

PREFACE

In this high-tech era of molecular biology and designer drug therapies, it remains a basic fact that good nutrition is the single most cost-effective way to improve the health and well-being of the greatest number of individuals on our planet (1,2). *Beverages in Nutrition and Health* is the first book dedicated to helping us discover how different beverages impact our basic nutrition and the risk of disease. This book also helps explain the potential value of these beverages for the promotion of optimal human health and well-being. In addition, it discusses developments in the formulation of beverages and the likely implications on human health.

During the last century, we have vastly improved the palatability and variety of beverage choices available to a population that is expanding in size, demands, and affluence. We have also seen many changes in the state of our health, sometimes for the better and sometimes for the worse. It has only been in the last 100 years that the Western diseases have become prominent in the cultures that have embraced the new diet of affluence (3), and beverages are very much a part of that diet of affluence.

Beverages have been an integral part of life since animals left the sea and moved onto dry land. The first period of human life occurs bathed in a sea of fluids; indeed as a fetus we begin to drink even before birth has occurred. Beverage consumption starts for most of us immediately after we are born with breast milk. For the rest of our lives, we will continue to require approx 1.2 mL of water per dietary calorie spent per day.

Until modern times, our choices of beverages were fairly limited and included water, alcoholic drinks, milk, and a few fermented milk products. The history of the human use of these drinks is discussed in Chapter 1 by Grivetti and Wilson. However, in recent years, there has been an explosion in the number of beverage choices available for acquiring our daily fluid requirements. This has been made possible by using such industrial processes as carbonation, processing to add ingredients, such as high-fructose corn syrup, vitamins, and minerals, and the development of new processing and preservation methods. But what has the impact of these changes been on our ability to obtain proper nutrition and maintain health? These impacts are the focus of *Beverages in Nutrition and Health*.

Alcohol has been a part of our diet for thousands of years. In recent years, we have come to a new understanding of how alcohol affects our health, and how the amounts and types of alcoholic beverages that increase or decrease mortality rates. This is discussed in Chapter 2 by Rimm and Temple. Research has revealed mechanisms by which substances in wine may have specific health benefits, a topic reviewed in Chapter 3 by Walzem and German.

Recent advances in ideas and methods for investigation available to researchers in the food sciences and medicine have provided new insights into how fruit and vegetable juices affect disease outcomes in both beneficial and potentially deleterious ways. Wilson, in Chapter 4, discusses how cranberry juice has been clinically determined to prevent

urinary tract infections and possibly other diseases. McGill, Wilson, and Papanikolaou, in Chapter 5, review how citrus juice consumption affords protection against various diseases, whereas Johnston, in Chapter 6, discusses how processing methods and storage may actually limit the availability of vitamin C and flavonoids from these same juices. The observation that some citrus juices may actually create harmful interactions with prescription drugs is another possibly important ancillary issue and is discussed in Chapter 7 by Kane. In addition, the intriguing associative link between tomato juice consumption and reduced risks of prostate and other cancers is explored by Hadley, Schwartz, and Clinton in Chapter 8.

How do coffee and tea and the caffeine and other substances they contain affect our health? The health effects of green and black teas are discussed in Chapter 10 by Afaq, Adhami, Ahmad, and Mukhtar. In Chapter 9, Tavani and La Vecchia discuss the general lack of associations between coffee intake and cancer. They also discuss the complex relation between coffee and heart disease. Chocolate was originally consumed in the form of a drink and its consumption in a liquid form remains popular. In Chapter 11, Schmitz, Kelm, and Hammerstone investigate this topic from a historical and health-related point of view. In Chapter 12, Weinberg and Bealer discuss the health effects of the caffeine that is a ubiquitous component of these and numerous other beverages. Finally, in Chapter 13, Craig discusses the health risks and some of the benefits that may be obtained from the increasing number of herbal teas that are available.

A variety of milks and milk products have been in the diet of many human cultures for millenia. Chapter 14 by McBean, Miller, and Heaney provides an optimistic view of how cow's milk can provide some degree of protection against osteoporosis, obesity, and heart disease, and discuss some of the claims and counterclaims that have emerged in regard to milk consumption. The potential of probiotic organisms in dairy and fermented dairy products to impact the health qualities of beverages is discussed by Heller in Chapter 17. Finally, because many persons avoid dairy products for health or religious reasons, substitutes are needed and Woodside and Morton, in Chapter 15, discuss the health qualities of the most commonly consumed substitute, soy milk.

Different beverages become more important as we pass from neonate to adult to elderly adult. Friel reviews the current state of affairs in the heated and continuing breast milk vs neonate/infant formula debate, fueled on one side by our traditional habits and on the other by commercial forces. As we enter middle age, weight management becomes a problem for many of us and Chapter 18 by Stubbs and Whybrow discusses how particular beverages can contribute to weight problems, whereas others may become part of the solution. Finally, Johnson and Glassman, in Chapter 19, look at what happens when an elderly person's diet is unable to meet his or her nutrient needs. They describe the often overrated value of nutritional support beverages for helping us achieve our required intake of vitamins and minerals.

