

Drinking and Cognitive Function

The Issue in Brief

Alcohol consumption has been shown to have both beneficial and harmful effects on cognitive and neurological functioning.

The nature of this relationship depends on the pattern of drinking and follows a U-shaped curve:

- Heavy drinking is related to brain damage and cognitive decline.
- Moderate drinking may have a protective role for some people.

The effects of heavy drinking patterns (both chronic and episodic) on brain injury and impaired cognitive function have been well described.

Lifestyle and environmental factors may modulate cognitive deficits associated with heavy drinking.

Cognitive impairment due to heavy drinking is cumulative throughout life; however, even among young heavy drinkers, there is evidence of early impairment.

Beneficial effects on cognition have been demonstrated in light-to-moderate drinkers and apply to both men and women.

Effects on cognitive function seem to be more positive for current drinkers than for lifetime abstainers or former drinkers.

The relationship between drinking and cognitive function may be confounded by various other factors, including family history, smoking, and diet.

ICAP's Health Briefings cover the effects of alcohol consumption on health. They offer an overview of the relationship between drinking patterns and health outcomes, compile the key literature, and provide the reader with an extensive bibliography that refers to original research on each topic. The Briefings attempt to present the balance of the available evidence. They have been peer reviewed by external experts and do not necessarily reflect the views of ICAP or its sponsoring companies.

Relevant ICAP Publications:

Ellison, R. C. (Ed.). (2007, May). Health risks and benefits of moderate alcohol consumption: Proceedings of an international symposium. *Annals of Epidemiology*, 17(Suppl.), S1–S116. Available: <http://www.annalsofepidemiology.org/issues>.

What Is the Evidence?

Alcohol consumption has been shown to have both beneficial and harmful effects on cognitive and neurological functioning.

The nature of this relationship depends on the pattern of drinking and follows a U-shaped curve.

- Heavy drinking, particularly chronic heavy drinking, is related to brain damage and cognitive decline.
- Moderate drinking may have a protective role against dementia (1), especially among older adults.

Harmful outcomes

Heavy drinking patterns (both chronic and episodic) can result in severe impairments of the nervous system, including brain function.

Impairment of cognitive function, learning and memory, as well as personality changes, have been described among heavy chronic drinkers and alcohol-dependent individuals (15, 24).

- Chronic heavy drinking can also result in brain damage, including atrophy of nerve cells and brain shrinkage (25) in cortical and subcortical regions and the hippocampus (26-28).
- Cognitive decline may result in serious irreversible neurological impairment (29).

Cognitive deficits have also been described for episodic heavy drinkers.

- Impairments have been reported among nondependent individuals who are heavy episodic drinkers (29).
- Among social “binge” or “extreme” drinkers, impairment of executive-type cognitive function and particularly memory has been described (30).

There is evidence that brain atrophy among heavy chronic drinkers may be partially reversible once drinking has ceased (31).

Various lifestyle and environmental factors may modulate cognitive deficits associated with heavy drinking.

These factors include:

- family history, which may affect susceptibility to the effects of alcohol;
- nutritional factors, which have a mediating role (for example, among alcohol-dependent patients with Wernicke-Korsakoff syndrome or alcohol dementia, cognitive deficits are linked with thiamine deficiency and can be improved by a supplemented diet (32, 33));

- long-term cigarette smoking with an impact on the dynamics of structural and cognitive changes in the brains of alcoholics (34);
- family history of heavy drinking, which has been shown to correlate with smaller brain volume among alcohol-dependent individuals, suggesting a role in the onset of alcoholism and cognitive impairment (35);
- head trauma and other injuries.

Cognitive impairment from heavy drinking is cumulative throughout life; however, even among young heavy drinkers, there is evidence of early impairment (36).

- Reduced cognitive function may be present without any associated structural brain abnormalities (37).

Beneficial outcomes

Research evidence shows that moderate drinking may slow cognitive decline.

The relationship has been documented among those who drink little (less than 1 drink per week), as well as those who drink over 2 drinks per day (5).

- Improved cognitive function in light-to-moderate drinkers is based on comparisons with abstainers, who are used as the baseline measure.

