Part D. Section 7: Alcohol

Introduction

The hazards of heavy alcohol (ethanol) intake have been known for centuries. Heavy drinking increases the risk of liver cirrhosis, hypertension, cancers of the upper gastrointestinal tract, injury, and violence (USDA, 2000). A recent analysis of the preventable causes of mortality in the United States (US) attributed 90,000 deaths a year to alcohol misuse (Danaei, 2009). However, the health consequences of consuming lesser amounts of alcohol are also important because of the large percent of the population that consumes alcohol at or below government recommendations on limits for intake. It is estimated that 26,000 fewer deaths were averted due to reductions in heart disease, stroke and diabetes from the benefits attributed to moderate alcohol consumption.

Estimates from the most recent national surveys, conducted 2003-2006, indicate that 76 percent of men and 65 percent of women consumed alcohol at least once in the last year (Guenther, 2010). The *Dietary Guidelines for Americans, 2005* defined moderate alcohol consumption as the consumption of up to one drink per day for women and up to two drinks per day for men (HHS/USDA, 2005). One drink was defined as 12 oz. of regular beer, 5 oz. of wine (12 percent alcohol), or 1.5 oz. of 80-proof distilled spirits. Of concern is that a large number of individuals exceed the recommended upper limits of average intake. An estimated 9 percent of men consumed an *average* of more than two drinks per day and 4 percent of women consumed an *average* of more than one drink per day (Guenther, 2010). Furthermore, heavy drinking is also common. On any single day, 9 percent of men drank five drinks or more and 4 percent of women drank four drinks or more. These thresholds of heavy consumption in men and women are considered as a "heavy drinking day" and are used to identify an individual as "at risk" for adverse health outcomes (NIAAA, 2009).

The recent release of *Rethinking Drinking* by the National Institutes of Alcohol Abuse and Alcoholism (NIAAA), provides guidelines that are consistent, in part, with the 2005 Dietary Guidelines, but also add additional guidance on weekly patterns of consumption. This NIAAA booklet, which is also designed to help individuals drink less if they are heavy or "at risk drinkers," defines "low-risk" drinking as no more than 14 drinks a week for men and 7 drinks a week for women with no more than 4 drinks on any given day for men and 3 drinks a day for women (NIAAA, 2009).

The 2010 Dietary Guidelines Advisory Committee (DGAC) largely agreed with this definition of moderation from the NIAAA because it implied that consumption was based on daily intake averaged over the week and also because the NIAAA guideline was generally consistent with the recommendation from the 2005 Dietary Guidelines. The DGAC further wanted to explore whether additional new information on alcohol drinking patterns and health supported a change in the

guidelines. The DGAC explored whether there was a sufficient evidence base from large-scale human populations to apply guidelines on drinking patterns to the general US population.

The beneficial and detrimental effects of alcohol consumption on health are well known and have been studied extensively as summarized in the *Dietary Guidelines for Americans, 2005* and updated below (HHS/USDA, 2005). The DGAC determined that for many of these chronic diseases there was not a meaningful incremental change in the research findings. However, because these associations, even for moderate consumption, are of great importance they are summarized below.

- ***Cancer.*** The recent comprehensive summary from the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR, 2007) summarized the available evidence from epidemiological studies of alcohol and cancer.
    - ***Colon Cancer -*** There is convincing evidence that alcohol is associated with risk of colon cancer in a dose response manner, but this evidence is strongest for men and stronger for populations that drink on average in excess of two drinks a day.
    - ***Breast Cancer -*** There is also robust evidence from more than 100 studies that suggest a dose-response association between alcohol and breast cancer. A woman who drinks, on average, one drink per day has a 10 percent elevated risk. However, alcohol is known to modestly suppress blood folate levels (Barak, 1993; Chiuve, 2005) and in some, but not all, studies of alcohol and breast cancer the elevated risk attributed to alcohol is attenuated among women with ample dietary folate (Baglietto, 2005; Beasely, 2010; Zhang, 1999).
    - ***Liver Cancer –*** Liver cancer is rare in the US, especially among individuals who do not drink in excess. However; even moderate drinkers have a modest increase in risk compared to those who abstain. There are substantial differences between studies (WCRF/AICR, 2007), which suggests that other personal characteristics such as smoking, diet, or underlying viral infections may modify risk.
- ***Diabetes.*** Several studies have found that alcohol in moderation may increase insulin sensitivity and reduce fasting glucose levels (Shai, 2007). Further, results from comprehensive reviews and meta-analyses suggest that risk of diabetes is significantly lower among moderate drinkers than abstainers (Baliunas, 2009; Howard, 2004). The systematic review by Howard et al. (2004) covered 32 studies. Compared with no alcohol use, moderate consumption (1 to 3 drinks/day) was associated with a 33 percent to 56 percent lower incidence of type 2 diabetes (T2D) and a 34 percent to 55 percent lower incidence of diabetes-related coronary heart disease (CHD). Importantly, compared with moderate consumption, heavy consumption (>3 drinks/day) was associated with up to a 43 percent increased incidence of T2D. Despite the benefit of alcohol when consumed in moderation,

