



ALCOHOL AND HEALTH

# ALCOHOL AND THE HUMAN BODY



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# INTRODUCTION

In various surveys conducted by Éduc'alcool in Québec, people were asked which drinking-related topics were of greatest interest to them.

More than 70% of all respondents said they wanted to know about the effects of alcohol on the human body.

Éduc'alcool has responded by publishing *Alcohol and the Human Body*. Written in a straightforward, easy-to-understand style, its purpose is to provide information and, even more importantly, to influence behaviour.

Éduc'alcool believes strongly that one way to prevent alcohol abuse is to make sure that people know thoroughly and exactly what happens to their bodies—and to the alcohol—when they drink.

People who are equipped with accurate information are more likely to be aware of the dangers of abusive drinking, and understand even more clearly the importance of drinking moderately and responsibly.

When it comes to drinking, there is no hard and fast rule for everyone. Each of us must take our specific differences into account as we make our own choices. Nonetheless, the path that alcohol travels through the body *is* the same for everyone. And it remains true that excessive, abusive drinking and intoxication will always be unacceptable—socially, culturally and medically.

In other words, moderation is always in good taste.



# ALCOHOL – UNLIKE ANYTHING ELSE WE INGEST

More than 80% of Quebecers drink alcohol regularly, most of them moderately. Still, anyone who drinks should be aware that alcohol is not like anything else we eat or drink. People should know exactly what happens physiologically when they drink: how the alcohol is absorbed, how it is eliminated, the processes and mechanisms involved, and the impact it has as it travels through the body.

## It's absorbed differently

### Why does alcohol get into the bloodstream so quickly?

Alcohol is absorbed very quickly by the blood and spreads easily to all the organs. That's because alcohol molecules are very tiny. They don't have to be broken down by digestive enzymes to get into the blood, and they dissolve easily in water and fat, both of which are prime components of the human body.

### Why is alcohol absorbed more quickly when the stomach is empty?

Alcohol moves quickly from the mouth to the stomach and on to the intestines. Some of it is absorbed directly through the mucous membranes of the mouth and esophagus, some is absorbed through the walls of the stomach and the rest is absorbed by the intestines, mainly the small intestine.

If there is no solid food in the stomach or intestines, the alcohol will come into contact with the intestinal walls more easily and pass quickly into the blood. All the alcohol in one drink may well be absorbed within 30 minutes.

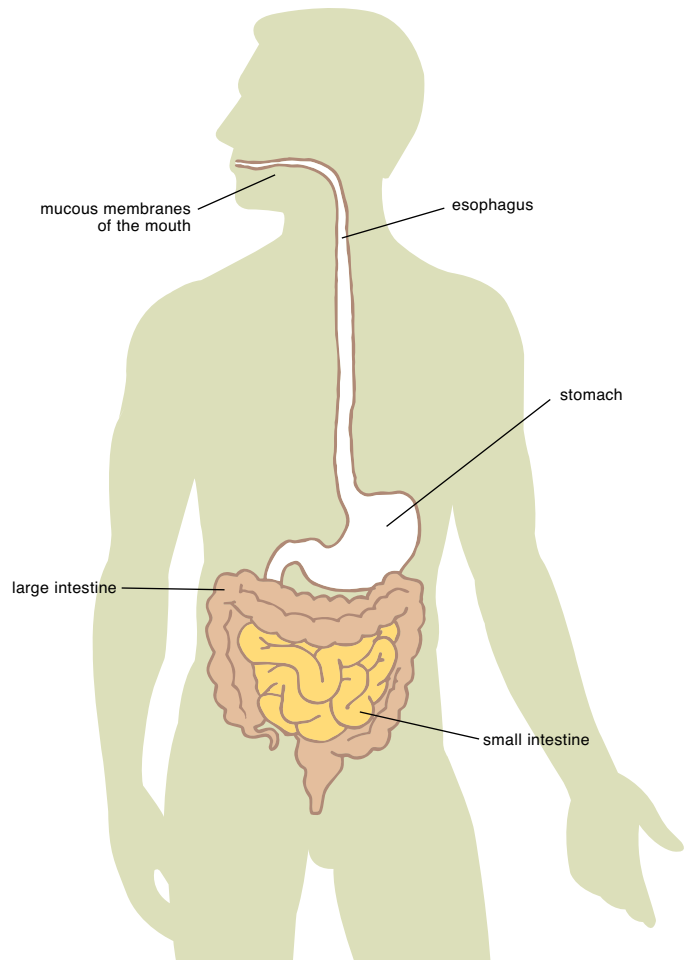
However, if the stomach is relatively full, the alcohol will stay there longer. The absorption process will be slower and may take up to 90 minutes.