Beverages have also evolved to meet specific physiological functions and needs for simple hydration. The topic of sports beverage content and effectiveness is reviewed in Chapter 20 by Maughan. Ramakrishna considers the factors that have helped oral electrolyte-carbohydrate rehydration therapies save more lives on our planet every year than any other medical treatment. In Chapter 21, our transition to living in an urbanized, and sometimes affluent, culture has created new opportunities for safe water and at the same

time created potential exposure to new water-borne pathogens, a topic discussed in Chapter 23 by Chauret. Our affluence and concern about water safety has led many to consume bottled water. In Chapter 20, Jamal and Eisenberg discuss some surprising facts regarding the quality and content of these products.

The consumption of soft drinks has recently been linked to a wide range of health problems, especially for children and young adults. This problem is discussed in Chapter 24 by Jacobson from the watchdog organization the Center for Science in the Public Interest. In that chapter, as well as in Chapter 25 by Balay-Karperien, Temple, and Nestle, the authors discuss marketing practices used to promote the consumption of these products.

Regulation of beverage content and marketing practice has been a part of American life for nearly a century since the establishment of the US Food and Drug Administration and the original “Snake Oil Laws” of the 1920s. These laws sought to limit the use of bogus health claims that manufacturers used to market their products. The fast growing popularity of “functional foods” (including beverages) has created a resurgence of concern and interest in the area of regulation. Chapter 27 by Krasny provides a current update of the status of these laws and regulations with regards to how beverages can be marketed in the United States. Other nations have similar laws, and in Chapter 26, Ohki, Nakamura, and Takano provide a review of the status of the recreational and tonic beverage industry in Japan and how the laws of Japan regulate beverage-health claims on products sold there.

In recent decades, researchers have made considerable progress in our understanding of possible associations between beverages and the Western diseases. This book provides an overview of the field. In that respect it continues from our previous books (2,3). Every one of us will undoubtedly (unless we want to die) continue to consume beverages and experience potentially beneficial or possibly detrimental effects related to our choices. Readers of this book will have a better understanding of how to optimize their beverage consumption for optimizing health. *Beverages in Nutrition and Health* is also intended to help the reader understand how current and probable future innovations in the beverage industry have the potential to affect our health in both positive and negative ways. At the risk of stating the obvious, beverage nutrition research is very much an ongoing activity. As a result, there are many contrasting views on aspects of the field, and the significance of some of these contrasts is discussed in the final chapter (28) by Jacobs, Temple, and Wilson. An important means of resolving these contentious areas is by debate. To some extent this debate can be found on the pages of this book. Accordingly, the editors make no apology if the reader finds that statements in one chapter may contradict those in another.

Ted Wilson, PhD
Norman J. Temple, PhD

REFERENCES

1. Wilson T. What types of nutrition research give the best results? *Nutrition* 2002;18:352.
2. Wilson T, Temple NJ, eds. *Nutritional health: Strategies for Disease Prevention*. Humana Press, Totowa, NJ, 2002.
3. Temple NJ, Burkitt DP, eds. *Western Diseases: Their Dietary Prevention and Reversibility*. Humana Press, Totowa, NJ, 1994.

2

What Are the Health Implications of Alcohol Consumption?

Eric Rimm and Norman J. Temple

The harmful effects of alcohol are far better known than its beneficial effects. This is scarcely surprising: it requires no training in epidemiology to recognize the devastating harm that often comes with both drunkenness and chronic alcohol abuse. However, findings that have emerged in recent years have uncovered several surprising associations between moderate alcohol intake and enhanced health and well being.

In this chapter, the American definition of a drink, namely 12.5–13.0 g of alcohol, is used. This quantity of alcohol is approximately the amount contained in 12 oz (356 g) of regular beer, 4–5 oz (118–148 g) of wine, or 1.5 oz (42 g) of spirits. We also use the US Department of Agriculture (USDA) dietary guidelines' definition of moderate alcohol consumption as up to two drinks a day for men and one drink a day for women.

1. HARMFUL EFFECTS OF ALCOHOL

1.1. Accidents, Violence, and Suicide

It is well established that abuse of alcohol is associated with accidents, violence, and suicide. The most dramatic evidence of this has come from Russia. Between 1984 and 1994, there was serious economic decline and great political turmoil. During this period, life expectancy fell by 4 yr in men and by 2 yr in women. A major factor contributing to this decline was widespread alcohol abuse, particularly binge drinking, which led to large increases in deaths from accidents, homicide, and suicide, as well as cardiovascular disease (1,2).

In 1999 in the United States, there were approx 15,800 alcohol-related traffic accidents, approx 38% of all traffic fatalities. This is a decrease of 30% when compared with 1989 (3). Stricter enforcement of existing legal codes and the passage of new laws have been suggested as promoting these beneficial changes.

