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# ALCOHOL ALERT

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National Institute on Alcohol Abuse and Alcoholism

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## ***Alcohol and Coronary Heart Disease***

Heart attacks and other forms of coronary heart disease (CHD) result in approximately 500,000 deaths annually (1), accounting for 25 percent of the Nation's total mortality (2). Research has revealed an association between moderate alcohol consumption<sup>1</sup> and lower risk for CHD. This *Alcohol Alert* reviews epidemiologic evidence for this association, explores lifestyle factors and physiological mechanisms that might suggest ways to explain alcohol's apparent protective effects, and presents available data on the balance between alcohol's beneficial and harmful effects on health.

### ***Epidemiologic Evidence***

With few exceptions, epidemiologic data from at least 20 countries in North America, Europe, Asia, and Australia demonstrate a 20- to 40-percent lower CHD incidence among drinkers compared with nondrinkers (3,4). *Moderate* drinkers exhibit lower rates of CHD-related mortality than both heavy drinkers and abstainers (3,4). Such studies range from comparisons of nationwide population data to retrospective analyses of health and drinking patterns within communities.

The most persuasive epidemiologic evidence for alcohol's possible protective effects on CHD comes from prospective studies, in which participants provide information on their drinking habits and health-related practices *before* the onset of disease. Participants' subsequent health histories are evaluated through a series of followup interviews. Large-scale prospective investigations confirm an association between moderate drinking and lower CHD risk. The specific studies described here represent a total population of more than 1 million men and women of different ethnicities. Followup periods average 11 years,<sup>2</sup> the longest being the 24-year prospective phase of the Framingham CHD mortality study (5). The two largest of these studies were conducted by the American Cancer Society, one including 276,800 men (6) and the other including 490,000 men and women (7).

Other large prospective investigations that associate moderate drinking with lower risk for CHD include a series of studies by Kaiser-Permanente analyzing CHD hospitalization (8,9) and death rates (10,11) in both men and women; studies of CHD incidence (12) and mortality (13) among female nurses; and studies of CHD incidence (14,15) and mortality (16) among male physicians. Results of these American studies are confirmed by data from similar investigations conducted in England (17), Denmark (18), China (19), and other countries (1,4). In addition, a smaller 12-year study found an association

between moderate drinking and lower risk of CHD-related death among older persons (average age of 69) with late-onset diabetes, a population at high risk for CHD (20). However, a recent 21-year prospective study from Scotland found no association between moderate drinking and lower risk for CHD among 6,000 working men ages 35 to 64 (21).

### ***Is Alcohol's Role Causal or Incidental?***

An association between moderate drinking and lower risk for CHD does not necessarily mean that alcohol itself is the cause of the lower risk. For example, a review of population studies indicates that the higher mortality risk among abstainers may be attributable to shared traits other than participants' nonuse of alcohol (22). Substantial evidence (1) has discounted speculation that abstainers include a large proportion of former heavy drinkers with pre-existing health problems (i.e., "sick quitters"). Nevertheless, health-related lifestyle factors that correlate consistently with drinking level could account for some of the association between alcohol and lower risk for CHD (4). Among the most widely studied of these factors are exercise and diet.

Few studies have adjusted for subjects' levels of physical activity, despite evidence that exercise protects against CHD occurrence and mortality. In a comprehensive review of published studies, Berlin and Colditz (23) concluded that risk for CHD was proportionately lower at higher exercise levels. Measures of activity level vary among studies. Studies evaluate factors such as job-related physical requirements, frequency of participation in unspecified sports, estimated vigorousness of given activities, calculations of energy expended, and tests of cardiovascular fitness (23). Results of a community survey indicated that the prevalence of regular exercise was higher among moderate and heavy drinkers than among nondrinkers (24). Regular exercise was defined as any form of nonoccupational physical activity performed at least three times per week. The role of exercise in the alcohol-CHD association requires additional study.

Diet is one of the strongest influences on CHD-related death among men ages 50 to 70 (25). International comparisons, laboratory data, and prospective studies suggest that diets high in saturated fat and cholesterol increase the risk for CHD (26). Epidemiologic data suggest that moderate drinkers may consume less fat and cholesterol than heavier drinkers (14) and abstainers (27), potentially accounting for a portion of the lower CHD risk associated with alcohol. However, results of other prospective studies indicate that alcohol's association with lower CHD risk is independent of nutritional factors (12-14).