when consumed in excess, alcohol can cause serious metabolic disturbances and increase diabetes risk.

- ***Hypertension and Stroke.*** Many studies have addressed the question of alcohol in relation to hypertension and stroke and several meta-analyses have followed to summarize this information. In a meta-analysis of 35 observational studies, Reynolds et al. (2003) found that, compared with abstainers, consumption of more than 4 drinks per day was associated with an increased risk of total stroke, increased risk of ischemic stroke, and increased risk of hemorrhagic stroke. On the other hand, consumption of approximately one drink per day was associated with reduced risk of total stroke and ischemic stroke, and consumption of 1 to 2 drinks per day was associated with reduced risk of ischemic stroke. These results indicate that heavy alcohol consumption increases risk of stroke while light to moderate alcohol consumption may be protective against total and ischemic stroke. Since that publication ten prospective cohort studies have provided further evidence to support these findings. Most studies reported a beneficial effect of low to moderate alcohol consumption, but a detrimental effect with high alcohol consumption (Bazzano, 2007; Emberson, 2005; Elkind, 2006; Ikehara, 2008; Iso, 2004; Mukamal, 2005a; Mukamal, 2005b; Sundell, 2008). Iso et al. (2004) reported that alcohol consumption was positively associated with age-adjusted risk of total stroke with a 68 percent increased risk among drinkers (>450 g/week) compared with occasional drinkers; this risk was confined primarily to hemorrhagic stroke. Although fewer studies differentiate the stroke subclasses, the stronger positive association for heavier alcohol consumption and hemorrhagic stroke than for ischemic stroke is consistent in the literature. Most importantly for the proposed guidelines for alcohol, strong evidence indicates that moderate alcohol consumption does not elevate risk of either hypertension or stroke. It is also well documented that alcohol consumed in excess of moderation causes an increase in blood pressure and stroke (Reynolds, 2003; Taylor, 2009). For the growing percentage of the population with elevated blood pressure, reduction in alcohol is an effective treatment for lowering blood pressure, although this is most effective when included in a regimen with changes in diet and physical activity patterns (Dickinson, 2006).
- ***Total Mortality*.** In most Western countries where chronic diseases such as CHD, cancer, stroke and diabetes are the primary causes of death, results from large epidemiological studies consistently show that alcohol has a favorable association with total mortality especially among middle age and older men and women. A recent updated meta-analysis of all-cause mortality demonstrated an inverse association between moderate drinking and total mortality (Di Castelnuovo, 2006). The relative risk of all-cause mortality associated with moderate drinking was approximately 0.80. The J-shaped curve, with the lowest mortality

risk for men and women at the average level of one to two drinks per day, is likely due to the protective effects of moderate alcohol consumption on CHD, diabetes and ischemic stroke as summarized in this chapter.

- ***Hepatic effects.*** Alcohol abuse is the leading cause of liver-related mortality in the US, likely accounting for a majority of cirrhosis deaths (CDC, 1993; Vong, 2004). Lower levels of alcohol intake can result in liver function abnormalities short of cirrhosis. For example, alcohol consumption may modulate pharmaceutical catabolism by liver enzymes and may potentiate the carcinogenic potency of hepatotoxins (NIAAA, 2003).
- ***Young age.*** Children or adolescents should not consume alcohol. Alcohol consumption increases the risk of drowning, car accidents, and traumatic injury, which is the number one cause of death in this age group. Animal data on alcohol-related structural changes in the adolescent brain, while less compelling, illustrate why drinking is inappropriate for adolescents (Land, 2004; Markwiese, 1998).
- ***Pregnancy.*** Heavy drinking during pregnancy can produce a range of behavioral and psychosocial problems, malformations, and cognitive dysfunction in the offspring (NIAAA, 2003; NIAAA, 2009). Even daily moderate drinking during pregnancy, especially in the first few months or before the pregnancy is recognized, may have behavioral or neurocognitive consequences in the offspring. This effect may be from the direct toxic effects of alcohol or its metabolites or the effect that alcohol has on suppressing folate status—a known determinant of neural tube defects.
- ***Other conditions.*** Alcohol consumption should be avoided by individuals who cannot restrict their drinking to moderate levels, individuals taking medications that can interact with alcohol, and persons with specific medical conditions, such as liver disease (NIAAA, 2009). NIAAA highlights specific advice and suggestions for individuals who cannot restrict their alcohol consumption (NIAAA, 2009).