1.2. Chronic Alcohol Abuse

For many people, years of alcohol abuse eventually lead to chronic health and nutritional problems. Alcohol is rich in calories and typically devoid in nutrients, especially alcohol-rich and sugar-rich hard liquors. The body often compensates for the high caloric intake by decreasing the stimulus to eat regular nutrient-rich foods. As a result, there is

From: *Beverages in Nutrition and Health*

Edited by: T. Wilson and N. J. Temple © Humana Press Inc., Totowa, NJ

a high probability of malnutrition, especially of folate and thiamin. The thiamin deficiency associated with alcohol abuse is known as Wernicke-Korsakoff syndrome. Liver disease is also a likely result, with a downward spiral from fatty liver to alcoholic hepatitis and, eventually, to cirrhosis.

1.3. Fetal Alcohol Syndrome

Pregnancy is another situation in which alcohol misuse can have tragic consequences. This induces fetal alcohol syndrome (FAS). FAS encompasses several symptoms, including prenatal and postnatal growth retardation, abnormal facial features, and an increased frequency of major birth defects. Children born with FAS never recover.

A subclinical form of FAS is known as fetal alcohol effects (FAE). Children with FAE may be short or have only minor facial abnormalities or develop learning disabilities, behavioral problems, or motor impairments.

FAS occurs at a level of alcohol intake that in a nonpregnant woman would not be considered alcohol abuse. Approximately four drinks per day pose a real threat of FAS, whereas one or two drinks per day may still retard growth, although the epidemiological data are weaker and somewhat inconsistent at these lower consumption levels. Although women who have an occasional drink during pregnancy should not fear they are doing irreparable harm to their fetuses, it is now generally accepted that any woman who is or may become pregnant should abstain from alcohol.

1.4. Cancer

Alcohol increases the risk of cancer of the mouth, throat, and esophagus (4,5). It also acts as a cocarcinogen with cigarette smoke (6). It is likely that among heavy alcohol consumers, the alcohol or one of its metabolites, acetaldehyde, is toxic to mucosal epithelial cells. Alcohol also increases the risk of cancer of the liver, ovary, and breast (4,5). The risk ratio (RR) with an alcohol intake of four drinks per day is estimated to be 2.3 for cancer of the mouth, throat, and esophagus; 1.7 for breast cancer; and 1.15–1.35 for cancer of the stomach, colon-rectum, liver, and ovary (5). For all cancer combined, a significant risk is seen starting at an alcohol intake of two drinks per day, with a RR of 1.22 at four drinks per day (5). For breast cancer, it is less likely that ethanol is toxic, because the increase has been seen at relatively low levels. It is more likely that alcohol influences circulating estrogen levels, which may affect disease occurrence (7,8).

Emerging evidence also indicates that alcohol, even in moderation, may suppress circulating folate levels, which could affect DNA synthesis and gene expression. Several recent large prospective studies of breast cancer (9,10) show that an adequate folate intake ameliorated the carcinogenic action of alcohol (*see* Fig. 1). As with breast cancer, the effect of alcohol on colon cancer may be muted or eliminated completely if the diet has sufficient folate or methionine (both methyl donors) (11).

1.5. Obesity

Alcohol, of course, is a source of calories (7 kcal/g). It is important to remember that alcoholic beverages also contain carbohydrates that add additional calories. A half liter of wine contains approx 350 kcal, whereas three cans of beer supply approx 250–450 kcal, clearly enough to tip the energy balance well into positive territory. These numbers explain the popularity of low-calorie “light beers.” It is predictable, therefore, that alcohol con-

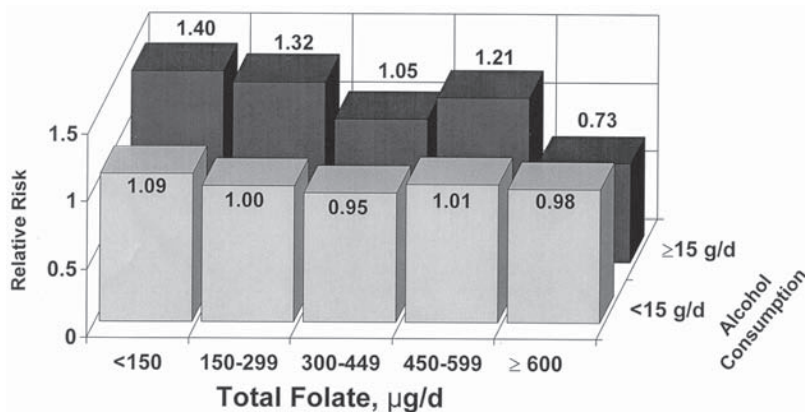


Fig. 1. Multivariate relative risk of breast cancer by total folate intake and alcohol consumption. The reference group for all comparisons was women who consumed 150–299 µg/d of total folate and fewer than 15 g/d alcohol.

sumption should be associated with excess weight gain. But, as so often happens in nutrition, predictions collapse in the face of reality. A solid body of evidence from mostly cross-sectional studies has demonstrated that alcohol intake actually has an inverse association with body mass index (an index of weight relative to height) (12–14). However, when diet, physical activity, and other lifestyle factors are not examined prospectively, it can be difficult to interpret whether the association is causal. Thus, more longitudinal studies of alcohol and weight gain are needed. Intervention studies are inconclusive, although Cordain et al. (15) reported that supplementation with 35 g of alcohol per day (a little less than three glasses of wine) to the daily energy requirements for a period of 6 wk did not affect body weight and/or energy metabolism. It is feasible that the increase in basal metabolic rate caused by moderate alcohol consumption may offset the additional calories from consuming alcohol-containing beverages (16).

