

HERE AND NOW

Half-Truths About Alcohol

Much is known about alcohol, but much more needs to be learned to effectively and safely manage its use. There are several half-truths that are commonly believed by the general public that should be clarified:

- **Belief:** Alcohol, if used in moderation, is healthy for everyone.
- **Fact:** Moderate drinking benefits only men older than 50 years of age and women who are postmenopausal. Even for these populations, the benefits appear to be minimal in persons who already have healthy lifestyles.
- **Belief:** Pound for pound, women hold their liquor as well as men.
- **Fact:** Because women have proportionally less body water and tend to metabolize alcohol more slowly than men, women become more intoxicated with comparable dose consumption per body weight.
- **Belief:** A drink before bed induces sleep.
- **Fact:** After moderate drinking, onset of sleep may be faster, but the sleep itself becomes restless, marked by frequent wakings and inability to get back to sleep.
- **Belief:** If you don't feel drunk, it is okay to drive.
- **Fact:** People are typically unable to determine accurately how much alcohol is in their system. For most states in the United States, 0.08% to 0.1% alcohol in the blood is the legal threshold for driving (i.e., it is against the law to drive with this blood alcohol content or higher), but studies have shown that driving performance is significantly impaired at half this concentration.
- **Belief:** You can sober up by taking a shower or drinking caffeine.
- **Fact:** Time is the only thing that truly sobers you up after consuming alcohol. Caffeine is a stimulant that does not neutralize the alcohol effects, but can interfere with sleeping.

Data from "Your Health: Alcohol: The Whole Truth, Seven Half-Truths About Drinking," *Excerpted from Consumer Reports* 64 (December 1999): 60–61; National Institute on Alcohol Abuse and Alcoholism (NIAAA). "FAQs for the General Public." 2007. Available <http://www.niaaa.nih.gov/FAQs/General-English>; Greenfield, S. "Women and Alcohol Use Disorders." *Harvard Review Psychiatry* 10 (2002): 76–85; Saks, M. "Testing the Limits of Topsy." *The Wall Street Journal* (August 2, 2011); A Forever Recovery. "5 Myths About Alcohol Abuse vs. the Facts." 2 April 2015. Available aforeverrecovery.com/blog/information/5-myths-about-alcohol-abuse-vs-the-facts

fat. Because it can provide many calories, the drinker's appetite may be satisfied; as a result, he or she may not eat properly, causing malnutrition (Kovacs 2010). The tolerance that develops to alcohol is comparable to that observed with barbiturates. Some people have a higher tolerance for alcohol and can more easily disguise intoxication.

■ Alcohol and Tolerance

Repeated use of alcohol results in tolerance and reduces many of alcohol's pharmacological effects. As with other psychoactive drugs, tolerance to alcohol encourages increased consumption to regain its effects and can lead to severe physical and psychological dependence (Fleming et al. 2006). Tolerance to alcohol is similar to that seen with CNS depressants, such as the benzodiazepines. It consists of both an increase in the rate of alcohol metabolism (due to stimulation of metabolizing enzymes in the liver) and a reduced response by neurons and transmitter systems (particularly by increasing the activity of the inhibitory

neurotransmitter, gamma-aminobutyric acid [GABA]) to this drug. Development of tolerance to alcohol is extremely variable; some users can consume large quantities of this drug with minor pharmacological effects. The tolerance-inducing changes caused by alcohol can also alter the body's response to other drugs (referred to as *cross-tolerance*) and can specifically reduce the effects of some other CNS depressants (Kenna 2013).

Many chronic alcohol users learn to compensate for the motor impairments of this drug by modifying their patterns of behavior. These adjustments are referred to as **behavioral tolerance**. Examples of this adjustment include individuals altering and slowing their speech, walking more deliberately, or

KEY TERM

behavioral tolerance

compensation for motor impairments through behavioral pattern modification by chronic alcohol users

moving more cautiously to hide the fact that they have consumed debilitating quantities of alcohol.

■ Alcohol Metabolism

Alcohol is principally inactivated by liver metabolism (Masters and Trevor 2015). The liver metabolizes alcohol at a slow and constant rate and is unaffected by the amount ingested. Thus, if one can of beer is consumed each hour, the BAC will remain constant without resulting in intoxication. If more alcohol is consumed per hour, the BAC will rise proportionately because large amounts of alcohol that cannot be metabolized spill over into the bloodstream.

■ Polydrug Use

It is a common practice to take alcohol with other drugs, such as tobacco (Kelly et al. 2015), prescription drugs (Kenna 2013), and even illegal substances (Hedden et al. 2010); this mode of consumption is known as **polydrug use** (Kenna 2013), and it occurs in about 64% of alcoholics (Hedden et al. 2010). Mixing alcohol with other types of drugs can intensify intoxication. This probably helps explain why marijuana users are more likely to combine their marijuana use with alcohol than with other drugs (Liquori, Gatto, and Jarrett 2002; Peters and Hughes 2010). In a recent report, approximately 64% of those seeking treatment for alcoholism also were diagnosed with another drug dependence (Hedden et al. 2010).

