (8), Leevy & Kanagasundaram (26), Rothman (34), Schmidt (36)
Cardiovascular	Cardiomyopathy, hypertension, cardiac arrhythmias, antiatherogenic effects	Bridgen (5), Hillbom & Kaste (15, 16), Klatzky et al (25), Matikainen & Juntunen (27), Turner et al (42)
Hematologic and immunologic	Anemia (hemodilution, iron deficiency, megaloblastic and sideroblastic anemias, hemolytic anemias), thrombocytopenia, granulocytopenia, general immunodepression	Colman & Herbert (7), Palmer (32)
Endocrinologic	Diuretic effects (inhibition of the antidiuretic hormone), hyperprolactinemia, changes in growth hormone levels, decrease in testosterone, increased plasma cortisol level, increased serum catecholamine concentrations, hypoglycemia	Noth & Walter (30)

Table 2. Neurological effects of alcohol drinking.

Type of effect	Effect
Acute	Drunkenness, intoxication, idiosyncratic intoxication
Chronic ^a	Amnesic syndrome, dementia, Wernicke-Korsakoff syndrome, cerebellar degeneration, polyneuropathy, myopathy, reticular neuropathy, central pontine myelinolysis, hepatic encephalopathy, hepatocerebral degeneration, fetal alcohol syndrome
Withdrawal	Hangover, tremulousness, hallucinosis, epilepsy, delirium

^a For references, see, eg, the reports of Victor (45) and Freund (12).

These definitions are of course arbitrary, and, particularly regarding heavy drinking, opinions may differ greatly. Therefore the subjective nature of the definitions is emphasized.

Pathogenesis of nervous system dysfunction among heavy drinkers

Alcoholic nervous system dysfunction is caused by a number of pathogenetic mechanisms, including pharmacological actions of alcohol, nutritional deficiency, liver diseases, and unknown mechanisms (12, 14, 45). The pharmacological mechanisms are perhaps the most important in modern societies and particularly in occupational medicine.

The nervous system effects of alcohol can best be explained by the membrane effects. There is strong experimental evidence suggesting that increased neuronal membrane fluidity is responsible for the acute effects of ethanol (6). These acute membrane changes are, at first, fully reversible. With long-term chronic exposure, however, adaptive changes occur in the membrane that enable it to maintain its normal fluidity in the presence of ethanol. This occurrence leads to tolerance to ethanol and to the accompanying phenomenon of physical dependence. When ethanol is withdrawn acutely, the membrane undergoes change

again and becomes more rigid than normal. This change leads to the withdrawal phenomenon (46).

Clinical manifestations of nervous system dysfunction among heavy drinkers

In practice, neurological dysfunction caused by alcohol can be divided into acute, chronic, and withdrawal effects (table 2). Each type is briefly considered in the following discussion.

Acute effects

Alcohol is a descending central nervous system depressant, and the clinical picture of alcohol intoxication is dose-dependent, ranging from slight mental syndromes to unconsciousness, coma, and even death. Conventionally, *alcohol intoxication* refers to a clinical state with rather severe, life-threatening symptoms. From the toxicologic point of view, common *drunkenness* is also a state of intoxication, one which carries a high risk of accidents at workplaces. An interesting and controversial phenomenon is *idiosyncratic intoxication*, in which marked behavioral changes take place after the ingestion of only moderate amounts of alcohol. This occurrence may be due to the combined effects of alcohol and other exogenous agents, such as drugs or organic solvents, or the subject may have some underlying neurological disease such as temporal lobe epilepsy (17).

Alcohol has acute effects also on the peripheral nervous system. Those physicians who have patients with polyneuropathy may have encountered the story that alcohol drinking has a beneficial effect on sensory symptoms of polyneuropathy. It seems as if the nerves of neuropathic patients (for example diabetics) may react in an entirely different way to acute ethanol intoxication, and there is also physiological evidence for this possibility (23). This phenomenon may partly account for the high prevalence of heavy drinking observed among patients with diabetic neuropathy in some epidemiologic studies (28). Heavy drinking also increases the risk of pressure palsies

and prolongs disability due to acute compression palsies of the peripheral nerves (24).

Chronic effects

A list of some of the more common chronic alcohol diseases of the nervous system is given in table 2. Without going into detail about each of these disease entities, it should be emphasized that, although severe cases are rare, the milder forms can be diagnosed in many superficially healthy heavy drinkers. This possibility is, of course, dependent on the sensitivity of the examination techniques. For example, the prevalence of peripheral neuropathy among heavy drinkers seems to be unexpectedly high, as detected by sensitive clinical and neurophysiological methods (21, 22). Dementia associated with alcoholism is particularly important when work ability is considered. The disease can vary from mild to severe impairment in intellectual and social functioning. It should be emphasized that there are several neurobehavioral syndromes associated with the long-term consumption of alcohol (3, 9, 13). These syndromes are valuable prodromal symptoms of developing alcohol psychoorganic syndrome, but it is sometimes very difficult to differentiate substance-specific toxic neurobehavioral syndromes from constitutional ones (20).