2. PROTECTIVE EFFECTS OF ALCOHOL

2.1. Coronary Heart Disease

A convincing body of evidence suggests that the risk of coronary heart disease (CHD) is reduced by 10–40% in persons who consume alcohol in moderation (17). In some populations, this association can be skewed if individuals at higher risk for CHD reduce or eliminate alcohol consumption due to a diagnosis of a related chronic disease (e.g., hypertension or diabetes). This is frequently described as the “sick quitter” syndrome and can create a spurious artificial inverse association between alcohol and CHD (18). Because conditions like hypertension and diabetes increase the risk of CHD by twofold to threefold, a study that does not consider these conditions may find that moderate drinkers have as much as 50–70% less heart disease. However, even in large cohort studies where sick quitters are removed or moderate drinkers are compared to lifelong abstainers, alcohol has had strong cardiovascular benefits (19).

There has been much speculation that wine may be more potent than beer or spirits in preventing CHD. This is largely based on findings from ecological studies (i.e., countries

like France that have a high intake of wine have relatively low CHD rates) (17). It has been repeatedly shown that such associations can easily be spurious. This is indicated by the findings from case-control and cohort studies: these show no clear trend for one type of alcohol to be more consistently associated with protection from CHD (17). Where one type of alcohol does manifest a stronger association than other types, this is likely due to confounding by such factors as smoking and drinking pattern or to differences in other lifestyle factors, such as eating patterns or physical activity.

Short-term experimental studies have helped to explain the mechanisms by which alcohol prevents CHD (20). First and foremost, alcohol causes an increased level of high-density lipoprotein (HDL) cholesterol. This explains approximately half of the association between alcohol and CHD. Another protective mechanism is that alcohol exerts an antithrombotic action by reducing hepatic production of fibrinogen and other clotting proteins. There is also some evidence indicating that alcohol may lower low-density lipoprotein (LDL) cholesterol levels (21), but findings are not consistent.

Alcohol has been reported to elevate the blood homocysteine level, a relatively new CHD predictor. This was seen with 6 wk of consumption of a moderate level of alcohol (30 g/d) (22). Red wine and beer had a greater effect than spirits. This action of alcohol is predicted to partly counter its protective benefit on CHD.

As with cancer, there is a suggestion of an alcohol-folate interaction: the beneficial effects of alcohol on CHD may be strongest among those with folate-sufficient diets (23,24). Because alcohol may suppress folate levels leading to a subsequent increase in homocysteine, individuals with high folate intakes may benefit the most from a moderate alcohol intake because they will have low levels of homocysteine from the extra folate yet still reap the beneficial effects of alcohol on lipids, coagulation factors, and insulin sensitivity.

Recent findings from the Physicians' Health Study reveal a genetic component to the relationship between alcohol intake and risk of CHD (25). The enzyme alcohol dehydrogenase is crucial to the metabolism of alcohol. Approximately 15% of the population is homozygous (or has two copies of the gene) for the form of the gene that induces a slow rate of alcohol metabolism. Slow metabolizers have higher plasma HDL cholesterol levels than fast metabolizers, and, among those in the Physicians' Health Study who drink moderately there is a dramatically low risk of CHD. This is one of the first diet-gene interactions to be reported in the literature and provides strong evidence that the ethanol component of alcohol-containing beverages is responsible for the benefit rather than other components in wine, beer, or spirits.

2.2. Blood Pressure and Stroke

A relatively high alcohol intake (>4 drinks/d) is associated with elevated blood pressure (26,27) and an increased risk of stroke. Recent evidence from cohort studies suggest that the association between alcohol and hypertension may be J-shaped, such that light and moderate drinkers have a modestly reduced risk of developing hypertension, although the exact mechanism for this effect is unknown (28). Studies on the association between moderate alcohol consumption and stroke have been mixed. Several case-control and cohort studies have seen a reduced risk of stroke among moderate drinkers. Yet others find little benefit in the moderate range. In studies that find benefit, the reduction is usually limited to ischemic rather than hemorrhagic stroke (4,29–31).

Clearly, the data support no increase in ischemic risk at moderate levels, but more work is needed to determine if drinking patterns influence risk of stroke (i.e., frequent consumption of small amounts of alcohol vs binge drinking).

2.3. Impotence

The relationship between excessive alcohol intake and poor erectile function is well known. As Shakespeare wrote: “It provokes the desire, but takes away from the performance” (Macbeth). However, as in the case of alcohol and blood pressure, recent findings have revealed an apparently beneficial effect, or at least no ill effects, of moderate alcohol consumption. Preliminary data from the Health Professionals’ Follow-up Study, a prospective cohort study of more than 50,000 US male health professionals, show a modest U-shaped relationship between alcohol intake and erectile dysfunction. Like CHD, the strongest risk reduction was among those who consumed one to two drinks per day (32). Although erectile dysfunction was originally believed to be purely psychogenic in nature, 80–90% of the dysfunction is likely the result of biological factors that may share a similar profile to atherosclerosis.