### Why is stronger alcohol absorbed more slowly?

The concentration gradient principle tells us that, generally speaking, the higher the concentration of alcohol in a beverage, the more quickly the alcohol is absorbed. But starting at 30%, alcohol irritates the lining of the stomach. This slows the opening of the pyloric valve, through which the contents of the stomach pass into the small intestine. Drinking several shots of spirits one after the other in the hope of getting drunk quickly may actually produce the opposite result. Mixing spirits with carbonated soft drinks can mitigate this effect.

### Why are sparkling drinks absorbed more quickly?

This has been the subject of some research. In one study, participants were given regular, bubbly champagne one day, and flat champagne another day (the bubbles were removed by whisking the champagne with an electric beater). When blood alcohol content was measured, it was found that the bubbly champagne increased blood alcohol levels more quickly.



Similar results were achieved when comparing mixed vodka-based drinks containing still water and sparkling water. While these results may be interesting, they should be taken with a grain of salt, because the studies involved a very small number of subjects.

It is not understood clearly what causes the difference. Some suggest that the gas creates pressure that forces the stomach contents into the small intestine, where alcohol is absorbed more quickly. However, several studies have refuted this hypothesis, finding no impact on gastric emptying.

Another explanation could be that the gas exerts pressure within the stomach itself, causing more rapid absorption through the stomach walls. But while we know that carbon dioxide is absorbed very quickly this way, it is not clear that this would also affect alcohol absorption.

### Why does alcohol go to your head so quickly?

Once it's in the bloodstream, the alcohol spreads to all parts of the body and is distributed in all tissues containing water. Because alcohol is carried by the blood, it follows that it will be delivered particularly quickly to organs with many blood vessels, such as the brain, the lungs and the liver.

## It's eliminated differently

### Why is there alcohol in exhaled breath and breast milk?

Some alcohol (about 10%) is eliminated as is, through urine or perspiration. It can also be eliminated through the breath, since the bloodstream carries it to the lungs. This is why a breathalyzer can effectively measure your blood alcohol content.

Nursing mothers should be aware that the concentration of alcohol in breast milk is about 10% higher than in the blood, because of the high water content of the milk.

