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Editor

Norman M. Kaplan, MD

Biff F. Palmer, MD

Nutritional and Health Benefits of Beer

Author

Margo A. Denke, MD

ABSTRACT: Physicians should be aware of the growing evidence supporting the nutritional and health benefits of moderate consumption of alcohol as part of a healthy lifestyle. The recently approved voluntary label on wine ("the proud people who made this wine encourage you to consult your family doctor about the health effects of wine consumption") implies that physicians should promote wine as the preferred source of dietary alcohol.

In the 1980s, data suggesting a cardiovascular health benefit of alcohol consumption began to emerge. Given the health problems associated with alcohol excess, acceptance of the validity of these benefits was not easily garnered.¹ Skeptics suggested that self-reported alcohol intake was so unreliable that any attempt to correlate self-reported intake with disease would be invalid. Initial reports suggesting the superiority of wine over beer failed to take into account confounding from important covariates associated with beverage preference. A brief understanding of how self-reported alcohol intakes have been validated and what important covariates must be considered before accepting the conclusions of an observational study will be presented, followed by a summary of the data supporting the benefits of moderate alcohol consumption, with a focus on beer.

Validation of Observational Data on Alcohol Consumption

Annual consumption of alcohol in the United States is 2.7 gallons of ethanol per person. According to 1998 statistics collected by The Texas Alcoholic Beverage Commission, per capita monthly consump-

From the Center for Human Nutrition, University of Texas Southwestern Medical Center at Dallas, Medical Service, Veterans Health Administration North Texas Health Care System, Dallas, Texas.

Correspondence: Margo A. Denke, M.D., 5323 Harry Hines Boulevard Y3-234, Dallas, TX 75390-9052 (Email: mdenke@ednet.swmed.edu).

However, studies evaluating the relative benefits of wine versus beer versus spirits suggest that moderate consumption of any alcoholic beverage is associated with lower rates of cardiovascular disease. From a nutritional standpoint, beer contains more protein and B vitamins than wine. The antioxidant content of beer is equivalent to that of wine, but the specific antioxidants are different because the barley and hops used in the production of beer contain flavonoids different from those in the grapes used in the production of wine. The benefits of moderate alcohol consumption have not been generally endorsed by physicians for fear that heavy consumers may consider any message as a permissive license to drink in excess. Discussions with patients regarding alcohol consumption should be made in the context of a general medical examination. There is no evidence to support endorsement of one type of alcoholic beverage over another. The physician should define moderate drinking (1 drink per day for women and 2 drinks per day for men) for the patient and should review consumption patterns associated with high risk. **KEY INDEXING TERMS:** Beer; Alcoholic beverages; Cardiovascular disease [Am J Med Sci 2000;320(5):320-326.]

tion is 3.3 drinks from spirits, 1.3 from wine, and 11.1 from beer each month (Texas Alcoholic Beverage Commission, 1998 statistics). Consumption rates do not disclose the distribution of individual consumption. The distribution of drinkers in the population is not normally distributed. Approximately one third of the adult population in the United States report abstinence from alcohol. In statistics collected by survey of over 8000 Texans from the Texas Commission on Alcohol and Drug Abuse, 29% of men and 41% of women do not consume alcohol (Wallisch L, 1996 Texas Survey of Substance Use Among Adults, Texas Commission on Alcohol and Drug Abuse, 1997). Heavy drinking, defined by the Commission as 5 or more drinks on 5 or more days in the past month, was reported by 5% of the adults surveyed. It has been estimated that half of the alcohol sold in the United States is bought by the 10% of adults with a drinking problem.²

Reliability of Self Reports for Alcohol Intake

Observational studies rely on self-reported alcohol intake. Health professionals are taught to be skeptical of self-reported alcohol intake and are taught to improve the accuracy of self-report by using the "top high" technique.³ In this technique, the patient is asked in a nonjudgmental manner whether or not he drinks a larger amount than the physician suspects (eg, "two bottles of whiskey a day"). The response of the patient will be denial of this larger amount and perhaps admission to a smaller amount better reflecting true consumption. Applying the rationale of the top high technique to observational studies sug-

gests that all assessments of intake will be grossly underestimated.