In light of the nature of the higher central nervous system functions which can be disturbed in alcoholic psychoorganic syndrome, one can readily imagine the complexity of the problems which may ensue in the work environment of the afflicted persons.

Withdrawal syndromes, tolerance and alcohol dependence

Withdrawal syndromes refer to those clinical states which result from the cessation of or a reduction in prolonged heavy drinking. [See, eg, the report of Victor (45).] *Hangover* is perhaps the most common single nervous system dysfunction which causes problems at workplaces. *Tremulousness* is a more severe form of hangover. *Alcohol hallucinosis* is a relatively rare disorder, sometimes confused with delirium tremens. It usually occurs shortly after the cessation of or a reduction in heavy drinking, usually among persons with clear alcohol dependence. Vivid auditory hallucinations are typical, and consciousness is not clouded as in delirium tremens. *Alcoholic epilepsy* is a common withdrawal phenomenon, and it can occur within 2 d after the cessation of drinking without any underlying epilepsy. *Delirium tremens* usually occurs within a week after the cessation of heavy drinking. It is characterized by clouded consciousness accompanied by a reduced capacity to sift, focus, and sustain attention to environmental stimuli and by perceptual disturbances, insomnia, altered psychomotor activity, disorientation, severe memory disturbances, and autonomic dysfunction. Mortality of about 15 % has been reported.

In addition to these more or less severe neurological alcohol diseases, the nervous system is in a key position also in the development of tolerance and the alcohol dependence syndrome (41). By definition, alcohol dependence includes heavy drinking, development of tolerance, withdrawal when drinking is discontinued, continued drinking in spite of contraindications, and the clinical picture of a heavy drinker. This dependence makes it difficult to detect and treat alcoholics, and it is perhaps the most widely studied single neurobiologic phenomenon at present.

Heavy drinker at work

Because of the multitude of the alcohol disease entities and the difficulties in obtaining an adequate drinking history, the diagnostic problems in individual cases are often difficult to overcome, even in advanced cases. The estimated number of heavy drinkers for instance in Finland is about 250 000. The important thing is that most of the heavy drinkers are active workers. It has been estimated that even 12 % of the men and 2 % of the women at work are heavy drinkers (38). The magnitude of the health problems due to heavy drinking among the working population is thus great.

It is important to notice that only one-fifth of heavy drinkers are alcoholics, and most of them are without any somatic alcohol disease. However, heavy drinkers carry a high risk of developing alcohol diseases; they are accident prone and also targets for the possible interactions of alcohol and industrial chemicals.

Early detection of heavy drinkers at work

On the basis of the preceding considerations a vital step in research on alcohol abuse, particularly in occupational health settings, seems to be the development of valid procedures for the early detection of heavy drinking (18, 39). This is a difficult task indeed. Epidemiologic studies have tried to approach the problem with the use of several biological and psychological screening tests (10, 18, 33, 39, 44). The disadvantage of these tests, however, is that they are rather nonspecific. Psychological tests, particularly, are problematic since they tend to detect alcoholism and the social consequences of it rather than heavy drinking.

In this connection the concept of specificity and sensitivity is emphasized. The examination techniques used in neurobehavioral research highlight the core problem of the diagnostic procedure. The more sensitive the method, the more nonspecific it often may be (37). In individual diagnostics, comprehensive clinical examinations and the assessment of all the test results is probably the only reliable way, but

this procedure is too laborious and time-consuming in epidemiologic studies.

It should be kept in mind that alcohol-induced health problems are generally masked by other somatic diseases. The most common disease groups which conceal alcohol diseases in Finland are mental disorders, traumas, respiration diseases and infections, cardiovascular diseases, neurological diseases, and gastrointestinal diseases (35). Along with change in attitudes among patients and physicians, alcohol diseases may become also officially more prevalent than they are today.

The psychosocial characteristics of the heavy drinker at work may help in individual diagnostics. Heavy drinkers are heavy consumers of the health services, they are accident-prone and more often absent due to illness, they have social difficulties, and their work performance is poor. In occupational health care units such data can usually be obtained. The clinical picture shows various nonspecific symptoms and signs such as headache, insomnia, nausea, palpitations, memory disturbances, tremor, nervousness, hypertension, abdominal pain, and hepatomegaly.

Of the laboratory tests gamma glutamyl transferase and mean corpuscular volume are relatively good indicators of alcohol abuse, although there is no test pattern specific for heavy drinking only. Successful treatment of heavy drinkers at work is largely dependent on their early recognition (29), and, therefore, all efforts should be made to develop suitable screening methods (40).

Concluding remarks

Work-related alcohol problems are well recognized in industrial countries, mainly because of their magnitude, which obviously exceeds that of many other health problems. Nervous system dysfunction is in a key position when the adverse effects of alcohol on work performance are considered. Interactions of industrial chemicals and alcohol, effects of occupation on the development of alcoholism, and the early detection of heavy drinkers at work provide great challenges for future researchers in the field of occupational health.

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