Despite this lengthy list of diseases and conditions in which solid scientific evidence supports a cause and effect, the DGAC thought several questions should be further addressed. For most of the questions, the DGAC also wanted to explore whether there was enough information to make specific recommendations on patterns of consumption rather than on a simple daily limit. Unlike most other micronutrients and macronutrients which are consumed every day, most individuals do not drink every day. Thus, the DGAC surveyed the evidence to determine whether recommendations should continue to be based on a maximum number of drinks allowable on a single day or instead be based on an average consumed over the course of a week or even a month?

Methodology

The Committee recognized that alcohol affects many health outcomes due both to the acute effects of alcohol in the bloodstream and to the chronic effects of regular alcohol consumption. As noted above, many associations with disease are well known and well documented; therefore a few specific questions where a new evidence review could modify conclusions from previous DGAC Reports were examined. In addition, the Committee chose those specific health outcomes that would be most influenced by moderate alcohol consumption of up to one drink a day for women and two drinks a day for men, where changes in recommendations would have the broadest impact.

Although the 2005 DGAC summary of the health effects of alcohol consumption were based on an evidence-based review, in many instances these reviews included a substantial number of cross sectional studies. Since 2005, a large number of prospective studies of alcohol and chronic disease have been published. Thus, to refine the evidence search for each question, the DGAC limited the reviews to studies with greater methodological rigor and only conducted systematic reviews of observational prospective studies and randomized control trials. The exception being the question related to alcohol intake and unintentional injury because cross-sectional or case control studies are of equal or even better validity. For the question related to alcohol consumption and CHD, only systematic reviews and meta-analyses were used since the NEL review found several recent studies.

Despite this lengthy list of diseases and conditions in which solid scientific evidence supports a cause and effect, the DGAC thought many questions should be further addressed, many of them specific to patterns of alcohol consumption that may potentially identify differential health effects based on more than just overall average alcohol (e.g., frequency of consumption or choice of beverage).

The methodology used in the search strategies varied depending upon the question. All questions, except for the breastfeeding sub-question related to offspring growth, included adults of legal drinking age (21 years and older). Other strategies used to identify relevant literature for the questions are discussed under each section. Additional information about the search strategies and criteria used to review each question can be found online in the Nutrition Evidence Library at www.nutritionevidencelibrary.com. The overall search strategies used to identify relevant literature and update scientific evidence appear in ***Part C. Methodology***.

List of Questions

ALCOHOL INTAKE AND HEALTH OUTCOMES

1. What is the relationship between alcohol intake and weight gain?

2. What is the relationship between alcohol intake and cognitive decline with age?
3. What is the relationship between alcohol intake and coronary heart disease?
4. What is the relationship between alcohol intake and bone health?

ALCOHOL INTAKE AND UNINTENTIONAL INJURY

5. What is the relationship between alcohol intake and unintentional injury?

ALCOHOL INTAKE AND LACTATION

6. Does alcohol consumption during lactation have adverse health effects? What is the relationship between alcohol consumption and the quality and quantity of breast milk available for the offspring? What is the relationship between alcohol consumption and postnatal growth patterns, sleep patterns, and/or psychomotor patterns of the offspring?

Question 1. What is the Relationship between Alcohol Intake and Weight Gain?

Conclusion

Moderate evidence suggests that among free-living populations, moderate drinking is not associated with weight gain. However, heavier consumption over time is associated with weight gain.

Implications

Regardless of the alcoholic beverage, in general, all contain calories that are not a good source of nutrients and when consumed beyond an average of two drinks a day may lead to weight gain. Below this level of consumption, the results from most well designed large prospective studies suggest that individuals who drink in moderation do not gain weight at a faster rate than non-drinkers.