The reasons why individuals combine alcohol with other drugs of abuse are not always apparent. The following explanations have been proposed:

- Alcohol enhances the reinforcing properties of other CNS depressants.
- It decreases the amount of an expensive and difficult-to-get drug required to achieve the desired effect.
- It helps to diminish unpleasant side effects of other drugs of abuse, such as the withdrawal caused by CNS stimulants.
- There is a common predisposition to use alcohol and other substances of abuse.

KEY TERMS

polydrug use

the concurrent use of multiple drugs

disinhibition

loss of conditioned reflexes due to depression of inhibitory centers of the brain

Clearly, coadministration of alcohol with other substances of abuse is a common practice that can be very problematic and result in dangerous interactions (AddictionCenter 2016).

■ Short-Term Effects

The impact of alcohol on the CNS is most similar to that of sedative-hypnotic agents such as barbiturates. Alcohol depresses CNS activity at all doses (Masters and Trevor 2015), producing definable results.

At low to moderate doses, **disinhibition** occurs; this loss of conditioned reflexes reflects a depression of inhibitory centers of the brain. The effects on behavior are variable and somewhat unpredictable. To a large extent, the social setting and mental state determine the individual's response to such alcohol consumption. For example, alcohol can cause one person to become euphoric, friendly, and talkative but can prompt another to become aggressive and hostile. Low to moderate doses also interfere with motor activity, reflexes, and coordination. Often this impairment is not apparent to the affected person (CDC 2008; "Your Health" 1999).

In moderate quantities, alcohol slightly increases the heart rate; slightly dilates blood vessels in the arms, legs, and skin; and moderately lowers blood pressure. It stimulates appetite, increases production of gastric secretions, and markedly stimulates urine output. At higher doses, the social setting has little influence on the expression of depressive actions of the alcohol. The CNS depression incapacitates the individual, causing difficulty in walking, talking, and thinking. These doses tend to induce drowsiness and cause sleep. If large amounts of alcohol are consumed rapidly, severe depression of the brain system and motor control area of the brain occurs, producing incoordination, confusion, disorientation, stupor, anesthesia, coma, and even death (CDC 2008).

The lethal level of alcohol is between 0.4% and 0.6% by volume in the blood (Masters and Trevor 2015). Death is caused by severe depression of the respiration center in the brain stem, although the person usually passes out before drinking an amount capable of producing this effect. Although an alcoholic may metabolize the drug more rapidly than a light drinker, the toxicity level of alcohol stays about the same. In other words, it takes approximately the same concentration of alcohol in the body to kill a nondrinker as it does to kill someone who drinks on a regular basis.

The amount of alcohol required for anesthesia is very close to the toxic level, which is why it would not be a useful anesthetic. See "Signs & Symptoms: Psychological and Physical Effects of Various Blood Alcohol Concentration Levels" for a summary of the effects of various BAC levels.

As a general rule, it takes as many hours as the number of drinks consumed to sober up completely. Despite widely held beliefs, drinking black coffee, taking a cold shower, breathing pure oxygen, and so forth will not hasten the sobering process. Stimulants such as coffee may help keep the drunk person awake but will not improve judgment or motor reflexes to any significant extent.

THE HANGOVER

A familiar consequence of overindulgence is fatigue combined with nausea, upset stomach, headache, sensitivity to sounds, and ill temper—the hangover. These symptoms are usually most severe many hours after drinking, when little or no alcohol remains in the body. No simple explanation exists for what causes the hangover. Theories include accumulation of acetaldehyde (a metabolite of ethanol), dehydration of the tissues, poisoning due to tissue deterioration, depletion of important enzyme systems needed to maintain routine functioning, an acute withdrawal (or rebound) response, and metabolism of the impurities in alcoholic beverages (Compound Interest 2016).

SIGNS & SYMPTOMS

Psychological and Physical Effects of Various Blood Alcohol Concentration Levels

Number of Drinks*	Blood Alcohol Concentration	Psychological and Physical Effects
1	0.02-0.03%	No overt effects, slight mood elevation.
2	0.05-0.06%	Impairment begins. Feeling of relaxation, warmth, slight decrease in reaction time and in fine muscle coordination.
3	0.08-0.09%	Balance, speech, vision, hearing slightly impaired; feelings of euphoria, increased confidence; loss of motor coordination.
3-4	0.08%	Legal intoxication.
4	0.11-0.12%	Coordination and balance becoming difficult; distinct impairment of mental faculties, judgment.
5	0.14-0.15%	Major impairment of mental and physical control; slurred speech, blurred vision, lack of motor skills.
7	0.20%	Loss of motor control—must have assistance in moving about; mental confusion.
10	0.30%	Severe intoxication; minimum conscious control of mind and body.
14	0.40%	Unconsciousness, threshold of coma.
17	0.50%	Deep coma.
20	0.60%	Death from respiratory failure.