Investigators familiar with self-reported estimates suggest that the method of data collection, and not its self-reported nature, determines the validity of the measure. For example, data collected on alcoholics enrolled in an alcohol treatment program may have undue bias⁴ because disclosing recidivism to the alcohol counselor would have untoward consequences. Similarly, alcoholics enrolled in a treatment program tend to overestimate intake to justify their need for treatment.⁵ Do problems with data collection diminish the value of self-reported intake? Most researchers in the field still feel that the validity of self-reported intake can be interpreted by assessing 5 methodological variables⁶: (1) the context of the inquiry (eg, questioning as a component of a general request for demographic data is more likely to obtain accurate disclosure than questioning as a component of an inquiry regarding an arrest or an alcohol-related disease); (2) the specificity of the validation criteria (eg, comparison with other methods of self-report); (3) the personal characteristics of the respondents (eg, sober versus intoxicated); (4) the time window of the report (eg, lifetime versus recent intake; intake over the past few months is more reliable); (5) the demand characteristics of the task situation (eg, clinical interview vs. research evaluation)

Self-reports obtained by a trained⁴ interviewer correlate well with collateral reports obtained from spouses who were asked to estimate intake,⁷ with r values typically > 0.80 , even in alcoholics. Different methods of self-report are well correlated with each other (eg, food frequency questionnaire and 4 1-week food records, $r = 0.86-0.90$). High-density lipoprotein (HDL) cholesterol levels correlate with alcohol intake from food records ($r = 0.33$) and food frequency questionnaires ($r = 0.33-0.40$).⁸ No systematic bias by beverage type has been discerned.^{9,10} In summary, the evidence suggests that self-reported alcohol intake is as valid as any other self-reported measurement in the general population.

Covariates with Alcohol Consumption

Many health behaviors that affect the risk for heart disease are associated with alcohol intake. Klatsky characterized the taste preferences and cardiovascular risk profile in 53,172 members of the Kaiser Permanente Health Maintenance Program.¹¹ Beverage preference was reported by half of consumers. Wine drinkers were more likely to be women, nonsmokers, and free of symptoms. Spirit drinkers were more likely to be men, heavier drinkers, less educated, and afflicted with disease symptoms or disease risk factors. Beer drinkers were more likely to be young men who fall between the other 2 groups for most traits.

The large number of covariates with alcohol consumption reduces the effect of a univariate analysis for predicting risk. Given the population characteristics of wine drinkers, the younger age of beer drinkers, and the association of spirit drinking with smoking, it should be unsurprising that wine drinking was initially highlighted as being the most beneficial. Sufficiently large studies that have quantified multiple covariates were necessary to fully characterize the association between moderate alcohol consumption per se on cardiovascular risk.

Moderate Consumption and Total/Cardiovascular Mortality

Several early studies point out the methodological difficulties of analyzing alcohol intake with respect to mortality. In the prospective British Regional Heart Study,¹² 7735 men aged 40 to 59 were followed for $7\frac{1}{2}$ years. Although a u-shaped curve between alcohol intake and total mortality was observed, the relationship dissipated when adjusted for risk factors of smoking, age, and preexisting coronary disease. Other studies, such as the Yugoslavia Cardiovascular Disease study,¹³ measured frequency of alcohol intake, not quantity, allowing only limited conclusions to be made. In the Framingham study,¹⁴ only a weak negative association between alcohol ingestion and coronary heart disease (CHD) was observed.

The majority of more recent, large, population-based studies have observed that moderate drinking in the range of 1 to 3 drinks daily is associated with a rate of coronary disease 30 to 40% lower compared with nondrinking. This association is present even after accounting for covariates of cigarette smoking and age. The association between alcohol consumption and cardiovascular disease is not linear but more "u-shaped," with higher death rates found among those who abstain as well as those who drink in excess of 6 drinks a day. The finding has been true for both myocardial infarction¹⁵ and CHD death (Table 1). These findings have been replicated in multiple case control studies and in prospective observational studies of special populations, such as diabetics²⁷ and patients with existing heart disease.²⁸ Light drinking was a significant modifiable lifestyle factor that predicted the 15-year likelihood of remaining free from myocardial infarction, stroke, or the development of diabetes.²⁹ As Hein, Suadicani, and Gyntelberg wrote in their letter to the editor³⁰: "The proposal that alcohol has a protective effect on the risk of ischaemic heart disease no longer has the charm of novelty."