Review of the Evidence

Based on the literature dating back to November 1994, one randomized control trial (RCT) (Flechtner-Mors, 2004) and seven prospective observational studies (Koh-Banerjee, 2003; Liu, 1994; Sammel, 2003; Sherwood, 2000; Tolstrup, 2008; Wannamethee, 2004; Wannamethee and Shaper, 2003) from the US, Germany, Denmark, and the United Kingdom directly addressed the question of alcohol consumption and weight gain. The RCT was in the setting of an energy-restricted diet and was designed to test whether weight loss would be different if the energy-restricted diet contained 10 percent of energy from white wine or grape juice. The authors reported that everybody in the study lost weight as designed and the magnitude of the weight loss was similar between groups.

The remaining studies were mostly large scale prospective studies which followed people over time and examined whether a baseline report of alcohol was associated with subsequent weight gain after accounting for other lifestyle characteristics typically associated with body weight. In a subset of the first National Health and Nutrition Examination Study (NHANES), Liu et al. (1994) reported that drinkers were less likely to have either major weight gain or weight loss than nondrinkers over 10 years of follow-up. Similar results were reported in several other smaller studies (Sammel, 2003; Sherwood, 2000).

In the largest studies to examine this association, light to moderate drinkers did not have a significant increase in weight compared to abstainers. However, in these studies significant weight gain was seen in men and women drinking more than 2 drinks per day (Wannamethee, 2004; Wannamethee, 2003). In the two studies (Koh-Banerjee, 2003; Tolstrup, 2008) which specifically assessed changes in waist circumference, the results were similar. Individuals who consumed on average 1 to 2 drinks per day did not have a significant increase in waist circumference when compared with non-drinkers. There is insufficient evidence to determine the relationship of drinking pattern or frequency of consumption to change in waist or weight; however, in each of the prospective studies intake was based on average daily consumption typically over the past month or year.

Relevant Contextual Issue

Despite the lack of evidence to support a strong association between moderate alcohol consumption and weight gain, there is still concern that diets of individuals who drink may be inadequate if calories from alcoholic beverages replace calories from foods which may be more nutrient-dense. The NIAAA and the USDA Center for Nutrition Policy and Promotion used the Healthy Eating Index-2005 (a gauge of adherence to the 2005 Dietary Guidelines) to examine the relationship of alcohol consumption with nutrient intakes and diet quality, as measured by the Healthy Eating Index-2005 (HEI-2005). In this recently published cross sectional study (Breslow, 2010) using data from the National Health and Nutrition Examination Survey (NHANES), the authors described the following:

- Among men, there was not a clear difference between current drinkers and non-drinkers for total energy intake or HEI-2005 scores.
- Among women, current drinkers had significantly higher total energy and lower HEI-2005 scores.
- Among all drinkers, as the average number of drinks per day increased, total energy increased and the HEI-2005 scores decreased.

This study was based on alcohol consumption over the past year, and a 24-hour dietary intake. It did not take into account physical activity as an important source of energy expenditure, but it does highlight the important concept that alcoholic beverages supply calories but few nutrients. The energy contribution from alcoholic beverages varies widely. Specifically, some alcoholic beverages, such as dessert wines and mixed drinks, provide almost three times as many calories as do the standard drink portions: 12 oz. of regular beer, 5 oz. of wine, or 1.5 oz. of distilled spirit. Individuals who drink should be aware of the total calories of alcoholic beverage (see Table D.1.6 in ***Part D. Section 1. Energy Balance and Weight Management*** for a list of selected alcoholic beverages and their caloric content) and carefully assess how alcohol fits into their overall dietary pattern, especially with respect to the number of calories needed to maintain a healthy weight.

For those who choose to drink an alcoholic beverage, it is advisable to consume it with food to slow alcohol absorption. Data suggest that the presence of food in the stomach can slow the absorption of alcohol (Jones, 1997) and thereby mitigate the associated rise in blood alcohol concentration.

Question 2. What is the Relationship between Alcohol Intake and Cognitive Decline with Age?

Conclusion

Moderate evidence suggests that compared to non-drinkers, individuals who drink moderately have a slower cognitive decline with age. Although limited, evidence suggests that heavy or binge drinking is detrimental to age-related cognitive decline.