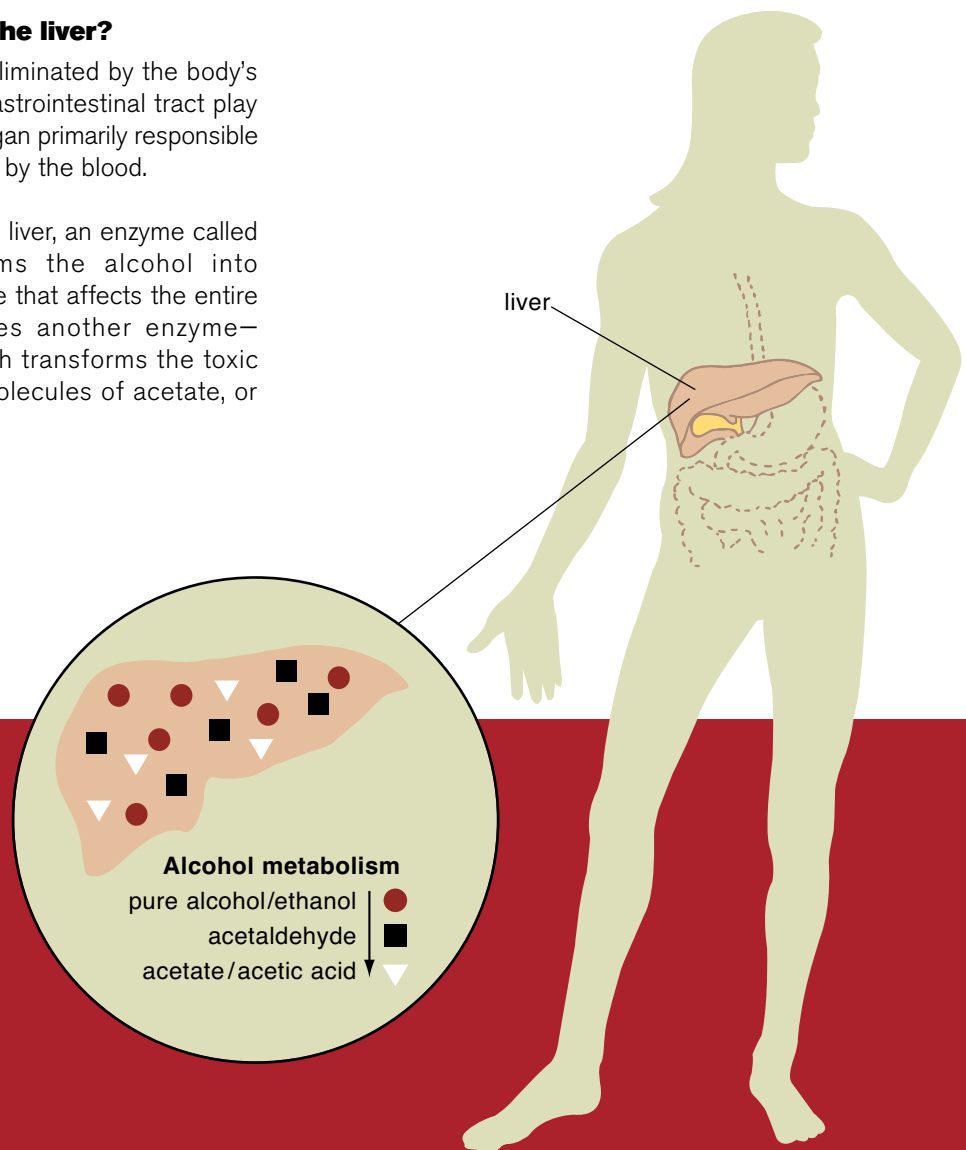
### How is alcohol metabolized by the liver?

Most of the alcohol (about 90%) is eliminated by the body's metabolism. While the kidneys and gastrointestinal tract play a role in this process, the liver is the organ primarily responsible for transforming the alcohol absorbed by the blood.

In the first stage of metabolism in the liver, an enzyme called alcohol dehydrogenase transforms the alcohol into acetaldehyde, a highly toxic substance that affects the entire body. This initial process activates another enzyme—acetaldehyde dehydrogenase—which transforms the toxic acetaldehyde into inert, harmless molecules of acetate, or acetic acid.

### Why do different people eliminate alcohol differently?

No matter how much or how little you drink, the liver can metabolize only 7-8 grams of alcohol every hour, which reduces blood alcohol content by 15-17 mg/100 ml per hour. The speed at which this occurs depends primarily on the quantity of metabolic enzymes in the liver, which varies from one individual to the next and is thought to be genetically determined. Other factors also influence the process.





### **Food: Full stomach or empty stomach?**

The speed at which alcohol is eliminated depends on the amount and type of food present in the gastrointestinal system. During digestion, stomach contents pass into the small intestine (a process known as gastric emptying). The higher the fat content of the food in the stomach, the longer gastric emptying takes, and the slower the process of alcohol absorption.

Research has shown that people who drink after a meal rich in fats, proteins and carbohydrates absorb alcohol more slowly than those who drink on an empty stomach.