2.4. Gallstones

Most studies that have examined this question have reported a protective association between alcohol and risk of gallstones. For instance, Leitzmann et al. (33) observed that men who consume alcohol frequently (5–7 d/wk) have a reduced risk of gallstones but not those who consume alcohol less frequently (1–2 d/wk). These findings indicate that frequency of alcohol consumption rather than quantity is the critical factor.

2.5. Bone Health

Although findings are not consistent, several studies have reported an inverse association between moderate alcohol intake and bone mineral density, especially in women who are postmenopausal (34,35). This suggests that alcohol may help prevent osteoporosis. However, as osteoporosis is so dependent on lifetime diet, physical activity, obesity, and other factors, it is probable that alcohol does not play an important role in osteoporosis. In contrast to the situation with osteoporosis, high levels of drinking cause loss of balance and falls, leading to an increased risk of hip or wrist fracture.

2.6. Hearing Loss

A cross-sectional study of subjects aged 50–91 years reported that moderate alcohol intake was associated with better hearing (36). Again, like bone health, many other environmental and genetic effects play a more important role in the etiology of hearing loss.

2.7. Cognitive Function

Findings from the Framingham study, conducted among older adults, suggested that alcohol is associated with enhanced cognitive ability, especially in women (37). This was seen at an intake of two to four drinks per day in women and four to eight drinks per day in men, an intake above what is usually considered moderate. An earlier study observed that this benefit was seen only in women (38). It is well known that higher intakes have a damaging effect on brain function. Once again, therefore, alcohol manifests a U-shaped or J-shaped relationship. An even more revealing study that had detailed measures of

cognitive function and dementia also reported benefits of alcohol consumption. In a 6-yr follow-up of 8000 middle-aged and older men and women in the Netherlands, Ruitenberg et al. (39) found that men and women consuming 1–3 drinks per day had a 42% lower risk than abstainers of developing dementia (mainly Alzheimer's disease).

2.8. Benign Prostatic Hyperplasia

A cohort study reported that moderate alcohol intake (2.5–4 drinks/d) was associated with a reduced risk of benign prostatic hyperplasia (RR of 0.59) (40). The mechanisms for this action are speculative but may include the effects of alcohol on steroid hormone levels.

2.9. Diabetes

Cohort studies have suggested that alcohol may be protective against type 2 diabetes. A British (41) and an American (42) cohort study indicated that moderate alcohol consumption reduces risk of the condition by approx 40% in men but less so among American women (43). Interestingly, there have been several recent studies suggesting that moderate alcohol consumption among men and women with type 2 diabetes is also associated with a much reduced risk of subsequent CHD, the leading killer of people with diabetes (44–47).

2.10. Lung Disease

Alcohol may also be protective against chronic obstructive pulmonary disease (COPD). A cohort study of middle-aged men in Finland, the Netherlands, and Italy revealed a protective association between alcohol intake and risk of death from COPD (48). The lowest risk was seen at an intake of up to approximately three drinks per day. Alcohol intake has also been observed to manifest a protective association with emphysema in smokers (49).

3. EFFECT OF ALCOHOL ON TOTAL MORTALITY

When alcohol intake is moderate, the beneficial health effects on the cardiovascular system outweigh most detrimental effects. As a result, the net effect of alcohol on total mortality is a J-shaped curve, with minimum mortality associated with a moderate alcohol intake but with a rising curve as consumption increases. A major study by the American Cancer Society reported that in each gender, persons consuming one drink daily had a risk of death from all causes approx 20% below those of nondrinkers (4). To put this in perspective, among American men and women aged 35–69 yr, a moderate consumption of alcohol prevents approximately one death for every six deaths caused by smoking (4).

The alcohol intake corresponding to the nadir for mortality is still unclear but in people aged 50–80 is approx 0.7–1.2 drinks per day in men and 0.3 drinks per day in women (50). However, because this is based on self-reported intake, which represents a substantial underestimation, the true nadir is almost certainly higher (50).

The benefits of alcohol are most apparent in the middle-aged and elderly. This is because alcohol reduces risk of CHD and stroke, the first and third leading causes of death, respectively, in that age group. By contrast, the leading cause of death in Americans under age 40 yr is accidents, with homicide and suicide also being major causes,

especially in men. These are all associated with alcohol. This age effect is illustrated by a report from the Nurses' Health Study. A moderate alcohol intake has a protective relationship with total mortality in women aged over 50 yr (RR is 0.80–0.88) but is associated with a doubling of the risk of death in those aged 34–39 yr (51). Similar findings were reported from England and Wales. A net favorable mortality outcome was seen only in men over age 55 and women over 65 yr (52).