Implications

Alcohol, when consumed in moderation, did not quicken the pace of age-related loss of cognitive function. In most studies, it was just the opposite—moderate alcohol consumption, when part of a healthy diet and physical activity program, appeared to help to keep cognitive function intact with age. Despite the potential benefit at moderate consumption levels, heavy drinking and episodes of binge drinking impairs short- and long-term cognitive function and should be avoided.

Review of the Evidence

Over the past ten years, a substantial new body of evidence has supported a modest beneficial association between alcohol consumption and cognitive function. The DGAC restricted its search to prospective studies to reduce bias associated with reverse causation of effect (i.e., the bias that individuals with reduced cognitive function may be less capable and less likely to drink). Based on the included literature dating back to 2001, one systematic review/meta-analysis (Peters, 2008) and

11 additional US and international prospective cohort studies (Bond, 2005; Deng, 2006; Espeland, 2006; Luchsinger, 2004; Mehlig, 2008; Ngandu, 2007; Piquet, 2006; Solfrizzi, 2007; Stott, 2008; Wright, 2006; Zuccala, 2001) directly addressed the question related to alcohol intake and cognitive decline. Results from Peters et al. (2008), a systematic review and meta-analysis of 23 studies conducted primarily in the US, Canada, and Europe, found that in older adults, small to moderate amounts of alcohol consumption were associated with reduced incidence of dementia and Alzheimer's disease (Peters, 2008). Small amounts of alcohol may be protective against dementia and Alzheimer's disease, but not for vascular dementia or cognitive decline.

Several prospective cohort studies (Bond, 2005; Deng, 2006; Espeland, 2006; Stott, 2008; Wright, 2006; Zuccala, 2001) found similar results that suggest that individuals who are light to moderate drinking have a decreased risk or reduced severity of dementia and/or cognitive decline especially in comparison to nondrinkers.

Question 3. What is the Relationship between Alcohol Intake and Coronary Heart Disease?

Conclusion

Strong evidence consistently demonstrates that compared to non-drinkers, individuals who drink moderately have lower risk of coronary heart disease. Insufficient evidence was available to determine if any one single drinking pattern was predictive of lower or higher risk of coronary heart disease, although there was moderate evidence to suggest that heavy or binge drinking is detrimental.

Implications

An average daily intake of one to two alcoholic beverages is associated with a low risk of coronary heart disease among middle-aged and older adults. Binge or heavy irregular drinking should be avoided.

Review of the Evidence

The issue of moderate alcohol consumption and risk of cardiovascular disease (CVD) was updated from the 2005 DGAC and also addressed alcohol consumption patterns. The NEL review searched published literature dating back to 1995 to 2009 and included seven systematic reviews/meta-analyses conducted in the US and internationally (Bagnardi, 2008; Cleophas, 1999; Corrao, 2000; Djousse and Gaziano, 2008; Di Castelnuovo, 2002; Mukamal, 2001; Rotonodo, 2001). Overall, the evidence shows that compared to those who abstain from alcohol, regular light to moderate drinking can reduce the risk of CHD, whereas, heavy irregular or binge drinking increases risk of CHD.

This overall conclusion of general benefit from moderate intake of alcohol is also supported by the *State of the Science Report on the Effects of Moderate Drinking* (NIAAA, 2003), an extensive review of the literature conducted by scientific staff of the NIAAA and reviewed by 14 outside experts. In addition to recognizing the apparent mortality benefit of moderate alcohol consumption among middle-aged and older adults, the report concludes, "Except for those individuals at particular risk…, consumption of [up to] 2 drinks a day for men and 1 for women is unlikely to increase health risks" (NIAAA, 2003). Individuals at particular risk include persons who cannot restrict their drinking to moderate levels, children and adolescents, persons taking prescription or over-the-counter medications that can interact with alcohol, and individuals with special medical conditions (e.g., liver disease). In this 2010 DGAC report, individuals who may be at risk particularly with respect to unintentional injury and lactating women are more clearly defined.

Many of the observational studies which have documented a benefit of moderate alcohol consumption on CVD prevention are summarized in the 2005 DGAC report in Table D8-1, but are not summarized again here. The inverse association has been demonstrated in a variety of populations and is independent of many other cardiac risk factors, including age, sex, race/ethnic group, smoking habits, physical activity, diet, and body mass index (Corrao, 2000; Marmot, 2001; Mukamal, 2001). Similar to the evidence summarized above for alcohol and weight gain, the majority of prospective studies of alcohol and CHD assess average weekly intake over the past several months or year and are not based on a daily maximum of 1 to 2 drinks for the definition of moderate. On average, the relative risk of CHD associated with moderate drinking as defined by the DGAC is between 0.50 and 0.80 and is directly related to the benefits of alcohol on HDL-C, glucose, and clotting factors such as fibrinogen (Mukamal, 2005).