Wine is not the only alcoholic beverage whose consumption is associated with lower cardiovascular risk. In a meta-analysis evaluating benefits of different alcoholic beverages,³¹ findings that one beverage was superior to other beverages were equally

Table 1. Examples of Reported or Estimated Adjusted Relative Risk for Moderate Drinkers

Study	Participants	Baseline year	Years obs	Relative Risk CHD Death RR 1.0 = abstainers
British Doctors Study ¹⁶	12,321 physicians aged 48–78	1978	6–13	13 drinks/week RR ~0.51
α -Tocopherol, β -carotene study ¹⁷	7,052 male smokers aged 50–69	1984–8	4.7	Moderate drinkers RR ~0.74
Kaiser Permanente study ¹⁸	128,934 adults	1978–85	3–10	Men 1–2/day RR 0.80 Women 1–2/day RR 0.80
Puerto Rico ¹⁹	9,150 men aged 35–79	1965–8	12	Single 24-hour recall RR .70
Italian Rural Cohort Study ²⁰	1,536 men aged 45–64	1965	15	4–5 drinks/day RR 0.69
Copenhagen city heart study ^{21,22}	6,051 men, 3,234 women aged 30–70	1976–8	10–12	1–6 drinks/week RR 0.63
Shanghai Cancer Study ²³	18,244 men aged 45–64	1986–9	6	1–28 drinks/week RR 0.64
Honolulu Heart study ²⁴	8,006 men born 1900–19	1965–8	6	2 drinks/week RR 0.74
Nurses Health Study ²⁵	87,526 women	1980	4	1 drink/day RR 0.6
Health Professionals Study ²⁶	51,529 men	1986	2	Up to 2 drinks/day RR 0.74

distributed among beer, wine, and spirits. This suggests that the majority of the cardioprotective effect is caused by the alcohol content of the beverage and not by inherent differences in other components found in these beverages.

The consistency of the data are persuasive. Most studies have observed that moderate alcohol intake afforded a one-third reduction in CHD risk. It should be emphasized that this reduction in risk applies only to the portion of the population that is currently not drinking. Translating this figure to the population at large will lead to lesser benefits, because fewer than 30% of men do not drink.

Corroborating Evidence: Lesion Size

In a recent study of coronary atherosclerosis,³² 484 men undergoing coronary angiography were questioned regarding their alcohol intake. The extent of atherosclerosis by angiography was inversely associated with alcohol consumption. When HDL cholesterol levels were considered, the trend of protection against heart disease was lessened but still significant. Similar associations have been observed for carotid atherosclerosis³³ determined by ultrasound. In the recently published Bruneck Study,³⁴ 5-year progression of carotid lesions was measured by Doppler ultrasonography in 826 men and women. The association between progression of disease and alcohol intake was j-shaped. No differences between source of alcohol were seen.

Mechanism of Action

Several proposed mechanisms have been forwarded. In several studies, 30 to 50% of the overall reduction in heart disease can be explained by the HDL-raising effects of alcohol.^{35,36} Alcohol raises

HDL cholesterol levels in a dose-dependent fashion. A single beer consumed daily raised HDL cholesterol levels by 4.4%, or 2 mg/dL.³⁷ Besides raising HDL cholesterol levels, 3 other speculated mechanisms have been gathering scientific support: the anti-thrombotic properties of alcohol, the antioxidant properties of components in certain alcoholic beverages, and improvements in insulin resistance.

It is well known that alcohol intake increases bleeding time. Moderate alcohol consumption impairs platelet aggregation³⁸ by affecting production of thromboxane A₂.³⁹ Alcohol may improve the fluidity of red blood cell membranes.⁴⁰ Certainly, the effects of alcohol as an antithrombotic agent could explain a component of its ability to reduce coronary risk.

A portion of the beneficial effects of alcohol could be caused by the nonalcohol components of alcoholic beverages. Beer contains more protein and B vitamins than wine,⁴¹ and the nutritional value of beer can contribute substantially to the diet.⁴² Alcoholic beverages contain a variety of biologically active compounds^{43–45} (Table 2). Polyphenols (formerly referred to tannins) are present in beer and wine.^{46–48} All polyphenols prevent low-density lipoprotein (LDL) oxidation in vitro when added to a tissue culture system; the magnitude of protection depends upon the phenolic concentration of the beverage and the oxidation system used. It is interesting to note that alcohol itself seems to be a pro-oxidant for LDL, and the phenol content in wine and beer reduces LDL oxidation.⁴⁹ Beer has a total polyphenol content equivalent to that of red wine (Table 3) and has a greater capacity to prevent LDL oxidation than white wine.⁵⁰ Both beer and bourbon contain phy-