Protective effects for cognitive function are seen with light-to-moderate drinking patterns and have been described primarily for older individuals.

- Reduced risk of dementia is seen in individuals aged 55 and older (6).

Moderate drinking patterns correlate with reduced prevalence of brain abnormalities, such as those seen in Alzheimer’s patients (7).

Both cognitive decline with aging and Alzheimer’s disease are related to vascular disease.

- The relationship between drinking and cognitive function, therefore, appears to be mediated through similar mechanisms as those involved in CVD (2).
- The relationship is modulated by other possible environmental and intrinsic factors.

The effect is independent of the type of alcohol beverage consumed (3).

Beneficial effects on cognition have been demonstrated in light-to-moderate drinkers as compared with abstainers.

- Compared with abstainers, light-to-moderate drinkers have been shown to have improved cognition and subjective wellbeing, as well as fewer symptoms of depression (5, 8-14).
- The association applies to both men and women and is borne out across cultures and ethnic groups.

Elderly women may benefit more than men from the protective effects of moderate drinking on cognitive function (15).

- Among elderly women, moderate alcohol consumption has been found to be one of the predictors of maintaining optimal cognitive function into old age (16).

Improved cognitive skills among drinkers over abstainers may not be limited to the elderly.

- Benefits have been described in samples of young (17, 18) and middle-aged adults (19).

Effects on cognitive function seem to be better for current drinkers than for lifetime abstainers or former drinkers (10).

Those who drank in midlife showed enhanced cognitive function later in life as compared to abstainers (20, 21).

- The relationship was found for both infrequent and frequent drinkers.
- An optimal level of drinking has not been determined.

While the relationship between drinking and cognitive function is robust, it may be confounded by various other factors.

Abstainers' overall health and personality traits, as well as their demographics (22), may account for some of the observed differences.

- The progression of some health conditions, notably Type II diabetes mellitus, can have an impact on brain function, resulting in gradual cognitive impairment (23).
- Lifestyle factors such as smoking and diet are associated with age-related changes in cognitive function, predementia syndrome, and cognitive decline associated with neurodegenerative disease (e.g., Alzheimer's disease).
- The relationship may also be influenced by differences in educational level between drinkers and abstainers (22).