4. DRINKING PATTERNS

More recently, research has focused on the importance of drinking pattern on risk of health outcomes. Not surprisingly, alcohol is most protective when consumed in small regular amounts rather than binge or episodic drinking. This was demonstrated in a cohort study in the United States (53). People who engaged in occasional heavy drinking had a higher risk of death than persons with the same alcohol intake but who did not engage in binge drinking. Similar observations were made on cardiovascular disease in Canada. The data from that study revealed that although alcohol consumption has a protective association with both CHD and hypertension, binge drinking increases the risk of both, especially in men (54). In a recent study of US male health professionals, frequency of consumption (d/wk) was more important than quantity consumed. Men who consumed alcohol at least 4 d/wk had the lowest risk of type 2 diabetes, regardless of the total amount consumed (55). These findings are hardly surprising: many dietary components cause no harm in small frequent doses but are toxic when a large dose is taken.

5. CONCLUSIONS

Clearly, alcohol can do much good but also much harm. It is important to remember that the harmful effects of alcohol frequently occur at a much younger age than the benefits. Consequently, if the effects of alcohol are measured in terms of quality years of life (lost or gained), then the harm done to one (usually younger) person by alcohol may be far greater than the benefit gained by another (usually older) person.

The majority of the harmful effects of alcohol can be avoided by sensible drinking, by not smoking, by drinking in moderation, and by avoiding alcohol when driving. For the person who can drink sensibly and can avoid alcohol's negative side effects, alcohol can be of considerable benefit. Like so much else in life, it's a matter of balance. Although alcohol should perhaps not be prescribed (56), neither should it be proscribed.

Australian researchers estimated that for people aged over 60 yr, the cost per life year gained by moderate consumption of alcohol was A\$5700 (US \$2900) in men and A\$19,000 (US \$9600) in women (57). On this basis, alcohol can be considered a cost-effective medication. For instance, it is many times more cost-effective than medication with statins for treatment of hypercholesterolemia (58).

The findings discussed in this chapter have implications for public health policy. But what are these implications? One possible policy is the following: all adults aged over 40 yr should be encouraged to consume moderate amounts of alcohol daily, unless there is a specific reason to the contrary, such as religion, medication use, or a history of alcohol abuse. The problem with such a policy is the risk of causing a rise in the prevalence of alcohol abuse. Typically, approx 5–10% of people in any society where alcohol is available become abusers of the beverage. The actual proportion is related to the mean

alcohol intake: the higher the mean alcohol intake, the higher the proportion of alcohol abusers (59). Thus, a policy that encourages greater alcohol use will likely also lead to more problems associated with abuse.

Arguably, the most prudent policy is one that explains that alcohol in moderation will likely have several health benefits for people who are middle age and older, while also stressing the hazards of abuse.

6. MAIN POINTS FOR PRIMARY AND CLINICAL REVIEW

1. An alcoholic drink is generally considered to contain 12.5–13 g of alcohol (ethanol); this amount is found in a 12-oz (356 g) beer, 4–5-oz (118–148 g) wine, or 1.5-oz (42 g) of distilled spirits.
2. The US Department of Agriculture defines moderate alcohol consumption as 2 drinks/day for men or 1 drink/day for women.
3. Alcohol creates many social problems, such as violence and accidents, as well as negative health effects, most notably those related to cancer and fetal alcohol syndrome.
4. Although persons with alcoholism should perhaps never drink, moderate alcohol consumption is associated with significant protective effects with respect to cardiovascular disease, several other diseases, and overall mortality.
5. The alcohol intake associated with the lowest overall mortality is 0.7–1.3 drinks/day in men and approx 0.3 drinks/day in women, but this is probably an underestimate.

REFERENCES

1. Leon DA, Chenet L, Shkolnikov VM, et al. Huge variation in Russian mortality rates 1984-94: artefact, alcohol, or what? *Lancet* 1997;350:383–388.
2. Walberg P, McKee M, Shkolnikov V, Chenet L, Leon DA. Economic change, crime, and mortality crisis in Russia: regional analysis. *BMJ* 1998;317:312–318.
3. Available at website: <http://www.nhtsa.dot.gov/people/ncsa/factprev.html>. Accessed June 6, 2002.
4. Thun MJ, Peto R, Lopez AD, et al. Alcohol consumption and mortality among middle-aged and elderly U.S. adults. *N Engl J Med* 1997;337:1705–1714.
5. Bagnardi V, Blangiardo M, Vecchia CL, Corrao G. A meta-analysis of alcohol drinking and cancer risk. *Br J Cancer* 2001;85:1700–1705.
6. World Cancer Research Fund/American Institute for Cancer Research. *Food, Nutrition and the Prevention of Cancer: A Global Perspective*. American Institute for Cancer Research, Washington, DC, 1997.
7. Hankinson SE, Willett WC, Manson JE, et al. Alcohol, height, and adiposity in relation to estrogen and prolactin levels in postmenopausal women. *J Natl Cancer Inst* 1995;87:1297–1302.
8. Dorgan JF, Baer DJ, Albert PS, et al. Serum hormones and the alcohol-breast cancer association in postmenopausal women. *J Natl Cancer Inst* 2001;93:710–715.
9. Zhang S, Hunter DJ, Hankinson SE, et al. A prospective study of folate intake and the risk of breast cancer. *JAMA* 1999;281:1632–1637.
10. Sellers TA, Kushi LH, Cerhan JR, et al. Dietary folate intake, alcohol, and risk of breast cancer in a prospective study of postmenopausal women. *Epidemiology* 2001;12:420–428.
11. Giovannucci E, Rimm EB, Ascherio A, Stampfer MJ, Colditz GA, Willett WC. Alcohol, low-methionine—low-folate diets, and risk of colon cancer in men. *J Natl Cancer Inst* 1995;87:265–273.
12. Colditz GA, Giovannucci E, Rimm EB, et al. Alcohol intake in relation to diet and obesity in women and men. *Am J Clin Nutr* 1991;54:49–55.
13. Williamson DF, Forman MR, Binkin NJ, Gentry EM, Remington PL, Trowbridge FL. Alcohol and body weight in United States adults. *Am J Public Health* 1987;77:1324–1330.
14. Hellerstedt WL, Jeffery RW, Murray DM. The association between alcohol intake and adiposity in the general population. *Am J Epidemiol* 1990;132:594–611.