### ***The Role of Beverage Choice***

Some studies report that wine (particularly red wine) affords more CHD protection than beer or liquor at equivalent levels of alcohol consumption (28). This finding suggests that the association between alcohol consumption and CHD risk may result from the effects of beverage ingredients other than alcohol itself. Epidemiologic and laboratory studies investigating this hypothesis have produced conflicting results.

A comparison of data from 21 developed countries concluded that wine consumption was more strongly correlated with lower CHD risk than was consumption of other alcoholic beverages (29). However, large-scale prospective studies have not found any difference in the incidence of CHD associated with

beverage type (1,9). Red wine has been shown to contain certain nonalcoholic ingredients that could hypothetically interfere with the progression of CHD (30). However, research has not yet demonstrated a significant role for these chemicals in arresting CHD development in humans (30,31).

Evidence suggests that a preference for wine over other alcoholic beverages is associated with a lifestyle that includes other favorable health-related practices. For example, drinkers who prefer wine tend to smoke less and drink less (10,11,32) and have a more healthful diet (33) than those who prefer beer or liquor.

### ***How Might Alcohol Lower Risk for CHD?***

To function normally, the muscle tissue that constitutes the bulk of the heart requires a constant supply of oxygen-containing blood. Blood is delivered to the heart muscle through the coronary arteries. Cholesterol and other fatty substances can accumulate within the coronary arteries, partially impeding the flow of blood. This condition underlies the clinical manifestations of CHD, which may range from episodic chest pain to sudden death. The most common serious manifestation of CHD is the heart attack. Heart attacks are generally triggered by the formation of a blood clot within a constricted coronary artery, obstructing blood flow and depriving a portion of the heart muscle of oxygen. The resulting impairment of the heart's pumping ability may cause permanent disability or death, either immediately or through the progressive development of medical complications (2).

Researchers have investigated several theories to explain how alcohol itself might lower risk for CHD. For example, alcohol may protect the heart by preventing the constriction of the coronary arteries, inhibiting clot formation, and enhancing recovery following a heart attack. Most of the evidence supporting these potential mechanisms is derived from experiments using animals or cells isolated from artery walls and grown in the laboratory. Controlled clinical experiments are needed to confirm that the effects observed in such studies can alter the development or progression of CHD in humans.

Results of laboratory research indicate that alcohol administration may help prevent arterial narrowing in mice (34). Such an effect could stem from changes in the blood concentrations of certain fatty substances that influence the deposition of cholesterol within the coronary arteries (35). However, human (36) and animal (34,37) studies indicate that less than one-half of the lower risk for CHD associated with alcohol consumption can be explained by altered blood levels of these fatty substances. Therefore, researchers are investigating additional explanations for alcohol's apparent protective effects.

Alcohol may help prevent clot formation within already narrowed coronary arteries. Clotting occurs partly in response to chemicals released into the blood from the arterial wall. Exposure of these cells to alcohol in the laboratory suppresses the production of substances that promote clotting and stimulates the production and activity of substances that inhibit clotting (38). In addition, analyses of blood samples drawn from human volunteers indicate that alcohol consumption increases blood levels of anticlotting factors (39,40) and decreases the "stickiness" of the specialized blood cells (i.e., platelets) that clump together to form clots (41).

Results of laboratory research suggest that alcohol might help protect against reperfusion injury, a form of damage caused by the sudden restoration of blood flow to heart muscle weakened by previous oxygen deprivation. Alcohol's effects on reperfusion injury have been studied in guinea pigs (42) and rats (43), but not in humans. Heavy alcohol consumption by humans can cause rapid and irregular heartbeat and can impair the heart's pumping ability (41), two of the major causes of death following a heart attack (44). Alcohol may also interact harmfully with medications prescribed to treat heart diseases (45). Thus, although alcohol may help protect against CHD, drinking may increase the risk of adverse health effects after a heart attack (46).

### ***Risks and Benefits***

The apparent benefits of moderate drinking on CHD mortality are offset at higher drinking levels by increasing risk of death from other types of heart disease (5,16,32); cancer; liver cirrhosis; and trauma, including trauma from traffic crashes (47). Moderate drinking is not risk free. The trade-offs between risks and benefits can be exemplified by the fact that alcohol's anticlotting ability, potentially protective against heart attack, may increase the risk of hemorrhagic stroke, or bleeding within the brain (12).