References

- Stampfer, M. J. (2006). Cardiovascular disease and Alzheimer's disease: Common links. *Journal of Internal Medicine*, *260*, 211–223.
- Solfrizzi, V., Capurso, C., D'Introno, A., Colacicco, A. M., Santamato, A., Ranieri, M., et al. (2008). Lifestyle-related factors in predementia and dementia syndromes. *Expert Review of Neurotherapeutics*, *8*, 133–158.
- Letenneur, L. (2004). Risk of dementia and alcohol and wine consumption: A review of recent results. *Biological Research*, *37*, 189–193.
- Fogarty, J. N., & Vogel-Sprott, M. (2002). Cognitive processes and motor skills differ in sensitivity to alcohol impairment. *Journal of Studies on Alcohol*, *63*, 404–411.
- Wright, C. B., Elkind, M. S., Luo, X., Paik, M. C., & Sacco, R. L. (2006). Reported alcohol consumption and cognitive decline: The Northern Manhattan Study. *Neuroepidemiology*, *27*, 201–207.
- Ruitenbergh, A., van Swieten, J. C., Witteman, J. C., Mehta, K. M., van Duijn, C. M., Hofman, A., et al. (2002). Alcohol consumption and risk of dementia: The Rotterdam Study. *Lancet*, *359*(9303), 281–286.
- Mukamal, K. J., Longstreth, W. T., Jr., Mittleman, M. A., Crum, R. M., & Siscovick, D. S. (2001). Alcohol consumption and subclinical findings on magnetic resonance imaging of the brain in older adults: The cardiovascular health study. *Stroke*, *32*, 1939–1946.
- Lang, I., Wallace, R. B., Huppert, F. A., & Melzer, D. (2007). Moderate alcohol consumption in older adults is associated with better cognition and well-being than abstinence. *Age and Ageing*, *36*, 256–261.
- Espeland, M. A., Coker, L. H., Wallace, R., Rapp, S. R., Resnick, S. M., Limacher, M., et al. (2006). Association between alcohol intake and domain-specific cognitive function in older women. *Neuroepidemiology*, *27*, 1–12.
- Reid, M. C., Van Ness, P. H., Hawkins, K. A., Towle, V., Concato, J., & Guo, Z. (2006). Light to moderate alcohol consumption is associated with better cognitive function among older male veterans receiving primary care. *Journal of Geriatric Psychiatry and Neurology*, *19*, 98–105.
- Ganguli, M., Vander Bilt, J., Saxton, J. A., Shen, C., & Dodge, H. H. (2005). Alcohol consumption and cognitive function in late life: A longitudinal community study. *Neurology*, *65*, 1210–1217.
- Bond, G. E., Burr, R. L., McCurry, S. M., Rice, M. M., Borenstein, A. R., & Larson, E. B. (2005). Alcohol and cognitive performance: A longitudinal study of older Japanese Americans. The Kame Project. *International Psychogeriatrics*, *17*, 653–668.
- Stampfer, M. J., Kang, J. H., Chen, J., Cherry, R., & Grodstein, F. (2005). Effects of moderate alcohol consumption on cognitive function in women. *New England Journal of Medicine*, *352*, 245–253.
- Zimmerman, T., McDougall, G. J., Jr., & Becker, H. (2004). Older women's cognitive and affective response to moderate drinking. *International Journal of Geriatric Psychiatry*, *19*, 1095–1102.
- Yonker, J. E., Nilsson, L. G., Herlitz, A., & Anthenelli, R. M. (2005). Sex differences in spatial visualization and episodic memory as a function of alcohol consumption. *Alcohol and Alcoholism*, *40*, 201–207.
- Barnes, D. E., Cauley, J. A., Lui, L. Y., Fink, H. A., McCulloch, C., Stone, K. L., et al. (2007). Women who maintain optimal cognitive function into old age. *Journal of the American Geriatrics Society*, *55*, 259–264.
- Rodgers, B., Windsor, T. D., Anstey, K. J., Dear, K. B., Jorm, A. F., & Christensen, H. (2005). Non-linear relationships between cognitive function and alcohol consumption in young, middle-aged and older adults: The PATH Through Life Project. *Addiction*, *100*, 1280–1290.
- Bates, M. E., & Tracy, J. I. (1990). Cognitive functioning in young "social drinkers": Is there impairment to detect? *Journal of Abnormal Psychology*, *99*, 242–249.
- Wu, J. H., Haan, M. N., Liang, J., Ghosh, D., Gonzalez, H. M., & Herman, W. H. (2003). Impact of diabetes on cognitive function among older Latinos: A population-based cohort study. *Journal of Clinical Epidemiology*, *56*, 686–693.
- Ngandu, T., Helkala, E. L., Soininen, H., Winblad, B., Tuomilehto, J., Nissinen, A., et al. (2007). Alcohol drinking and cognitive functions: Findings from the Cardiovascular Risk Factors Aging and Dementia (CAIDE) Study. *Dementia and Geriatric Cognitive Disorders*, *23*, 140–149.
- Galanis, D. J., Joseph, C., Masaki, K. H., Petrovitch, H., Ross, G. W., White, & L. (2000). A longitudinal study of drinking and cognitive performance in elderly Japanese American men: The Honolulu-Asia Aging Study. *American Journal of Public Health*, *90*, 1254–1259.
- Anstey, K. J., Windsor, T. D., Rodgers, B., Jorm, A. F., & Christensen, H. (2005). Lower cognitive test scores observed in alcohol abstainers are associated with demographic, personality, and biological factors: The PATH Through Life Project. *Addiction*, *100*, 1291–1301.
- van den Berg, E., Kessels, R. P., Kappelle, L. J., de Haan, E. H., & Biessels, G. J. (2007). Type II diabetes, cognitive function and dementia: Vascular and metabolic determinants. *Timely Topics in Medicine. Cardiovascular Diseases*, *11*, E7.
- Oscar-Berman, M., Shagrin, B., Evert, D. L., & Epstein, C. (1997). Impairments of brain and behavior: The neurological effects of alcohol. *Alcohol Health and Research World*, *21*, 65–75.
- Cardenas, V. A., Studholme, C., Meyerhoff, D. J., Song, E., & Weiner, M. W. (2005). Chronic active heavy drinking and family history of problem drinking modulate regional brain tissue volumes. *Psychiatry Research: Neuroimaging*, *138*, 115–130.
- Medina, K. L., Schweinsburg, A. D., Cohen-Zion, M., Nagel, B. J., & Tapert, S. F. (2007). Effects of alcohol and combined marijuana and alcohol use during adolescence on hippocampal volume and asymmetry. *Neurotoxicology and Teratology*, *29*, 141–152.
- Beresford, T. P., Arciniegas, D. B., Alfors, J., Clapp, L., Martin, B., Du, Y., et al. (2006). Hippocampus volume loss due to chronic heavy drinking. *Alcoholism: Clinical and Experimental Research*, *30*, 1866–1870.
- Bloomer, C. W., Langleben, D. D., & Meyerhoff, D. J. (2004). Magnetic resonance detects brainstem changes in chronic, active heavy drinkers. *Psychiatry Research: Neuroimaging*, *132*, 209–218.
- Cairney, S., Clough, A., Jaragba, M., & Maruff, P. (2007). Cognitive impairment in Aboriginal people with heavy episodic patterns of alcohol use. *Addiction*, *102*, 909–915.
- Weissenborn, R., & Duka, T. (2003). Acute alcohol effects on cognitive function in social drinkers: their relationship to drinking habits. *Psychopharmacology*, *165*, 306–312.
- Cardenas, V. A., Studholme, C., Gazdzinski, S., Durazzo, T. C., Meyerhoff, D. J. (2007). Deformation-based morphometry of brain changes in alcohol dependence and abstinence. *NeuroImage*, *34*, 879–887.