Table 2. Summary of Identified Phytochemicals in Alcoholic Beverages

Alcohol source	Primary material	Additives	Phytochemicals
Beer ⁴³⁻⁴⁵	barley other cereal	hops	Phenolic acids (ferulic acid) Flavonoids (formononetin, genistein, biochanin A daidzein, prodelphinidin B3, procyanidin B3, catechin, epicatechin), harman
Wine	grapes rice or fruit		Phenolic acids (<i>p</i> -coumaric, cinnamic, caffeic, gentisic, ferulic, vanillic), trihydroxy stilbenes (resveratrol, polydatin), flavonoids (catechin, epicatechin, quercetin), harman
Distilled spirits			
Gin	Unmalted grain or molasses	herbs (eg, juniper)	?
Rum	Sugar cane byproduct		?
Vodka	Rye malt Potato starch Apples, grapes, berries, Plums		?
Whiskey	Cereal grain		?
Bourbon ⁴⁵	Maize		β -sitosterol biochanin A
Scotch	Malt & grain		?
Tequila	Guava		?

toestrogens;⁵¹ whether this concentration is sufficient to cause the estrogenic effect described for the micromolar concentrations in soy is unclear.

A new area of investigation is the effects of moderate alcohol intake on insulin resistance. Insulin levels in nondiabetics predict atherosclerosis risk.⁵² Moderate drinking is associated with lower insulin levels, even after adjusting for covariates.^{53,54}

Public Policy: Recommendations on Alcohol Intake

The USDA Dietary Guidelines recommend that if you drink, drink in moderation. Moderation is defined as no more than 1 drink per day for women and no more than 2 drinks per day for men. The Dietary Guidelines specify that some people should not drink alcohol, including children and adolescents, persons of any age who cannot restrict their drinking to moderate levels, women who are trying to conceive or who are pregnant, persons who plan to drive or take part in activities that require attention

or skill, and persons using prescription and over-the-counter medications.

An Approach to Alcohol Recommendations from Physician to Patient

Although evidence has been mounting that moderate consumption of alcohol is beneficial, recommending that patients consume 1 to 2 drinks per day has not been an easy recommendation to make. In a 1979 editorial, William Castelli wrote,⁵⁵ "With 17 million alcoholics in this country we perhaps have a message for which this country is not yet ready." In a 1997 editorial, Criqui reiterated this concern, writing⁵⁶ "Alcohol is too dangerous to be employed as a pharmacological agent except in highly selected situations."

Physicians wishing to recommend moderate alcohol consumption to patients⁵⁷ should consider the recommendation only after completing an appropriate history and physical examination to evaluate for the presence or potential for alcoholism.⁵⁸ Salient points for the history are detailed below with physical examination and laboratory issues listed in Table 4.

History

Current drinking habits and family/personal history of alcohol use/abuse. Permissive advice for drinking should not be given to patients with a personal or family history of alcoholism because these patients are at a 4-fold increased risk for developing alcoholism themselves. The **CAGE** questions⁵⁹ derived from a longer questionnaire, the

Table 3. Total Polyphenols of Grape Juice, Wine, or Beer

Beverage Source	Juice	Wine
	mg/drink	
Shiraz grape	41.7	114.7
Cabernet Sauvignon grape	24.8	124.9
Grenache grape	146.4	
Sauvignon Blanc		24.6
Chardonnay		35.3
Lager beer		112.3
Low-alcohol beer		119.9

Table 4. Physical and Laboratory Signs of Alcohol Problems¹

Physical examination
Signs of trauma
Signs of liver disease: tender hepatomegaly, spider nevi, secondary lunulae, palmar erythema, bruising, parotid enlargement, ascites
Conjunctival injection, facial telengectasia, tongue and hand tremors
Hypertension, obesity
Withdrawal features, commonly anxiety, sweating, and tachycardia
Evidence of intoxication—alcohol on the breath, ataxia, disinhibition
Laboratory evaluation
Half of the cases show some abnormality in liver function tests; γ -glutamyltransferase measurement is the most sensitive
Mean corpuscular volume is elevated

Adapted from Jurd SM. Alcoholism. In: Rakel RE, editor. *Conn's current therapy*. Philadelphia: WB Saunders; 1999. p. 112–118.

Michigan Alcoholism Screening Test⁶⁰ can be used for a rapid interview for alcohol abuse. Two or more positive answers suggests an alcohol problem.

1. Have you felt the need to Cut down?
2. Have others Annoyed you by criticizing your drinking?
3. Have you felt Guilty about your drinking?
4. Have you ever had a morning drink (Eye-opener) to steady your nerves or get rid of a hangover?