### **Gender does matter: Me Tarzan, you Jane**

All other things being relatively equal, if a woman and a man drink exactly the same amount, she will have a higher blood alcohol content than he does. That's because women generally weigh less than men and their bodies have a higher fat content. Since women's bodies contain less water and blood than men's, the alcohol is distributed in a smaller amount of liquid, resulting in a higher concentration of alcohol.

Also, because women tend to be smaller than men, they also have less alcohol dehydrogenase in their bodies, which means that a greater percentage of the alcohol women drink remains in their blood.

### **Age matters, too: Teens and seniors, beware!**

Teens and people over 65 don't tolerate alcohol as well as others, mostly because of their (generally) lower body weight. Consequently, as with women, the alcohol is dissolved in a smaller amount of liquid.

Also, teenagers and seniors have fewer alcohol-eliminating enzymes in their livers than others do.

### **Alcohol and medication: Unforeseeable reactions**

Some medications can hinder the elimination of alcohol, heighten or mask its effects, or cause unforeseeable reactions.

Conversely, alcohol can reduce the effectiveness of some medications or hinder their elimination.

The liver may be primarily responsible for these effects, since it is the organ in charge of eliminating alcohol and many medications. But the liver has limited resources: ridding the body of one chemical may interfere with its ability to deal with another one. And if the liver is constantly in demand to eliminate something, it can get sick.

## It behaves differently

### **What's the relationship between the amount of alcohol consumed and its negative impact?**

The impact of drinking on accidents, incidents, mortality and the morbidity related to chronic diseases varies according to the total volume of alcohol consumed and a person's drinking profile.

### **How does the volume of alcohol consumed affect health?**

The connection between alcohol and chronic disease is complex, but the World Health Organization has identified alcohol as the partial or total cause in more than 200 chronic illnesses, including several cancers, diabetes and some liver ailments. Generally speaking, there is a strong dose-response relationship for these diseases. The risk of developing or dying from one increases in direct proportion to the amount of alcohol consumed.

### **How do different drinking profiles affect health?**

Studies show that, all other things being equal, the risk of developing a chronic disease is lower when people drink while eating, as opposed to drinking without eating. As for the risk of accidents and incidents, the amount of alcohol consumed on a single occasion makes a huge difference. Seven drinks on one occasion does not have the same impact as one drink a day, seven days a week. The more a person drinks per occasion, the higher the risk of injury and accident—voluntary or involuntary—and the higher the risk of cardiovascular disease, even if the total volume consumed is relatively small.

### **What explains the link between the amount of alcohol consumed and its negative impact?**

#### **Toxic effect on organs and tissues**

When large quantities of alcohol are consumed, whether in terms of total volume or amount per occasion, toxic effects are observed on the body's organs and tissues. Recent studies have confirmed that consuming a large volume of alcohol over the course of a lifetime increases the risk of developing cancer. Among young women, for example, drinking a large amount drinking a large amount of alcohol on a single occasion increases the risk of developing breast cancer, since breast tissue is highly sensitive to abnormal cell growth.

#### **Intoxication**

Alcohol intoxication often causes impaired physical coordination, as well as distorted awareness, cognitive perception, emotional response and behaviour. Injuries from violent altercations, for example, are generally related to intoxication.

#### **Dependence**

Drinking a lot can lead to a dependence on alcohol. People generally begin to display lifestyle changes or clinically significant symptoms after one year of excessive drinking.





## It affects you differently



### **Why does alcohol have such an impact on the brain?**

Before it reaches the liver, the alcohol in the blood affects other vital organs that contain a lot of water and require a significant volume of blood in order to function. The most immediately observable effects can be seen in the brain.

Alcohol restricts a number of brain functions by stimulating the brain's pleasure centres. At first, the effects are pleasurable: there is a reduction in stress and inhibitions, and a sensation of either calm or excitement.

How you feel depends on your mood at the time. If you are sad or angry before you drink, the alcohol may initially put you in a better mood. But then the opposite occurs, and you may well end up even sadder or angrier than you were before you started drinking.

### **Alcohol and stress**

Alcohol often goes hand-in-hand with, and even promotes, sociability, conversation, pleasure and a sense of well-being. Among the social and psychological benefits of alcohol, some people report an increase in creativity; alcohol also has a certain therapeutic value as a means to reduce stress.