The DGAC pursued evidence to support a specific guideline for patterns of consumption. The same NEL review identified two meta-analyses (Bagnardi, 2008; Corrao, 2000) and one systematic review (Djousse and Gaziano, 2008) that addressed alcohol pattern consumption. Bagnardi et al. (2008) served as the strongest summary of the evidence. Based on somewhat similar measures of patterns of consumption from 4 prospective studies and 2 case-control studies, Bagnardi et al. (2008) concluded that among individuals who consumed alcohol on more than 2 days per week, risk of coronary heart disease was lowered even when alcohol was consumed at intake levels greater than two drinks a day. However, among irregular drinkers, moderate alcohol consumption was still inversely associated with CHD, but binge (or heavy) drinking was associated with an excess risk of CHD.

Question 4. What is the Relationship between Alcohol Intake and Bone Health?

Conclusion

Moderate evidence suggests a J-shaped association between alcohol consumption and incidence of hip fracture; there was a suggestion that heavy or binge drinking was detrimental to bone health.

Implications

There is insufficient evidence from epidemiological data to make a strong conclusion related to patterns of alcohol intake and bone health. However, it is very likely that the increased risk of fracture among individuals who drink more than one to two drinks per day on average is due to injuries that follow heavier consumption. What further complicates the interpretation of the existing studies is that moderate and heavy drinkers frequently were combined in the same category, making it impossible to disentangle potential benefits and risks. In addition, many studies failed to control adequately for physical activity, an important lifestyle characteristic beneficially related to bone density.

Review of the Evidence

The DGAC conducted a search for evidence published between 1995 and 2009. A recent systematic review and meta-analysis (Berg, 2008) involving 33 studies examined the association between ethanol intake and hip fracture and bone density mostly in white, European, or American adults. Studies were included if they used experimental, cohort, or case-control designs and included adults both exposed and not exposed to alcohol. The results from the meta-analysis involving thirteen studies (8 prospective cohorts and 5 case-control) with a fair quality rating involving men and women over 20 years of age revealed a J-shaped relationship between alcohol consumption and hip fracture. Compared with abstainers, a lower risk of hip fracture was found among persons consuming up to 0.5 drinks per day (RR=0.84 [95% CI, 0.70-1.01]) and persons consuming 0.5-1.0 drinks/day (RR=0.80 [95% CI, 0.71-0.91]). Those consuming one to two drinks per day did not differ from abstainers (RR=0.91 [95% CI, 0.76-1.09]). However, persons consuming more than 2 drinks per day had an elevated risk for fracture (RR=1.39, [95%CI 1.08-1.79]).

In the meta-analysis of bone mineral density, a linear relationship existed between alcohol consumption and bone density of the femoral neck and vertebral spine. With limited data, the authors could not assess relative associations between alcohol consumption and bone density in moderate compared with heavy drinkers. Even though there is a positive effect of alcohol consumption on hip fracture and femoral neck/vertebral spine bone density, the exact range of alcohol consumption that is beneficial cannot be determined.

Question 5. What is the Relationship between Alcohol Intake and Unintentional Injury?

Conclusion

Strong evidence demonstrates that drinking in excess of current guidelines increases the risk of unintentional falls, motor vehicle crashes, and drowning. When alcohol is consumed in moderation, the evidence for risk of unintentional injury is less well established for activities such as driving, swimming, and athletic participation, but abstention from alcohol is the safest.

Implications

Adverse effects, in terms of unintentional injury, can occur even at levels of moderate alcohol consumption.

Review of the Evidence

This conclusion is based on 22 US and international studies dating back to 2004, including five systematic reviews (Cherpitel, 2007; Driscoll, 2004; Gonzalez-Wilhelm, 2007; Kool, 2009; Norstrom, 2005), seven cohort studies (Bedford, 2006; Driscoll, 2004; Hall, 2009; Hingson, 2009; Johnson, 2004; Levy, 2004; Rehm, 2006), five case-control studies (Kool, 2008; Kurzthaler, 2005; Sorock, 2006; Watt, 2004; Yoonhee, 2009), four cross-sectional studies (Hingson, 2009; McDonald, 2004; McLean, 2009; Watt, 2006), and one trend study (Mukamal, 2004).