15. Cordain L, Bryan ED, Melby CL, Smith MJ. Influence of moderate daily wine consumption on body weight regulation and metabolism in healthy free-living males. *J Am Coll Nutr* 1997;16:134–139.
16. Klesges R, Maaler CZ, Klesges LM. Effect of alcohol intake on resting energy expenditure in young women social drinkers. *Am J Clin Nutr* 1994;59:805–809.
17. Rimm EB, Klatsky A, Grobbee D, Stampfer MJ. Review of moderate alcohol consumption and reduced risk of coronary heart disease: is the effect due to beer, wine, or spirits? *BMJ* 1996;312:731–736.
18. Shaper AG, Wannamethee G, Walker M. Alcohol and mortality in British men: explaining the U-shaped curve. *Lancet* 1988;2:1267–1273.
19. Rimm E. Alcohol and cardiovascular disease. *Curr Atheroscler Rep* 2000;2:529–535.
20. Rimm EB, Williams P, Fosher K, Criqui M, Stampfer MJ. Moderate alcohol intake and lower risk of coronary heart disease: meta-analysis of effects on lipids and haemostatic factors. *BMJ* 1999;319:1523–1528.
21. Castelli WP, Doyle JT, Gordon T, et al. Alcohol and blood lipids: the cooperative lipoprotein phenotyping study. *Lancet* 1977;2:153–157.
22. Bleich S, Bleich K, Kropp S, et al. Moderate alcohol consumption in social drinkers raises plasma homocysteine levels: a contradiction to the “French Paradox”? *Alcohol Alcohol* 2001;36:189–192.
23. Rimm EB, Willett WC, Hu FB, et al. Folate and vitamin B6 from diet and supplements in relation to risk of coronary heart disease among women. *JAMA* 1998;279:359–364.
24. Koehler KM, Baumgartner RN, Garry PJ, Allen RH, Stabler SP, Rimm EB. Association of folate intake and serum homocysteine in elderly persons according to vitamin supplementation and alcohol use. *Am J Clin Nutr* 2001;73:628–637.
25. Hines LM, Stampfer MJ, Ma J, et al. Genetic variation in alcohol dehydrogenase and the beneficial effect of moderate alcohol consumption on myocardial infarction. *N Engl J Med* 2001;344:549–555.
26. Ascherio A, Rimm EB, Giovannucci EL, et al. A prospective study of nutritional factors and hypertension among US men. *Circulation* 1992;86:1475–1484.
27. Puddey IB, Beilin LJ, Vandongen R, Rouse IL, Rogers P. Evidence for a direct effect of alcohol consumption on blood pressure in normotensive men. A randomized controlled trial. *Hypertension* 1985;7:707–713.
28. Thadhani R, Camargo CA Jr, Stampfer MJ, Curhan GC, Willett WC, Rimm EB. Prospective study of moderate alcohol consumption and risk of hypertension in young women. *Arch Intern Med* 2002;162:569–574.
29. Berger K, Ajani UA, Kase CS, et al. Light-to-moderate alcohol consumption and the risk of stroke among U.S. male physicians. *N Engl J Med* 1999;341:1557–1564.
30. Sacco RL, Elkind M, Boden-Albala B, et al. The protective effect of moderate alcohol consumption on ischemic stroke. *JAMA* 1999;281:53–60.
31. Camargo CA. Case-control and cohort studies of moderate alcohol consumption and stroke. *Clin Chim Acta* 1996;246:107–119.
32. Rimm EB, Bacon C, Giovannucci E, Kawachi I. Waist circumference, physical activity, and alcohol consumption in relation to erectile dysfunction among US male health professionals. Annual Meeting of the American Urological Association, May 2, 2000, Atlanta, GA.
33. Leitzmann MF, Giovannucci EL, Stampfer MJ, et al. Prospective study of alcohol consumption patterns in relation to symptomatic gallstone disease in men. *Alcohol Clin Exp Res* 1999;23:835–841.
34. Rapuri PB, Gallagher JC, Balhorn KE, Ryschon KL. Alcohol intake and bone metabolism in elderly women. *Am J Clin Nutr* 2000;72:1206–1213.
35. Feskanich D, Korrick SA, Greenspan SL, Rosen HN, Colditz GA. Moderate alcohol consumption and bone density among postmenopausal women. *J Women Health* 1999;8:65–73.
36. Popelka MM, Cruikshanks KJ, Wiley TL, et al. Moderate alcohol consumption and hearing loss: a protective effect. *J Am Geriatr Soc* 2000;48:1273–1278.
37. Elias PK, Elias MF, D’Agostino RB, Silbershatz H, Wolf PA. Alcohol consumption and cognitive performance in the Framingham Heart Study. *Am J Epidemiol* 1999;150:580–590.
38. Dufouil C, Ducimetiere P, Alperovitch A. Sex differences in the association between alcohol consumption and cognitive performance. EVA Study Group. *Epidemiology of vascular aging. Am J Epidemiol* 1997;146:405–412.