But while a small amount of alcohol may relieve stress in the short term, it does absolutely nothing to treat the source of the stress. In fact, studies show that the opposite is true: over the long term, alcohol increases anxiety levels. When the anxiety persists, the desire to self-medicate with more alcohol can lead to alcohol dependence.

### **Alcohol and sleep**

People commonly believe that alcohol helps you sleep. Certainly, it can help you fall asleep. But alcohol interrupts normal sleep cycles, and the morning after a night of heavy drinking may find you feeling tired and unwell, even if you have slept a long time. What's worse, alcohol can cause insomnia and frequent sleep interruptions, in addition to exacerbating existing sleep problems.

### **Alcohol and sex**

Alcohol can cause or aggravate sexual problems. Abusive drinking, for example, can make it difficult for men to achieve an erection and for women to achieve orgasm.

### Why is alcohol associated with weight gain?

Alcohol contains calories, but unlike the calories in many other foods, the ones in alcohol have no nutritional value of any importance. That's why we call them "empty calories." No matter what kind of alcohol you drink, the calorie content is approximately the same, or about 94 calories for a standard drink. Other ingredients in wine and beer can add to the basic calories from alcohol. Thus, from least to most calories, you have straight, unsweetened spirits, then wine, then beer. Sweetened alcoholic beverages, including many mixed cocktails, have even more calories.

What's more, alcohol cannot be stored, so the liver makes a high priority of eliminating it. Thus, instead of burning fat, liver resources are diverted into metabolizing alcohol, transforming it into fatty acids.



### Why does alcohol change behaviour?

#### Numbing effects

As your blood alcohol level rises, your brain's motor and sensory centres are affected. You begin to have difficulty with coordination and fine motor functions, and your reaction time slows.

These effects can be minor or major, depending on how much you drink. If you have a blood alcohol content of .08, or 80 mg of alcohol per 100 ml of blood—the legal limit for driving a motor vehicle in Canada—your reaction time will be 30% to 50% slower than when you have no alcohol in your blood. For example, driving under the influence of alcohol will make it difficult to brake quickly if the car ahead stops suddenly.

#### Aggression

As you become intoxicated, your speech, thought processes and senses are affected. Your cognitive and verbal skills are diminished; and since these are the skills that allow you to resolve conflicts, there is a greater likelihood of aggressive and violent behaviour.

#### Vomiting

The part of the brain that controls vomiting is affected by the alcohol and toxic acetaldehyde circulating in your blood.

#### Dehydration

Alcohol also affects the pituitary gland, resulting in reduced secretions of the anti-diuretic hormone that maintains the body's proper hydration level. More specifically, the kidneys are no longer able to reabsorb sufficient water from your urine, and your body ends up eliminating more water than it absorbs. The symptoms of dehydration are fatigue, back and neck pain, and headache.



### **Alcohol and young people**

Recent discoveries in neuroscience and child psychiatry show that the brain is not really fully developed until after age 20. The teenage brain is therefore more vulnerable to alcohol-related damage than the adult brain.

Other studies highlight the effects of alcohol on the ability to learn and make decisions.

The earlier children begin to drink with their peers, the greater the risk that they will develop an alcohol dependence later on.

### **Habituation**

The immediate effects on the brain are often less apparent among people who drink regularly, because they can develop a strong tolerance for alcohol. As a result, they can often drink a great deal without feeling too many short-term effects. Such tolerance is both metabolic—the liver processes the alcohol more quickly and efficiently—and functional—the person learns to compensate for the deficits caused by alcohol.

Nevertheless, the harmful effects of drinking will be seen and felt in the long term. In fact, people whose bodies are habituated to the immediate effects of alcohol are generally those who drink abusively.





## How does alcohol affect other vital organs?

### Heart and cardiovascular system

Just one or two drinks can affect your heart rate, blood pressure, circulation and contractions of the heart muscle, including its ability to pump blood through your body. While these reactions are generally not considered significant from a clinical point of view, they can be more serious if you already suffer from cardiovascular problems.