Note: For each hour elapsed since the last drink, subtract 0.015% blood alcohol concentration, or approximately one drink.

* One drink = one beer (4% alcohol, 12 oz.) or one highball (1 oz. whiskey).

Data from Ohio State Police Driver Information Seminars and the National Clearinghouse for Alcohol and Alcoholism Information, 5600 Fishers Lane, Rockville, MD 85206; Evans, W. "NTSB Wants Lower Legal Limit for Blood Alcohol." *Deseret News* 163 (15 May 2013): A1.

The body loses fluid in two ways through alcohol's **diuretic** action, which sometimes results in dehydration: (1) the water content, such as in beer, increases the volume of urine and (2) the alcohol depresses the center in the hypothalamus of the brain that controls release of a water conservation hormone (antidiuretic hormone). With less of this hormone, urine volume is further increased. Thus, after drinking heavily, especially the highly concentrated forms of alcohol, the person is thirsty. However, this effect by itself does not explain the symptoms of a hangover.

The type of alcoholic beverage one drinks may influence the hangover that results. Some people are more sensitive to particular alcohol impurities than others. For example, some drinkers have no problem with white wine but an equal amount of some red wines gives them a hangover. Whiskey, scotch, and rum may cause worse hangovers than vodka or gin, given equal amounts of alcohol, because vodka and gin have fewer impurities. There is little evidence that mixing different types of drinks per se produces a more severe hangover. It is more likely that more than the usual amount of alcohol is consumed when various drinks are sampled.

A common treatment for a hangover is to take a drink of the same alcoholic beverage that caused the hangover. This practice is called "taking the hair of the dog that bit you" (from the old notion that the burnt hair of a dog is an antidote to its bite). This treatment might help the person who is physically dependent, in the same way that giving heroin to a heroin addict eases the withdrawal symptoms. The "hair of the dog" method may work by depressing the centers of the brain that interpret pain or by relieving a withdrawal response. In addition, it may affect the psychological factors involved in having a hangover; distraction or focusing attention on something else may ease the effects.

Another remedy is to take an analgesic compound such as an aspirin–caffeine combination after drinking. This treatment is based on the belief that aspirin helps control headache, and the caffeine may help counteract the depressant effect of the alcohol. In reality, these ingredients have no effect on the actual sobering-up process. In fact, products such as aspirin, caffeine, and

Alka-Seltzer can irritate the stomach lining to the point where the person feels worse.

■ Dependence

According to the World Health Organization, approximately 3.3 million deaths related to alcohol consumption occur each year around the world (WHO 2016). It is estimated that in the United States 12.5 million men and women suffer from alcoholism. In this group, men are three times more likely than women to develop significant dependence on this drug (Alcohol Abuse Essentials 2010).

In 2015, 37.7% of high school seniors drank enough alcohol to get drunk (Johnston 2016). Unfortunately, many people become so dependent on the psychological influences of alcohol that they become compulsive, continually consuming it. These individuals can be severely handicapped because of their alcohol dependence and often become unable to function normally in society. People who have become addicted to this drug are called **alcoholics** and likely include many of the 6.1% of high school seniors in 2015 who would regularly drink heavily (Johnston 2016). Because of the disinhibition, relaxation, and sense of well-being mediated by alcohol, some degree of psychological dependence often develops even in routine users, and the availability of alcoholic beverages at social gatherings becomes required.

Because of the physiological effects, physical dependence also results from the regular consumption of large quantities of alcohol. This consequence becomes apparent when ethanol use is abruptly interrupted and withdrawal symptoms result. The severity of the withdrawal can vary according to the length and intensity of the alcohol habit. The prototypic withdrawal patterns are as follows (Fleming et al. 2006):

- *Stage 1 (minor)*: Restlessness, anxiousness, sleeping problems, agitation, tremors, and rapid heartbeat
- *Stage 2 (major)*: "Minor" symptoms plus hallucinations, whole-body tremors, increased blood pressure, and vomiting
- *Stage 3 (delirium tremens)*: Fever, disorientation, confusion, seizures, and fatality in 3% to 5% of cases

Recovery from alcohol dependence is a long-term process. Because of the severe withdrawal and the need for behavioral adjustments, most people relapse several times before long-term abstinence is achieved. Even people who have

KEY TERM

diuretic

a drug or substance that increases the production of urine

not used alcohol for years may relapse under very stressful circumstances, such as apparently was the case for the well-known actor Phillip Seymour Hoffman, who died from a drug overdose in 2014 after 2 decades of sobriety. Despite the occasional tragic examples of relapse after long-term sobriety, for those who achieve 5 years of sobriety relapse is not all that common and is typically less than 15%, compared to 30% relapse rate for those who are abstinent for less than a year (Manejwala 2014).