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### ***Alcohol and Coronary Heart Disease - A Commentary by NIAAA Director Enoch Gordis, M.D.***

We last visited the issue of the effect of moderate drinking on risk for coronary heart disease (CHD) in 1992 (*Alcohol Alert* No. 16). Since that time, research findings continue to confirm an association between moderate drinking and a lower risk for CHD. While there is an *association* between moderate drinking and lower CHD risk, science has not confirmed that alcohol itself *causes* the lower risk. It also is plausible that the lower risk might result from some as yet unidentified factor or surrogate associated both with alcohol use and lower CHD risk, such as lifestyle, diet and exercise, or additives to alcoholic beverages. Research is now in progress to answer these questions. The distinction between an *association* and a *cause* is important, particularly when considering what advice to give to the public. Further, even if we find that alcohol itself is responsible for the lower risk, still to be considered would be the trade-offs between the benefits and risks, particularly for specific subsets of the population. For example, moderate drinking by older persons may lower CHD but increase risk for other alcohol-related health conditions, such as adverse alcohol-drug interactions; trauma, including falls and automobile crashes; or hemorrhagic stroke.

Until these issues are clarified, we continue to believe that the most prudent advice is the following: (1) Individuals who are not currently drinking should not be encouraged to drink *solely* for health reasons, because the basis for health improvements has not yet been established as deriving from alcohol itself; (2) individuals who choose to drink and are not otherwise at risk for alcohol-related problems<sup>3</sup> should not exceed the one- to two-drink-per-day limit recommended by the *U.S. Dietary Guidelines*; and (3) individuals who currently are drinking beyond the *U.S. Dietary Guidelines'* recommended limits should be advised to lower their daily alcohol intake to these limits.

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## References

- (1) **Hennekens, C.H.** Alcohol and risk of coronary events. In: Zakhari, S., and Wassef, M., eds. *Alcohol and the Cardiovascular System*. NIAAA Research Monograph No. 31. NIH Pub. No. 96-4133. Washington, DC: U.S. Govt. Print. Off., 1996. pp. 15-24. (2) **McKenzie, C.R.**, and Eisenberg, P.R. Alcohol, coagulation, and arterial thrombosis. In: Zakhari, S., and Wassef, M., eds. *Alcohol and the Cardiovascular System*. NIAAA Monograph No. 31. NIH Pub. No. 96-4133. Washington, DC: U.S. Govt. Print. Off., 1996. pp. 413-439. (3) **Renaud, S.**; Criqui, M.H.; Farchi, G.; et al. Alcohol drinking and coronary heart disease. In: Verschuren, P.M., ed. *Health Issues Related to Alcohol Consumption*. Washington, DC: ILSI Press, 1993. pp. 81-123. (4) **Klatsky, A.L.** Epidemiology of coronary heart disease □ Influence of alcohol. *Alcohol Clin Exp Res* 18(1):88-96, 1994. (5) **Friedman, L.A.**, and Kimball, A.W. Coronary heart disease mortality and alcohol consumption in Framingham. *Am J Epidemiol* 124(3):481-489, 1986. (6) **Boffetta, P.**, and Garfinkel, L. Alcohol drinking and mortality among men enrolled in an American Cancer Society prospective study. *Epidemiol* 1(5):342-348, 1990. (7) **Thun, M.J.**; Peto, R.; Lopez, A.D.; et al. Alcohol consumption and mortality among middle-aged and elderly U.S. adults. *N Engl J Med* 337(24):1705-1714, 1997. (8) **Klatsky, A.L.**; Armstrong, M.A.; and Friedman, G.D. Relations of alcoholic beverage use to subsequent coronary artery disease hospitalization. *Am J Cardiol* 58(9):710-714, 1986. (9) **Klatsky, A.L.**; Armstrong, M.A.; and Friedman, G.D. Red wine, white wine, liquor, beer, and risk for coronary artery disease hospitalization. *Am J Cardiol* 80(4):416-420, 1997. (10) **Klatsky, A.L.**; Armstrong, M.A.; and Friedman, G.D. Risk of cardiovascular mortality in alcohol drinkers, ex-drinkers and nondrinkers. *Am J Cardiol* 66(17):1237-1242, 1990. (11) **Klatsky, A.L.**; Armstrong, M.A.; and Friedman, G.D. Alcohol and mortality. *Ann Intern Med* 117(8):646-654, 1992. (12) **Stampfer, M.J.**; Colditz, G.A.; Willett, W.C.; et al. A prospective study of moderate alcohol consumption and the risk of coronary disease and stroke in women. *N Engl J Med* 319(5):267-273, 1988. (13) **Fuchs, C.S.**; Stampfer, M.J.; Colditz, G.A.; et al. Alcohol consumption and mortality among women. *N Engl J Med* 332(19):1245-1250, 1995 [erratum *N Engl J Med* 336(7):523, 1997]. (14) **Rimm, E.B.**; Giovannucci, E.L.; Willett, W.C.; et al. Prospective study of alcohol consumption and risk of coronary disease in men. *Lancet* 338(8765):464-468, 1991. (15) **Camargo, C.A., Jr.**; Stampfer, M.J.; Glynn, R.J.; et al. Moderate alcohol consumption and risk for angina pectoris or myocardial infarction in U.S. male physicians. *Ann Intern Med* 126(5):372-375, 1997. (16) **Camargo, C.A., Jr.**; Hennekens, C.H.; Gaziano, J.M.; et al. Prospective study of moderate alcohol consumption and mortality in US male physicians. *Arch Intern Med* 157(1):79-85, 1997. (17) **Doll, R.**; Peto, R.; Hall, E.; et al. Mortality in relation to consumption of alcohol: 13 years' observations on male British doctors. *BMJ* 309(6959):911-918, 1994. (18) **Grønbaek, M.**; Deis, A.; Sørensen, T.I.A.; et al. Mortality associated with moderate intakes of wine, beer, or spirits. *BMJ* 310(6988):1165-1169, 1995. (19) **Yuan, J.-M.**; Ross, R.K.; Gao, Y.-T.; et al. Follow up study of moderate alcohol intake and mortality among middle aged men in Shanghai, China. *BMJ* 314(7073):18-23, 1997. (20) **Valmadrid, C.T.**; Klein, R.; Moss, S.E.; et al. Alcohol intake and the risk of coronary heart disease mortality in persons with older-onset diabetes mellitus. *JAMA* 282(3):239-246, 1999. (21) **Hart, C.L.**; Smith, G.D.; Hole, D.J.; et al. Alcohol consumption and mortality from all causes, coronary heart disease, and stroke: Results from a prospective cohort study of Scottish men with 21 years of follow up. *BMJ* 318:1725-1729, 1999. (22) **Fillmore, K.M.**; Golding, J.M.; Graves, K.L.; et al.