32. Ambrose, M. L., Bowden, S. C., & Whelan, G. (2001). Thiamin treatment and working memory function of alcohol-dependent people: Preliminary findings. *Alcoholism: Clinical and Experimental Research*, *25*, 112–116.
33. Bowden, S. C. (1990). Separating cognitive impairment in neurologically asymptomatic alcoholism from Wernicke-Korsakoff syndrome: Is the neuropsychological distinction justified? *Psychological Bulletin*, *107*, 355–366.
34. Yeh, P. H., Gazdzinski, S., Durazzo, T. C., Sjostrand, K., & Meyerhoff, D. J. (2007). Hierarchical linear modeling (HLM) of longitudinal brain structural and cognitive changes in alcohol-dependent individuals during sobriety. *Drug and Alcohol Dependence*, *91*, 195–204.
35. Gilman, J. M., Bjork, J. M., & Hommer, D. W. (2007). Parental alcohol use and brain volumes in early- and late-onset alcoholics. *Biological Psychiatry*, *62*, 607–615.
36. Zeigler, D. W., Wang, C. C., Yoast, R. A., Dickinson, B. D., McCaffree, M. A., Robinowitz, C. B., et al. (2005). The neurocognitive effects of alcohol on adolescents and college students. *Preventive Medicine*, *40*, 23–32.
37. Akine, Y., Kato, M., Muramatsu, T., Umeda, S., Mimura, M., Asai, Y., et al. (2007). Altered brain activation by a false recognition task in young abstinent patients with alcohol dependence. *Alcoholism: Clinical and Experimental Research*, *31*, 1589–1597.



International Center for Alcohol Policies
Analysis. Balance. Partnership.

1519 New Hampshire Avenue, NW
Washington, DC 20036 USA

Tel: +1.202.986.1159

Fax: +1.202.986.2080

www.icap.org

© International Center for Alcohol Policies, 2008

International Center for Alcohol Policies (ICAP) is a not-for-profit organization whose mission is to promote the understanding of the role of alcohol in society through dialogue and partnerships involving the beverage alcohol industry, the public health community, and others interested in alcohol policy, and to help reduce the abuse of alcohol worldwide. ICAP is supported by major international producers of beverage alcohol.