MEDICATIONS FOR DEPENDENCE

Although alcohol dependence afflicts about 4% of the adult population, only 10% to 15% of these patients receive appropriate treatment. This is partially due to the misconception that alcoholism is best dealt with by “willpower” and medicine has no role. However, as we have discussed in this chapter, chronic alcohol use has numerous neurobiological consequences, and thus it makes sense that biological strategies based on medications can be helpful in treating persons severely dependent on alcohol. The following three medications currently are approved by the FDA for adjunctive intervention (i.e., they should be used in combination with behavioral therapy) (Kenna 2018, Masters and Trevor 2015):

- The oldest drug approved for alcoholism treatment, disulfiram (Antabuse), has become less popular with many doctors because it makes users very sick and nauseous when they consume alcohol. It works by interfering with the metabolism of alcohol. It is easily avoided if the patient is anticipating drinking and is typically only helpful in the treatment of highly motivated alcoholics.
- Naltrexone (an opiate antagonist) relieves alcohol craving and helps to reduce relapse rates in alcohol-dependent patients. Although about 20% of this population have a positive response to naltrexone treatment, the other 80% are for the most part nonresponsive. One possible explanation for this finding is the existence of an opioid receptor variant in the responsive group that makes people vulnerable to the addicting effects of alcohol, which can be suppressed by naltrexone treatment. Thus, the lack of such a variant opioid gene in the majority of alcoholics could explain their lack of response to naltrexone (Falloon 2010).
- The third drug, acamprosate (Campral), blocks the release of the exciting neurotransmitter

glutamate, which reduces withdrawal in abstinent alcoholics.

Although these FDA-approved medications have significantly influenced strategies used to treat alcoholism, they are far from being universally effective. There continues to be considerable research as we try to discover even more effective medications for treating the problem of alcoholism. For optimal benefit, alcoholics need to be carefully subtyped (including features such as age, gender, duration of dependence, mental status, and even genetic makeup) and matched to the appropriate medication and behavioral therapy (Johnson 2010).

■ Alcohol and Genetics

Large-scale studies of twins suggest that addictions such as alcoholism are among the most inherited types of mental illnesses. Consequently, because of our unique gene patterns some of us get hooked on alcohol whereas others can party hard but afterwards walk away without any need or desire to consume more alcohol (Wallis 2009). Research has demonstrated that the specific genes that contribute to these inherited vulnerabilities can influence elements of alcohol intake, such as excessive consumption, dampening of neuronal feedback that warns a person that he or she has consumed too much alcohol, or an enhanced sense of pleasure after drinking alcohol (Wallis 2009).

Differences in the intensity of a hangover or the negative effects of drinking such as nausea or dizziness can also be influenced by genetics (see “Family Matters: Asian Glow”) and are likely to affect frequency of use and the development of addiction to alcohol. Despite the prominent role of heritability in the expression of alcohol dependence, the environment is equally as important; if it is supportive and healthy, it can diminish the genetic influence and reduce the likelihood that alcoholism will be expressed even when a person’s genetics increase the risk (Wallis 2009).

The Effects of Alcohol on Organ Systems and Bodily Functions

As mentioned earlier, BAC depends on the size of the person, presence of food in the stomach, rate of drinking, amount of carbonation, and ratio of muscle mass to body fat. Furthermore, alcohol has

FAMILY MATTERS

Asian Glow

The way people are affected by drinking has a significant influence on the likelihood of addiction. For example, if drinking causes nausea, vomiting, and a very unpleasant reaction, then repeated heavy use is not likely and alcoholism probably won't occur. Two variant genes found in about 36% of Asian populations, such as Chinese, Japanese, and Koreans, cause the build up of a very annoying and unpleasant metabolite of alcohol known as acetaldehyde, which, in turn, causes side effects such as nausea, vomiting, sweating, chest pains, and flushing of the face known as the *Asian glow*. Such reactions are typically unpleasant enough to encourage those with these genes to avoid alcohol, thus protecting them against becoming alcoholics. Interestingly, the accumulation of acetaldehyde and its effects also can be promoted

independent of genetics by using the medication Antabuse. Because of its ability to block the elimination of acetaldehyde after drinking, Antabuse is given to discourage alcohol-dependent people from abusing this drug.