Nonetheless, as of a certain age, regular, moderate drinking can provide some protection against cardiovascular disease and peripheral vascular disease.<sup>1</sup>

Among other things, alcohol causes the small blood vessels beneath the skin to dilate, which increases blood circulation. You may have noticed that some heavy drinkers have a particularly ruddy complexion. What you're seeing is the result of the dilated blood vessels.

The dilation of blood vessels also causes heat loss, and thus a drop in body temperature. Contrary to popular belief, it is very dangerous to drink alcohol to "warm up" when you are exposed to the cold.

Over the long term, excessing drinking can lead to a hardening of the arteries, which prevents them from dilating and contracting properly with changes in blood pressure. Thus, when blood pressure rises, the arterial walls may rupture and cause a hemorrhage.

Alcohol also contributes to lowering fibrinogen, a protein that functions as a blood coagulant. But coagulation is critical: it allows us to survive injury by stopping bleeding quickly. Should a blood vessel rupture as a result of elevated blood pressure, for example, alcohol can become harmful, or even fatal, because of its anticoagulant effect.

Dilated cardiomyopathy is another disease that may be caused by long-term heavy drinking. The left ventricle becomes enlarged, which weakens the ability of the heart to pump blood effectively to the rest of the body.

<sup>1</sup> Éduc'alcool, *Alcohol and Health: The effects of moderate, regular alcohol consumption*, 2005.



### **Liver**

The liver plays a central role in the metabolism of alcohol. It is also the only visceral organ able to regenerate itself after injury. However, continued, excessive drinking can cause permanent damage.

### **Intestines**

As soon as even a small amount of alcohol is ingested, the intestines begin to secrete acid. As the blood alcohol level rises, secretions of pepsin, a digestive hormone, are reduced, leading to an irritation of the intestinal walls and eventually diarrhea.



### **Pancreas**

The pancreas produces insulin, which the body needs to control blood sugar levels. Drinking causes a sudden spike in blood sugar; the pancreas responds by producing more insulin. This causes a rapid drop in blood sugar and the symptoms of hypoglycemia—dizziness, headaches, difficulty concentrating, depression, anxiety, trembling, cold sweats, heart palpitations, loss of coordination, and stomach aches.

# MORE INFORMATION MEANS BETTER DECISIONS

Understanding the physiological effects of alcohol can, among other things, help you calculate your blood alcohol content more accurately, taking into account the various factors that can affect the rate at which your body absorbs alcohol. This information is vital for anyone who has to do something demanding, such as drive a motor vehicle or engage in physical activity.

It is certainly good to know how much alcohol you have absorbed before you drive. But there are even more important reasons for understanding how alcohol affects the various organs and systems in

your body. More information helps you make better choices. When you have more knowledge, you tend to make more enlightened decisions.

Ultimately, we hope that when people know more about the negative effects of alcohol, they will understand that alcohol is not a benign substance and that it has a very real impact on the human body.

Well-informed people will be more conscious of the unpleasant and dangerous side-effects of abusive drinking, and more aware than ever that moderation is always in good taste.



Éduc'alcool wishes to thank the following organizations, whose publications were used in preparing this booklet:

- Institut national de la santé et de la recherche médicale (2001). *Alcool : Effets sur la santé*. Paris: INSERM.
- Institut suisse de prévention de l'alcoolisme et autres toxicomanies (2004). *L'alcool dans le corps - effets et élimination*. "Les jeunes et l'alcool" collection, Book 2. Lausanne: SFA/ISPA.
- National Health and Medical Research Council (2001). *Australian Alcohol Guidelines: Health Risks and Benefits*. Canberra: NHMRC.
- World Health Organization (2014). *Global status report on alcohol and health 2014*. Geneva: WHO.

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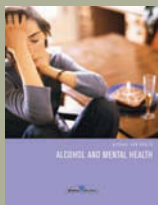
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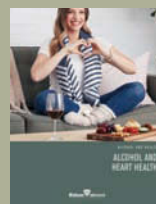
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Moderation is always in good taste.

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