Although the CAGE questions can be helpful, some patients regard the questions as confrontational. Alternative approaches to screening to alcohol use have been proposed:⁶¹

1. "How often do you use alcohol?" The question focuses on frequency and is asked in a nonjudgmental fashion. Frequency may be more reliable than quantity.
2. "How much to you usually use?" Query into drinking pattern. Six or more bottles of beer consumed during a single occasion was associated with a 3-fold increase in mortality compared with fewer than 3 bottles.⁶² Size of drinks needs to be queried. Spirit drinkers often make their drinks to "taste" rather than ounces.

3. "Have you ever used alcohol more heavily?"
4. "Does anyone close to you drink heavily?"

If concerned, the physician can extend the interview with additional questions:

5. "What are the circumstances in which you drink?" (social interactions, etc)
6. "Do you like yourself better when you drink?"
7. "Do you use alcohol as medication to relieve pain, anxiety, or trouble sleeping?"
8. "Have you had "blackouts"—loss of memory for events while intoxicated?"
9. "Is your drinking different now than it was 5 years ago?"

In addition to current drinking status, diseases or behaviors that may worsen with alcohol consump-

tion should be tabulated. Three are specific to beer and 7 apply to any form of alcohol:

Patients Taking Monoamine Oxidase (MAO) Inhibitors. Ten biogenic amines have been identified in beer, the most common being tyramine.⁶³ Bottled beers have low tyramine concentrations (0–1.14 mg/drink) and patients taking MAO inhibitors can probably consume 1 to 3 cans of beer in a 4-hour period without having a reaction. Tap beer, particularly bottom fermentation-derived lagers with *Saccharomyces carlsbergensis*, can have tyramine levels up to 40.8 mg/drink and should not be consumed by patients taking MAO inhibitors.^{64,65}

Patients with Gout or Elevated Uric Acid Levels. Alcohol reduces purine excretion, and beer contains guanine and adenine, 2 purines.⁶⁶ Patients with gout should not drink alcohol and should particularly avoid beer.

Patients with Sprue. The barley prolamins hordein is present in beer at a concentration of 1.12 g/drink.⁶⁷ Hordein is to barley as gliadin is to wheat—both are prolamins that cross-react with antigliadin antibodies. Beer consumption in patients with celiac disease may exacerbate their symptoms.

Patients Who Will Be Undergoing Elective Surgery. Alcohol increases the likelihood of intraoperative and postoperative bleeding, so patients should be counseled to abstain from alcohol 1 to 2 weeks before major surgery.⁶⁸

Patients with Existing Heart Disease. Excessive single-dose ingestion of >7 drinks of alcohol in a single setting, reduced heart rate variability for 12 hours after the dose.⁶⁹ Patients with existing disease should be explicitly instructed to avoid binge drinking.

Elderly Patients. Geriatric patients in a nursing home become more social when given a beer or a glass of wine during the evening meal.⁷⁰ Alcohol dose should be adjusted downward because of reduced tolerance with age.

Patients Stopping by for a Drink before Going Home. Alcohol is more rapidly absorbed on an empty stomach, resulting in a 2-fold increase in peak blood alcohol concentration compared with alcohol consumed with food.⁷¹

Patients who Consume More than 2 Drinks in a Single Setting. One third of persons arrested for driving under the influence of alcohol had attended a joyous social function where they drank too much, such as a wedding, family reunion, etc. Binge drinking is risky, even during a rare celebratory occasion.^{65,69}

Specific Patient Recommendations

After obtaining a history of current alcohol use, history of alcoholism in the family, history of illnesses that may worsen with greater alcohol ingestion, and corroborating this with the physical examination and laboratory evaluation, the physician

may choose an alcohol recommendation from the following:

1. Patients who report more than moderate alcohol intake or who have signs of alcoholic liver disease should be counseled to reduce or discontinue their current intake.

2. Patients who are light drinkers can be informed of the health benefits of moderate consumption.

3. Patients who abstain from alcohol and have no risk factors for alcoholism can be informed of the benefits. Personal choice (eg, dislike of side effects of alcohol consumption) may have more influence on behavior than the physician's advice.

4. There is no evidence that cardiovascular benefits are limited to a specific type of alcohol, and people who prefer beer or spirits over wine should be counseled to continue the beverage of their choice in moderation. Despite the voluntary labels approved by the Bureau of Alcohol, Tobacco, and Firearms that now appear on wine bottles, wine offers little advantage over beer or spirits.

5. All patients should be educated regarding risky behavior, defined minimally as drinking before driving or operating machinery, drinking during pregnancy, or drinking more than 2 drinks on one occasion.

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