Data from Buddy, T. "Antabuse Treatment for Alcoholism." VeryWell. July 2015. Available <http://alcoholism.about.com/od/meds/a/antabuse.htm>; Wallis, C. "The Genetics of Addiction: Research Shows How Genes and the Childhood Experience Pave the Road to Substance Abuse." CNNMoney.com. 16 October 2009. Available http://money.cnn.com/2009/10/16/news/genes_addiction.fortune/index.htm

pervasive effects on the major organs and fluids of the body (NIAAA 2010). In fact, the effects of this substance on body functions potentially can be so profound and destructive that alcoholism (severe addiction) is now considered a disease (NIAAA 2010). The pervasive effects of alcohol on bodily organs are discussed in greater detail in the following sections and summarized in **Figure 7.2**.

■ Brain and Nervous System

Every part of the brain and nervous system is affected—and in extreme cases can be damaged—by alcohol (see Figure 7.2). An important finding demonstrates that even moderate consumption of alcohol can cause shrinkage of brain volume. People who routinely drink more than 14 drinks per week lose approximately 1.6% of brain size compared to nondrinkers. The greatest effect was observed in female heavy drinkers older than 70 years of age (Reinberg 2007). In low to moderate doses, alcohol suppresses subcortical inhibitions of the cortical control centers, resulting in disinhibition. It also increases the release of endorphins, which likely contributes to the rewarding properties of alcohol; helps explain

why naltrexone, an opioid receptor antagonist, is an effective treatment for some alcoholics; and may explain why some people have a higher risk of becoming an alcoholic. In higher doses, it depresses the cerebellum, causing slurred speech and staggering gait. These doses also impair a person's ability to do tasks that require vigilance and rapid decision making. Often these people are unaware that their performance is impaired, making them potentially dangerous when engaging in activities such as driving a car (Masters and Trevor 2015).

Very high doses depress the respiratory centers of the medulla, resulting in death. Furthermore, alcohol alters the production and functioning of transmitters such as dopamine, serotonin, GABA, and brain endorphins (Ratsma, van der Stelt, and Gunning 2002). Recent findings suggest that even cannabinoid receptors—the targets of the active ingredients in marijuana—are affected by alcohol (Kenna 2013). These neurochemical effects contribute to the fact that alcohol consumption can aggravate underlying psychiatric disorders such as depression and schizophrenia (Bertolote et al. 2004) and may suggest novel ways to develop more effective therapies (Basavarajappa 2007).

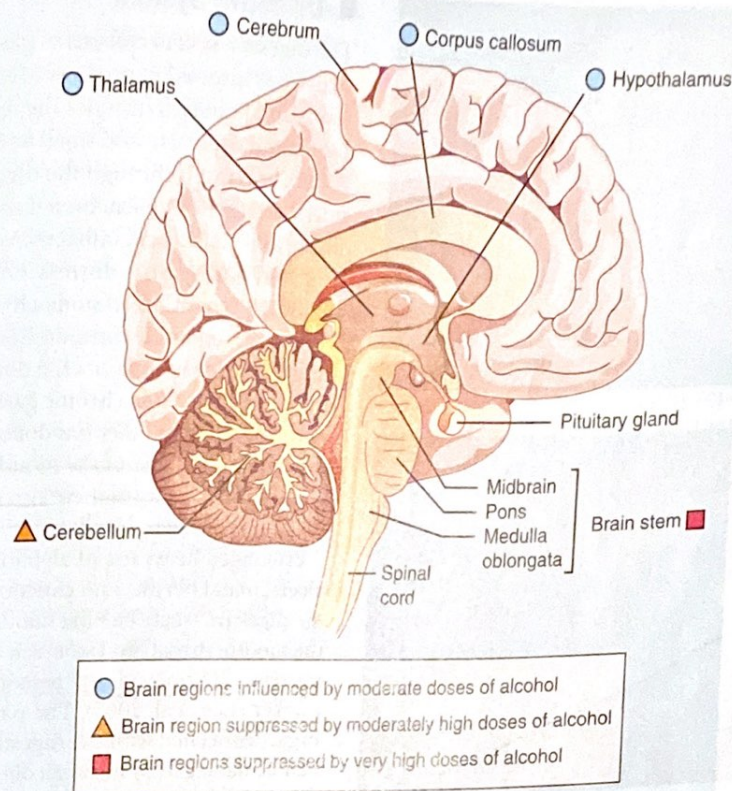


FIGURE 7.2 The principal control centers of the brain affected by alcohol consumption. Note that all areas of the brain are interconnected.

Heavy drinking over many years may result in serious mental disorders and irreversible damage to the brain and peripheral nervous system, leading to permanently compromised mental function and memory and alterations in other brain systems (Baxamusa 2010). In addition, abrupt cessation of alcohol consumption in the alcoholic can result in serious withdrawal effects, such as life-threatening seizures, and require intensive emergency care (Phys.org 2009).