Alcohol consumption and mortality: I. Characteristics of drinking groups. *Addiction* 93(2):183-203, 1998. **(23) Berlin, J.A.**, and Colditz, G.A. A meta-analysis of physical activity in the prevention of coronary heart disease. *Am J Epidemiol* 132(4):612-628, 1990. **(24) Barrett, D.H.**; Anda, R.F.; Croft, J.B.; et al. The association between alcohol use and health behaviors related to the risk of cardiovascular disease: The South Carolina Cardiovascular Disease Prevention Project. *J Stud Alcohol* 56(1):9-15, 1995. **(25) Huijbregts, P.**; Feskens, E.; Räsänen, L.; et al. Dietary pattern and 20 year mortality in elderly men in Finland, Italy, and the Netherlands: Longitudinal cohort study. *BMJ* 315(7099):13-17, 1997. **(26) Ascherio, A.**; Rimm, E.B.; Giovannucci, E.L.; et al. Dietary fat and risk of coronary heart disease in men: Cohort follow up study in the United States. *BMJ* 313(7049):84-90, 1996. **(27) Ashley, M.J.** Alcohol consumption and ischemic heart disease: The epidemiologic evidence. In: Smart, R.G.; Cappell, H.D.; Glaser, F.B.; et al. *Research Advances in Alcohol and Drug Problems*. Vol. 8. New York: Plenum Press, 1984. pp. 99-147. **(28) Ruf, J.-C.**; Berger, J.-L.; and Renaud, S. Platelet rebound effect on alcohol withdrawal and wine drinking in rats: Relation to tannins and lipid peroxidation. *Arteriosclerosis Thromb Vasc Bio* 15(1):140-144, 1995. **(29) Criqui, M.H.**, and Ringel, B.L. Does diet or alcohol explain the French paradox? *Lancet* 344(8939/8940):1719-1723, 1994. **(30) Reinke, L.A.**, and McCay, P.B. Interaction between alcohol and antioxidants. In: Zakhari, S., and Wassef, M., eds. *Alcohol and the Cardiovascular System*. NIAAA Research Monograph No. 31. NIH Pub. No. 96-4133. Washington, DC: U.S. Govt. Print. Off., 1996. pp. 441-457. **(31) Pellegrini, N.**; Pareti, F.I.; Stabile, F.; et al. Effects of moderate consumption of red wine on platelet aggregation and haemostatic variables in healthy volunteers. *Eur J Clin Nutr* 50(4):209-213, 1996. **(32) Kannel, W.B.**, and Ellison, R.C. Alcohol and coronary heart disease: The evidence for a protective effect. *Clinica Chimica Acta* 246(1-2):59-76, 1996. **(33) Tjønneland, A.**; Grønbæk, M.; Stripp, C.; et al. Wine intake and diet in a random sample of 48763 Danish men and women. *Am J Clin Nutr* 69(1):49-54, 1999. **(34) Emeson, E.E.**; Manaves, V.; Singer, T.; et al. Chronic alcohol feeding inhibits atherogenesis in C57BL/6 hyperlipidemic mice. *Amer J Pathol* 147(6):1749-1758, 1995. **(35) Dreon, D.M.**, and Krauss, R.M. Alcohol, lipids, and lipoproteins. In: Zakhari, S., and Wassef, M., eds. *Alcohol and the Cardiovascular System*. NIAAA Research Monograph No. 31. NIH Pub. No. 96-4133. Washington, DC: U.S. Govt. Print. Off., 1996. pp. 369-391. **(36) Aikens, M.L.**; Grenett, H.E.; Benza, R.L.; et al. Alcohol-induced upregulation of plasminogen activators and fibrinolytic activity in cultured human endothelial cells. *Alcohol Clin Exp Res* 22(2):375-381, 1998. **(37) Dai, J.**; Miller, B.A.; and Lin, R.C. Alcohol feeding impedes early arteriosclerosis in low-density lipoprotein receptor knockout mice: Factors in addition to high-density lipoprotein-apolipoprotein A1 are involved. *Alcohol Clin Exp Res* 21(1):11-18, 1997. **(38) Booyse, F.M.**; Aikens, M.L.; and Grenett, H.E. Endothelial cell fibrinolysis: Transcriptional regulation of fibrinolytic protein gene expression (t-PA, u-PA, and PAI-1) by low alcohol. *Alcohol Clin Exp Res* 23(6):1119-1124, 1999. **(39) Ridker, P.M.**; Vaughan, D.E.; Stampfer, M.J.; et al. Association of moderate alcohol consumption and plasma concentration of endogenous tissue-type plasminogen activator. *JAMA* 272(12):929-933, 1994. **(40) Hendriks, H.F.J.**; Veenstra, J.; Wierik, E.J.M.V.; et al. Effect of moderate dose of alcohol with evening meal on fibrinolytic factors. *BMJ* 308(6935):1003-1006, 1994. **(41) Rubin, R.** Effect of ethanol on platelet function. *Alcohol Clin Exp Res* 23(6):1114-1118, 1999. **(42) Miyamae, M.**; Diamond, I.; Weiner, M.W.; et al. Regular alcohol consumption mimics cardiac preconditioning by protecting against ischemia-reperfusion injury. *Proc Nat Acad Sci* 94(7):3235-3239, 1997. **(43) McDonough, K.H.** Chronic alcohol consumption causes accelerated myocardial preconditioning to ischemia-reperfusion injury. *Alcohol Clin Exp Res* 21(5):869-873, 1997. **(44) Guyton, A.C.** *Human Physiology and Mechanisms of Disease*. 5th ed. Philadelphia: Saunders,