All 22 studies reviewed found that alcohol consumption was positively associated with risk of unintentional injuries, and found associations with a wide range of different types of injuries. For example, many studies focused specifically on head injuries, spinal cord injuries, and soft tissue injuries (Cherpitel, 2007; Hingson, 2009a; Hingson, 2009b; Johnston, 2004; Levy, 2004; McDonald, 2004; McLean, 2009; Norstrom, 2005; Rehm, 2006; Watt, 2006; Yoonhee, 2009) while others were related to fatal and non-fatal motor vehicle crashes (Bedford, 2006; Gonzalez-Wilhelm, 2007; Hingson, 2009a; Hingson, 2009b; Levy, 2004; Sorock, 2006), boating incidents (Driscoll, 2004) and all-terrain vehicle crashes (Hall, 2009).

As discussed above in relation to bone health, there is evidence that even when consumed in moderation, alcohol consumption increases risk of falling (Kool, 2008; Kool, 2009; Kurzthaler, 2005; Mukamal, 2004; Sorock, 2006). Also, the specific reason that the DGAC chose to include swimming in list of the specific activities where alcohol should be avoided is because of the association between drinking alcohol and drowning (Driscoll, 2004a; Driscoll, 2004b; Levy, 2004). Other areas of unintentional injury linked to alcohol consumption include suicide, fire-related injuries, and violence-related injury.

Finally, while few studies had sufficient data, one study found evidence of a dose-response relationship between alcohol intake and injury (Kool, 2009), and several studies found that risk of unintentional injury tended to increase significantly after drinking two or more drinks per day (Kool, 2008; Mukamal, 2004; Watt, 2004).

Question 6. Does Alcohol Consumption during Lactation have Adverse Health Effects? What is the Relationship between Alcohol Consumption and the Quality and Quantity of Breast Milk Available for the Offspring? What is the Relationship between Alcohol Consumption and Postnatal Growth Patterns, Sleep Patterns, and/or Psychomotor Patterns of the Offspring?

Conclusion

Moderate, consistent evidence shows that when a lactating mother consumes alcohol, alcohol enters the breast milk, and the quantity of milk produced is reduced, leading to reduced milk consumption by the infant. Although limited, evidence suggests that alcohol consumption during lactation was associated with altered post-natal growth, sleep patterns, and/or psychomotor patterns of the offspring.

Implications

The benefits of breastfeeding to the infant are well established. A woman who chooses to breast feed, however, need not completely abstain from alcohol. Because the level of alcohol in breast milk mirrors the mother's blood alcohol content, after latch-on has been perfected and a pattern of consistent breastfeeding has been established (i.e., around age 2 to 3 months), a mother could wait 3 to 4 hours after a single drink (the time it would take to metabolize the ethanol) before breastfeeding and the infant exposure to alcohol would likely be negligible. It is not sufficient for a woman to express breast milk after alcohol consumption to prevent exposure to the infant because the concentration of alcohol in breast milk will remain at levels in the blood until all the alcohol is metabolized. Contrary to medical and cultural folklore, alcohol consumption does not enhance lactational performance and instead reduces milk production and decreases infant milk consumption in the 3 to 4 hours after alcohol is consumed. Finally, there is still insufficient evidence to conclude definitively that alcohol exposure to an infant during lactation affects the postnatal growth of the child, but nonetheless alcohol exposure to the breastfeeding infant by breastfeeding too soon after consuming a single drink should be avoided.

Review of the Evidence

Background

The Committee felt strongly that the issue of alcohol and breastfeeding should be addressed because substantial evidence clearly demonstrates that breastfeeding is beneficial to the health of the

infant. The DGAC did not want women to misinterpret the Dietary Guidelines and prematurely stop breastfeeding because they wanted to occasionally consume an alcoholic drink. In an effort to capture all available information on this new Dietary Guidelines topic, no date restrictions were imposed on the literature search.

Summary of Evidence

As briefly summarized above, there is substantial evidence that heavy drinking during pregnancy can cause serious health consequences to the unborn infant. Even daily moderate alcohol consumption among pregnant women may not be without risk and should be avoided. However, the DGAC has not previously adequately addressed the evidence for the health effects of alcohol among women who are breastfeeding and may expose their child to alcohol indirectly through the breast milk. A limited number of US and international studies have directly examined this relationship (Backstrand, 2004; Little, 1989; Little, 2002; Mennella, 2001; Mennella, 1998). In a small cohort from Mexico among women who consumed pulque (a "beer strength" alcoholic beverage from Mexico produced from fermented cactus sap), heavier pulque intake during lactation was associated with slower postpartum growth of the infant from one to 57 months (Backstrand, 2004).