■ Liver

Among alcoholics, liver disorders are responsible for 10% to 15% of deaths (Fairbanks 2009). Alcohol-induced liver disease progresses in three stages (Kenna 2013). In the first stage, known as *alcoholic fatty liver*, liver cells increase the production of fat, resulting in an enlarged liver. This direct toxic effect on liver tissue is known as the **hepatotoxic effect**. This effect is reversible and can disappear if alcohol use is stopped. Several

days of drinking five or six alcoholic beverages each day produces fatty liver in males. For females, as few as two drinks of hard liquor per day several days in a row can produce the same condition. After several days of abstaining from alcohol, the liver returns to normal.

The second stage develops as the fat cells continue to multiply. Generally, irritation and swelling that result from continued alcohol intake cause **alcoholic hepatitis**. At this stage, chronic inflammation sets in and can be fatal. This second

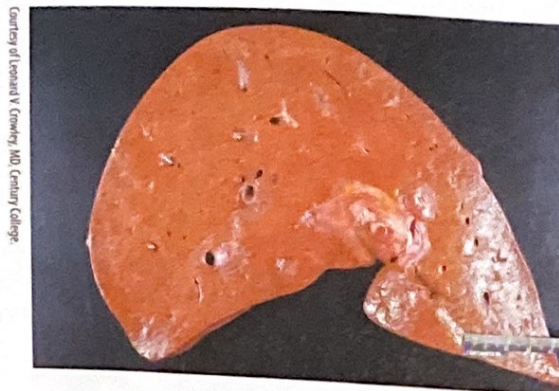
KEY TERMS

hepatotoxic effect

a situation in which liver cells increase the production of fat, resulting in an enlarged liver

alcoholic hepatitis

the second stage of alcohol-induced liver disease in which chronic inflammation occurs; reversible if alcoholic consumption ceases



A normal liver (top) as it would be found in a healthy human body. An abnormal liver (bottom) that exhibits the effects of moderate to heavy alcohol consumption.

stage also is reversible if the intake of alcohol ceases.

Unlike stages 1 and 2, stage 3 is not reversible. Scars begin to form on the liver tissue during this stage. These scars are fibrous, and they cause hardening of the liver as functional tissue shrinks and deteriorates. This condition of the liver is known as **cirrhosis** and often is fatal.

The liver damage caused by heavy alcohol consumption can cause problems when taking drugs that affect liver function. For example, the over-the-counter analgesic acetaminophen (Tylenol) can have a deleterious effect on the liver, especially when the function of this organ has already been compromised by alcohol (Masters and Trevor 2015).

KEY TERM

cirrhosis

scarring of the liver and formation of fibrous tissues; results from alcohol abuse; irreversible

■ Digestive System

The digestive system consists of gastrointestinal structures involved in processing and digesting foods and liquids; it includes the mouth, pharynx, esophagus, stomach, and small and large intestines. As alcohol travels through the digestive system, it irritates tissue and can even damage the tissue lining as it causes acid imbalances, inflammation, and acute gastric distress. Often, the result is gastritis (an inflamed stomach) and heartburn. The more frequently consumption takes place, the greater the irritation. One out of three heavy drinkers suffers from chronic gastritis. Furthermore, the heavy drinker has double the probability of developing cancer of the mouth and esophagus because alcohol passes these two organs on the way to the stomach.

Prolonged heavy use of alcohol may cause ulcers, hiatal hernia, and cancers throughout the digestive tract. The likelihood of cancers in the mouth, throat, and stomach dramatically increases (15 times) if the person is also a heavy smoker (Lee et al. 2005). The pancreas is another organ associated with the digestive system that can be damaged by heavy alcohol consumption. Alcohol can cause pancreatitis, pancreatic cirrhosis, and alcoholic diabetes (Federico et al. 2015).

■ Blood

High concentrations of alcohol diminish the effective functioning of the hematopoietic (blood-building) system, decreasing production of red blood cells, white blood cells, and platelets. Problems with clotting and immunity to infection are not uncommon among alcohol abusers. Often, the result is lowered resistance to disease. Heavy drinking appears to affect the bone marrow, where various blood cells are formed. The suppression of the bone marrow can contribute to anemia, in which red blood cell production cannot keep pace with the need for those cells. Heavy drinkers are also likely to develop alcoholic bleeding disorders because they have too few platelets to form clots (Fleming et al. 2006; Masters and Trevor 2015).

■ Cardiovascular System

The effects of ethanol on the cardiovascular system have been extensively studied, but much remains unknown. Ethanol causes dilation of blood vessels, especially in the skin. This effect accounts for the flushing and sensation of warmth associated with alcohol consumption.