39. Ruitenberg A, van Swieten JC, Witteman JC, et al. Alcohol consumption and risk of dementia: the Rotterdam Study. *Lancet* 2002;359:281–286.
40. Platz EA, Rimm EB, Kawachi I, et al. Alcohol consumption, cigarette smoking, and risk of benign prostatic hyperplasia. *Am J Epidemiol* 1999;149:106–115.
41. Wannamethee SG, Shaper AG, Perry IJ, Alberti KGMM. Alcohol consumption and the incidence of type II diabetes. *J Epidemiol Community Health*. 2002;56:542–548.
42. Conigrave KM, Hu BF, Camargo CA Jr, Stampfer MJ, Willett WC, Rimm EB. A prospective study of drinking patterns in relation to risk of type 2 diabetes among men. *Diabetes* 2001;50:2390–2395.
43. Stampfer MJ, Colditz GA, Willett WC, et al. A prospective study of moderate alcohol drinking and risk of diabetes in women. *Am J Epidemiol* 1988;128:549–558.
44. Tanasescu M, Hu FB, Willett WC, Stampfer MJ, Rimm EB. Alcohol consumption and risk of coronary heart disease among men with type 2 diabetes mellitus. *J Am Coll Cardiol* 2001;38:1836–1842.
45. Ajani UA, Gaziano JM, Lotufo PA, et al. Alcohol consumption and risk of coronary heart disease by diabetes status. *Circulation* 2000;102:500–505.
46. Solomon CG, Hu FB, Stampfer MJ, et al. Moderate alcohol consumption and risk of coronary heart disease among women with type 2 diabetes mellitus. *Circulation* 2000;102:494–499.
47. Valmadrid CT, Klein R, Moss SE, Klein BE, Cruickshanks KJ. Alcohol intake and the risk of coronary heart disease mortality in persons with older-onset diabetes mellitus. *JAMA* 1999;282:239–246.
48. Tabak C, Smit HA, Rasanen L, et al. Alcohol consumption in relation to 20-year COPD mortality and pulmonary function in middle-aged men from three European countries. *Epidemiology* 2001;12:239–245.
49. Pratt PC, Vollmer RT. The beneficial effect of alcohol consumption on the prevalence and extent of centrilobular emphysema. *Chest* 1984;85:372–377.
50. White IR. The level of alcohol consumption at which all-cause mortality is least. *J Clin Epidemiol* 1999;52:967–975.
51. Fuchs CS, Stampfer MJ, Colditz GA, et al. Alcohol consumption and mortality among women. *N Engl J Med* 1995;332:1245–1250.
52. Britton A, McPherson K. Mortality in England and Wales attributable to current alcohol consumption. *J Epidemiol Community Health* 2001;55:383–388.
53. Rehm J, Greenfield TK, Rogers JD. Average volume of alcohol consumption, patterns of drinking, and all-cause mortality: results from the US National Alcohol Survey. *Am J Epidemiol* 2001;153:64–71.
54. Murray RP, Connett JE, Tyas SL, et al. Alcohol volume, drinking pattern, and cardiovascular disease morbidity and mortality: is there a U-shaped function? *Am J Epidemiol* 2002;155:242–248.
55. Conigrave KM, Hu BF, Camargo CA Jr, Stampfer MJ, Willett WC, Rimm EB. A prospective study of drinking patterns in relation to risk of type 2 diabetes among men. *Diabetes* 2001;50:2390–2395.
56. Wannamethee SG, Shaper AG. Taking up regular drinking in middle age: effect on major coronary heart disease events and mortality. *Heart* 2002;87:32–36.
57. Simons LA, McCallum J, Friedlander Y, Ortiz M, Simons J. Moderate alcohol intake is associated with survival in the elderly: the Dubbo Study. *Med J Aust* 2000;173:121–124.
58. Thompson A, Temple NJ. *Ethics, Medical Research, and Medicine: Commercialization Versus Social Justice and Environmentalism*. Kluwer Academic Publishers, Dordrecht, the Netherlands, 2001, pp. 95–116.
59. Colhoun H, Ben-Shlomo Y, Dong W, Bost L, Marmot M. Ecological analysis of collectivity of alcohol consumption in England: importance of average drinker. *BMJ* 1997;314:1164–1168.