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Alcohol in the body

→ Key points

- ◆ Alcohol in the body is normally processed rapidly by the liver; however, this process is easily overwhelmed by the consumption of large quantities of alcohol in short periods of time, and toxic levels can build up.
- ◆ Much of the harm in drinking comes from a disruption of the normal biochemical balance because of the demands of processing excessive amounts of alcohol.
- ◆ Many of the common complications of alcohol abuse result from deficiencies in essential nutrients which are common among alcoholics.
- ◆ Alcohol directly suppresses hormone production in males and females, which not only impairs sexual performance but may also alter sexual characteristics, growth, and fertility.

The metabolism of alcohol

What happens to alcohol when you drink it? Essentially the same thing that happens when you don't drink it. It turns to vinegar.

When alcohol 'sours' in the open air, bacteria are responsible. To become vinegar (acetic acid) in the body, alcohol needs two enzymes:¹ alcohol dehydrogenase and aldehyde dehydrogenase. When alcohol is broken down or 'metabolized', it is converted first to acetaldehyde (by alcohol dehydrogenase) and then to acetic acid (by acetaldehyde dehydrogenase) which can be processed and burned in place of glucose for energy. Alcohol dehydrogenase is located, in rather large supply, in the liver where the majority of alcohol



processing occurs; consequently, it is the liver that suffers the most from repeated imbibing of alcohol. The second enzyme, acetaldehyde dehydrogenase, is present in abundance in all tissues. Its levels are generally sufficient to prevent the accumulation of the intermediate chemical, acetaldehyde, which is quite toxic. Acetic acid is ultimately ‘burned’ using the normal metabolic machinery to become carbon dioxide and water, generating 7 calories of energy per gram of alcohol in the process.

The reason that we humans have such high levels of alcohol-metabolizing enzymes in our bodies in the first place is somewhat controversial.

Did God anticipate that some day humans would develop a taste for alcohol and need a way to dispose of it? Perhaps there was another purpose.

As it turns out, these enzymes will act on any number of different alcohol and aldehyde molecules. It is widely believed that their so-called ‘natural’ function is, in fact, the metabolism of vitamin A which is required for healthy vision.

The harm in drinking

So what is the harm in drinking?

For your body, most of the problems start with the intake of large amounts of alcohol, quickly. Even in experienced drinkers, alcohol-metabolizing systems are easily overwhelmed, allowing alcohol to accumulate. Such drinking to drunkenness can also lead to an accumulation of acetaldehyde which can react with and damage cellular proteins and DNA. No doubt, repeated exposure to high levels of these toxins contributes to the development of many of the health problems commonly found in alcoholics.

The metabolism of alcohol also alters the normal cellular metabolic processes of the body in several specific ways.

1. There is an increase in the production of lactic acid, a cellular toxin.
2. There is an increase in uric acid which is associated with gout.
3. There is disruption of the regulation of blood sugar levels which can cause low blood sugar, especially after a night of heavy drinking.
4. There is an increase in the synthesis of fat, mainly in the liver, which can build up and clog the organ.



Such shifts in the chemical balance of the body are not usually a problem in small doses. The body is quite resilient. Over time, however, the persistent derangement of these systems can lead to serious problems.

Chronic heavy drinking can inflame the liver in particular, a condition known as alcoholic hepatitis. Hepatitis can cause cell death and permanent scarring, or cirrhosis, of the liver which can progress to death. Fortunately, cirrhosis only occurs in about 5–10 percent of alcoholics. Why only 10 percent? This is not clear, but heavy drinking appears to be the trigger in these individuals. It is clear that heavy alcohol use is damaging to many organ systems. The particular system damaged, and in whom, depends upon individual factors. Be it your liver, stomach, or pancreas, alcohol has a way of finding your weakest link. These problems are usually associated with heavy drinking, and even then may only occur in certain individuals.

Alcohol and nutrition

Alcoholics also tend to be malnourished, which only adds to their problems. Malnutrition in alcoholics can be attributed, in part, to poor dietary habits. For many alcoholics, the majority of their daily caloric intake comes from alcohol. Over time, however, the toxic effects of heavy drinking on the gut and other body systems begin to interfere with the body's ability to absorb and use dietary nutrients. In the end, the accelerated rate of alcohol processing depletes the remaining nutrient stores. This is especially true for vitamin B₁ (thiamine) which is required for the metabolism of sugars as well as alcohol. High rates of alcohol processing rob the body of thiamine, leading to deficiencies that can be severe. Severe thiamine deficiency selectively damages muscle and nerve tissues. Nerve damage in the extremities can produce neuritis, an inflammation of the peripheral nervous system. Similar damage in the brain can lead to coordination problems and memory impairments, a condition known as Wernike–Korsakoff syndrome. A large number of the adverse health effects found with heavy drinking are actually due to alcoholism-related nutritional deficiencies and not to the alcohol itself. We will review these conditions in Chapter 6.

Alcohol, sex, and hormones

Alcohol's effects on the libido and sexual performance are legendary. Some of these effects are due to alcohol's potent inhibitory actions on testosterone production in men and estrogen release in women. One study reported a 40 percent decrease in blood testosterone levels among college-age men after a single heavy-drinking episode. Alcohol disrupts hormone production at all

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levels of the endocrine system, beginning in the brain. Alcohol interferes not only with sexual performance but also with sexual characteristics in general, including fertility. Therefore, men who think that drinking alcohol will ‘make a man’ of them have got it backwards.

Frequent short-term decreases in testosterone levels caused by heavy drinking can permanently alter certain hormone responses in the brain, disrupt muscle and prostate function, and interfere with the formation of bone, leading to osteoporosis. These effects appear to be amplified in males exposed to repeated drops in testosterone or permanent hypogonadism² in adolescence.

In females, similar effects on estrogen production can disrupt the normal menstrual cycle and reproductive functions. Alcohol abuse in younger women and girls may alter bone growth and fertility. The abuse of alcohol in older women can produce osteoporosis and trigger the onset of menopause.