The long-term effects of alcohol on the cardiovascular system are dose dependent. Some studies have suggested that regular light to moderate drinking (two or fewer glasses of wine per day) actually reduces the incidence of heart diseases such as heart attacks, strokes, and high blood pressure by 20% to 40% in some populations (Masters and Trevor 2015), although the benefits have been challenged (Hartney 2012). The type of alcoholic beverage consumed does not appear to be important as long as the quantity of alcohol consumed is moderate (1 to 2.5 ounces per day). Although the precise explanation for this coronary benefit is not known, it has been suggested to be related to the effects of moderate alcohol doses in relieving stress and increasing the blood concentration of high-density lipoproteins (HDL) (Masters and Trevor 2015). HDL is a molecular complex used to transport fat through the bloodstream, and its levels are negatively correlated with cardiovascular disease. In addition, moderate levels of alcohol decrease the formation of blood clots that can plug arteries and deprive tissues of essential oxygen and nutrients. The populations most likely to benefit from the protective properties of moderate levels of alcohol appear to be men older than 50 years of age and postmenopausal women. Moderate drinking on a daily average is approximately one drink (e.g., a glass of wine) for women and two drinks for men. However, it should be noted that some scientists argue that it is not the alcohol itself that protects against cardiovascular disease but the fact that moderate drinkers tend to live healthier lifestyles such as not smoking, eating good diets, and engaging in regular exercise (Rabin 2009). These confounds need further study to determine if moderate consumption of alcohol is as healthy as suggested by earlier studies. Regardless of whether moderate drinking is healthy, it is clear that drinking more than moderate amounts of alcohol can result in increased health risks that more than offset the benefits (Ward 2013).

Some of the confusion about alcohol's health influences may be due to the fact that the cardiovascular protective effect of moderate drinking is at least partially race specific. A report suggests that alcohol use that prevents cardiovascular disease in white men may actually increase heart disease in black men (Fuchs 2004).

Because of the potential for developing addiction to alcohol and the increased health risk with heavy drinking, most health providers and researchers would not encourage a nondrinker to start to consume alcohol in an attempt to gain a

health benefit. In addition, even in those populations most likely to benefit from moderate alcohol consumption, the benefit is likely to disappear in persons who already have healthy lifestyles that include low-fat diets, stress and weight management techniques, and regular exercise. In general, most clinicians believe that alcohol use kills more people (approximately 100,000 per year) than it saves, and those it kills tend to be younger (Hanson and Li 2003; "Special Report" 1997; Ward 2013).

Chronic intense use of alcohol changes the composition of heart muscle by replacing it with fat and fiber, resulting in a heart muscle that becomes enlarged and flabby. Congestive heart failure from **alcoholic cardiomyopathy** often occurs when heart muscle is replaced by fat and fiber. Other results of alcohol abuse that affect the heart are irregular heartbeat or arrhythmia, high blood pressure, and stroke. A common example of damage is "holiday heart," so called because people drinking heavily over a weekend turn up in the emergency room with a dangerously irregular heartbeat. Chronic excessive use of alcohol by people with arrhythmia causes congestive heart failure. Malnutrition and vitamin deficiencies associated with prolonged heavy drinking also contribute to cardiac abnormalities (Fairfield and Fletcher 2002).

■ Sexual Organs

Although alcohol lowers social inhibition, its use interferes with sexual functioning. As Shakespeare said in *Macbeth*, alcohol "provokes desire, but it takes away the performance." Continued alcohol use causes prostatitis, which is an inflammation of the prostate gland. This condition directly interferes with a man's ability to maintain an adequate erection during sexual stimulation. Another frequent symptom of alcohol abuse is atrophy of the testicles, which results in lowered sperm count and diminished hormones in the blood (Dhawan and Sharma 2002; Emanuele and Emanuele 2010).

■ Endocrine System

Endocrine glands release hormones into the bloodstream. These hormones function as

KEY TERM

alcoholic cardiomyopathy

congestive heart failure due to the replacement of heart muscle with fat and fiber

messengers that directly affect cell and tissue function throughout the body. Alcohol abuse alters endocrine functions by influencing the production and release of hormones and affects endocrine regulating systems in the hypothalamus, pituitary, and gonads. Because of alcohol abuse, levels of testosterone (the male sex hormone) may decline, resulting in sexual impotence, breast enlargement, and loss of body hair in men. Women experience menstrual delays, ovarian abnormalities, and infertility (Masters and Trevor 2015).

■ Kidneys

Frequent abuse of alcohol can severely damage the kidneys. The resulting decrease in kidney function diminishes this organ's ability to process blood and properly form urine and can result in serious metabolic problems. Another consequence of impaired kidney function in alcoholics is that they tend to experience more urinary tract infections than do nondrinkers or moderate drinkers (National Kidney Foundation 2015).