In two separate studies of lactating women with regular exposure to moderate alcohol, the authors assessed infant motor development. In the first, Little et al. (1989) examined infants at 1 year of age and found a significant detrimental association with infant motor development among mothers who consumed on average two drinks per day compared to women who abstained. In a replication study by the same author the opposite association was reported but the children were examined at 18 months and the mothers consumed significantly less alcohol on average (Little, 2002).

Besides these potential longer term effects of alcohol on infant cognition, two studies examined the effects of alcohol during lactation on other characteristics of the infant. These studies reported short-term exposure to small amounts of alcohol in mothers' milk produces distinctive adverse changes in the infants' sleep–wake patterning (Mennella, 2001; Mennella, 1998).

Relevant Contextual Issues for the Entire Chapter

Abstention is an important option. Approximately one in three American adults does not drink alcohol. Moreover, studies suggest adverse effects at even moderate alcohol consumption levels in specific individuals and situations, as described above. People who should not drink include:

- Individuals who cannot restrict their drinking to moderate levels.

- Children and adolescents.
- Individuals taking prescription or over-the-counter medications that can interact with alcohol.
- Individuals with specific medical conditions (e.g., liver disease, hypertriglyceridemia, pancreatitis).

In addition, alcohol should be avoided in certain situations:

- Women who are pregnant or who are unsure if they pregnant.
- Individuals who plan to drive, operate machinery, or take part in other activities that require attention, skill, or coordination or in situations where impaired judgment could cause unintentional injury (e.g., swimming).

Chapter Summary

An average daily intake of one to two alcoholic beverages is associated with the lowest all-cause mortality and a low risk of diabetes and CHD among middle-aged and older adults. Despite this overall benefit of moderate alcohol consumption, the evidence for a positive association between alcohol consumption and risk of unintentional injuries and breast and colon cancer should be taken into consideration. The DGAC recommends that if alcohol is consumed, it should be consumed in moderation, and only by adults. Moderate alcohol consumption is defined as *average* daily consumption of up to one drink per day for women and up to two drinks per day for men and no more than three drinks in any single day for women and no more than four drinks in any single day for men. One drink is defined as 12 fl. oz. of regular beer, 5 fl. oz. of wine, or 1.5 fl. oz. of distilled spirits.

The substantial epidemiological literature is based on studies where individuals report their "average" intake as drinks per day, month or year. Because most US citizens do not drink every day, the DGAC also recommends that the definition for moderation be based on this general "average" metric over the course of a week or month instead of an exact threshold of "1 drink per day for women or two drinks per day for men" each day. The Committee further explored whether there was compelling evidence to expand the definition of moderation to include a specific healthy pattern of consumption, but could not find one particular pattern of consumption that had a strong evidence base and could provide more clarity than the recommendation above. The DGAC did find strong evidence that heavy consumption of four or more drinks a day for women and five or more drinks a day for men had harmful health effects. A number of situations and conditions call for the complete avoidance of alcoholic beverages.

Needs for Future Research

1. Conduct a comprehensive set of studies in a controlled setting to assess the influences that alcohol may have on factors that affect energy intake and expenditure.

   Rationale: The effects of energy from alcohol on body weight are complex and not completely understood. These studies will clarify whether the lack of association between moderate alcohol consumption and weight gain is due to biological compensation or changes in other behaviors (e.g., diet or physical activity).

2. Conduct research to enhance the currently limited data on changes in markers of bone health in metabolic studies of alcohol consumption.

   Rationale: In large epidemiological studies, a better classification of drinking pattern and a better documentation of the traumatic or non-traumatic cause of fracture are needed, but equally important is the need to study prospectively changes in alcohol consumption and changes in intermediate markers of bone structure and integrity.

3. Focus further research to avoid unintentional injury on effective communication policies that expand current messages on drinking and driving to inform individuals of other unintentional risk associated with alcohol consumption.

   Rationale: The documented benefit of drunk driving campaigns is a public health success yet alcohol related injury is still substantial in other areas and should be addressed with the same vigilance and governmental support.

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