1992. (45) **Thomas, B.A.**, and Regan, T.J. Interactions between alcohol and cardiovascular medications. *Alcohol Health Res World* 14(4):333-339, 1990. (46) **Wannamethee, G.**; Whincup, P.H.; Shaper, A.G.; et al. Factors determining case fatality in myocardial infarction: "Who dies in a heart attack?" *BMJ* 74:324-331, 1995. (47) **NIAAA**. *Ninth Special Report to the U.S. Congress on Alcohol and Health*. NIH Pub. No. 97-4017. Bethesda, MD: the Institute, 1997.

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<sup>1</sup>Definitions of moderate drinking vary among studies. The U.S. Department of Agriculture and the U.S. Department of Health and Human Services define moderate drinking as not more than two drinks per day for men and no more than one drink per day for women. A standard drink is 12 grams of pure alcohol, which is equivalent to one 12-ounce bottle of beer, one 5-ounce glass of wine, or 1.5 ounces of distilled spirits.

<sup>2</sup>The mean study duration is calculated from the date of the first intake interview and unadjusted for the number of participants or premature mortality.

<sup>3</sup>Individuals at risk for alcohol-related problems include pregnant or nursing women, operators of automobiles and other potentially dangerous machinery, individuals taking medications where alcohol use is contraindicated, individuals with a family history of alcoholism, and individuals who are recovering from alcoholism.

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