■ Mental Disorders and Damage to the Brain

Persons with mental disorders are significantly more likely to have an alcohol problem. This may be in part because heavy alcohol consumption compromises the functions of those parts of the brain that control emotions and social behavior (Healy 2009). For example, long-term heavy drinking can severely affect memory, judgment, and learning ability (Fleming et al. 2006). **Wernicke-Korsakoff's syndrome** is a characteristic psychotic condition caused by alcohol use and the associated nutritional and vitamin deficiencies. Patients who are brain-damaged cannot remember recent events, and compensate for their memory loss with confabulation (making up fictitious events that even the patient accepts as fact) (Masters and Trevor 2015).

KEY TERMS

Wernicke-Korsakoff's syndrome

psychotic condition connected with heavy alcohol use and associated vitamin deficiencies

fetal alcohol syndrome (FAS)

a condition affecting children born to alcohol-consuming mothers that is characterized by facial deformities, growth deficiency, and mental retardation



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Fetal alcohol syndrome is characterized by facial deformities, as well as growth deficiency and mental retardation.

■ The Fetus

In pregnant women, alcohol easily crosses the placenta, and often damages the fetus in cases of moderate to excessive drinking. It can also cause spontaneous abortion due to its toxic actions. Another tragic consequence of high alcohol consumption during pregnancy is **fetal alcohol syndrome (FAS)**, which is characterized by facial deformities, growth deficiency, mental retardation, and joint and limb abnormalities (Masters and Trevor 2015). The growth deficiency occurs in embryonic development, and the child usually does not catch up after birth. The mild to moderate mental retardation does not appear to lessen with time, apparently because the growth impairment affects the functional development of the brain as well.

The severity of FAS appears to be dose related: The more the mother drinks, the more severe the fetal damage. A safe lower level of alcohol consumption has not been established for pregnant women (Masters and Trevor 2015). Birthweight decrements have been found at levels corresponding to about two drinks per day, on average. Clinical studies have established that alcohol itself clearly causes the syndrome; it is not related to the effects of smoking, maternal age, parity (number of children a woman has borne), social class, or poor nutrition. Chronic maternal alcohol consumption is the leading cause of mental retardation and congenital defects in children (Masters

and Trevor 2015). Another study demonstrated that just a few episodes of heavy drinking by a pregnant woman increases the likelihood that the offspring will also abuse alcohol later in life (Psychology Today 2007).

■ Gender Differences

Research has demonstrated that there are important pharmacological differences in how males and females respond to the consumption of alcohol. For example, in women heavy alcohol use will cause accelerated damage to the brain, liver, heart, and muscles compared to male users. These differences persist even after adjusting for the quantity of alcohol according to the differences in gender size. It is thought that at least part of the greater sensitivity of women to the effects of this drug is due to their tendency to metabolize alcohol more slowly than their male counterparts (NIDA 2015b), or it may be due to a higher percentage of body fat in females, leading to greater retention of the drug (Kenna 2013; Leigh 2007). In addition, problems associated with alcohol abuse might express differently in men and women, with females more likely to experience depression, whereas men are more likely to binge drink and engage in fighting (Norton 2007). Other differences relate to their response to treatment. Gender differences in treatment outcomes likely reflect factors such as women's tendency to have a later onset of alcohol use and associated problems, a more positive family history, more marital disruption (Gomberg 2003), and more associated psychiatric disorders, such as depression, anxiety, and stress (Kenny, Jones, and Barnett 2015; *Women's Health Weekly* 2003). Although the reasons for these differences are unclear, they must be considered as researchers and clinicians

try to elucidate the causes, consequences, and most effective treatments for alcoholism.

■ Malnutrition

As previously mentioned, malnutrition is a frequent and extremely serious consequence of severe alcoholism that tends to occur most often in less affluent alcoholics. It has been suggested that malnutrition exaggerates the damage that alcohol causes to the body's organs, especially the liver. Malnutrition apparently expresses so frequently in this population because many alcoholics find it difficult to eat a balanced diet with adequate caloric intake. For example, heavy alcohol consumption often is associated with diets low in fruits and vegetables and high in calories from alcoholic beverages, added sugars, and unhealthy fats. Many alcoholics consume between 300 and 1000 kilocalories per day (2000 kilocalories per day is considered normal for an average man). In addition, most of the calories consumed by alcoholics come from alcohol, which contains 7 kilocalories/gram (less than fat, which contains 9 kilocalories/gram). The malnutrition problem is aggravated because alcohol's calories are empty; that is, alcohol does not contain other nutrients such as vitamins, minerals, protein, or fat. Because alcoholics may be deriving 50% or more of their usual caloric intake from alcoholic beverages, profound deficiencies in important nutrients result, leading to serious degeneration of health. In addition, the malnutrition problems may be further aggravated because of the damage done to the gastrointestinal tract by chronic exposure to the irritating effects of high doses of alcohol. This can damage the linings of both the stomach and intestines, thereby interfering with the proper absorption of essential nutrients from food (Thorley et al. 2015).