

Alcohol



A Town Built on Beer

[click to enlarge](#)



Photo courtesy Market Garden

Market Garden

The craft beer boom shows no signs of slowing down, as evidenced by the seemingly unending new shops opening from east to west. And that's welcome

Learning Objectives

- Describe the sources of alcohol and define terms related to alcohol intake.
- Outline the process of alcohol absorption, transport, and metabolism.
- Explain how alcohol consumption affects blood alcohol concentration.
- Discuss potential health risks and benefits of alcohol consumption.
- Describe the effects of chronic alcohol use on the body and nutritional status.
- List the signs of an alcohol use disorder.

Alcohol Consumption

- 65% of North American adults consume alcohol, 5% excessively
- Most adults do not drink every day
 - 5.8% of women drink daily
 - 10.8% of men drink daily
- Largest drinking population is young, white college students
 - “Caffeinated cocktails” are popular drinks on college campuses
 - 70% consume alcohol; 45% binge drink



Impact of Harmful and Underage College Drinking

- **Death:** About 1,825 college students between the ages of 18 and 24 die each year from alcohol-related unintentional injuries, including motor vehicle crashes.
- **Assault:** About 696,000 students between the ages of 18 and 24 are assaulted each year by another student who has been drinking.
- **Sexual abuse:** About 97,000 students between the ages of 18 and 24 report experiencing alcohol-related sexual assault or date rape each year.

Impact of Harmful and Underage College Drinking

- **Academic problems:** About 25% of college students report academic consequences of their drinking, including missing class, falling behind, doing poorly on exams or papers, and receiving lower grades overall. Higher amounts of drinking lead to more serious academic problems.
- **Alcohol use disorder:** 31% of college students met the criteria for a diagnosis of alcohol abuse and 6% for a diagnosis of alcohol dependence in the past 12 months, according to questionnaire-based self-reports about their drinking.
- **Other consequences:** These include suicide attempts, injury, unsafe sex, driving under the influence, vandalism, property damage, and police involvement.

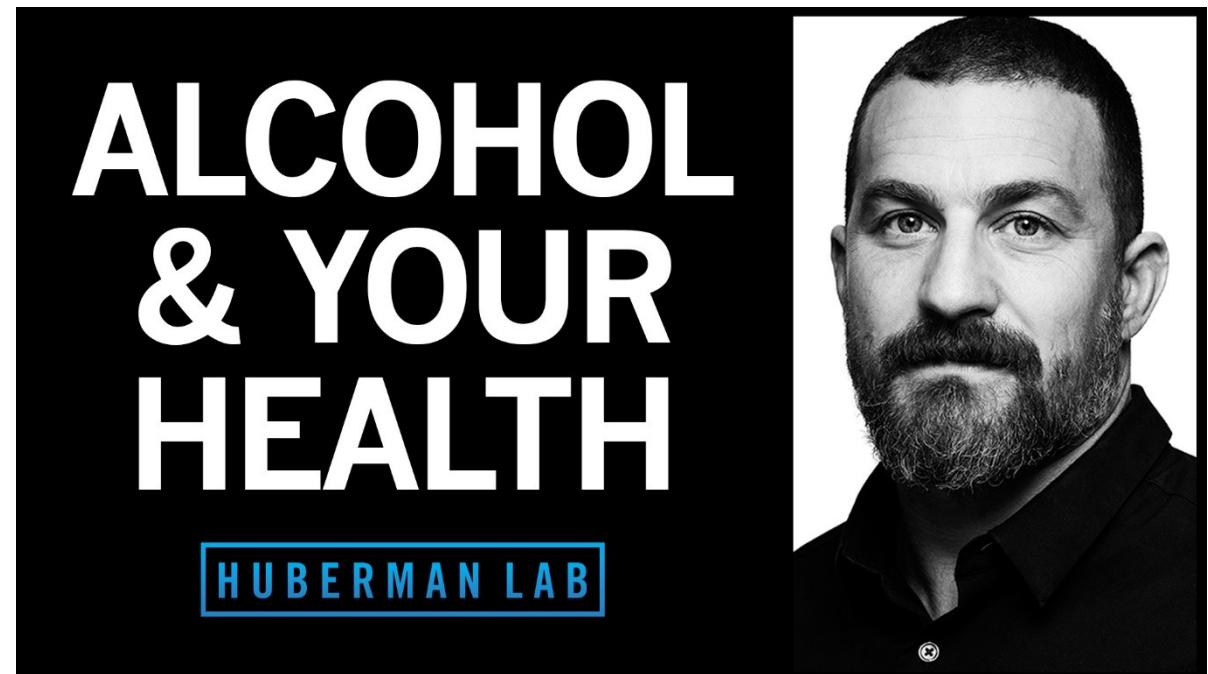
Health Effects of Alcohol

- Low to moderate use of alcohol has some health benefits
 - Social
 - Health-related (**controversial**)
- Excessive intake has serious effects on:
 - Health
 - Nutritional status
- The relationship between the amount of alcohol consumed and its health effects is described as a “J-shaped curve.”



Dr. Andrew Huberman

- Andrew D. Huberman is an American neuroscientist and tenured associate professor in the Department of Neurobiology at the Stanford University School of Medicine
- Areas of research: brain development, brain plasticity, and neural regeneration and repair



Huberman Podcast on Alcohol - Takeaways

- Chronic alcohol intake, even at low to moderate levels (1-2 drinks per day or 7-14 per week), can disrupt the brain
- When people drink, the prefrontal cortex and top-down inhibition are diminished and impulsive behavior increases – this is true in the short term while drinking, and rewires circuitry outside of drinking events in chronic drinkers (even those who drink 1-2 nights per week, long term)
- Damaging effects to the prefrontal cortex and rewiring of neural circuitry are reversible with 2-6 months of abstinence for most social/casual drinkers; chronic users will partially recover but likely feel long-lasting effects
- When people drink there is a shutdown of the prefrontal cortex and circuits that control memory, then there's a fork in the road: group 1 – people who feel sedated after a few drinks; group 2 – people who do not feel sedated after a few drinks (predisposition to alcoholism)

Huberman Podcast on Alcohol - Takeaways

- People who start drinking at a younger age (13-15) are more likely to develop dependence, regardless of the history of alcoholism in their family; people who delay drinking to early 20s are less likely to develop dependence even if there's a family history
- People who drink consistently (even in small amounts i.e., 1 per night) experience increases in cortisol release from adrenal glands when not drinking so feel more stress and more anxiety when not drinking
- With increased alcohol tolerance, you get less and less of the feel good blip and more and more of the pain signaling (so behaviorally you drink more to try to activate those dopamine and serotonin molecules again)
- The risk of breast cancer increases among women who drink – for every 10 grams of alcohol consumed per day, there's a 4-13% increase in the risk of cancer (alcohol increases tumor growth & suppresses molecules that inhibit tumor growth)
- Regular consumption of alcohol increases estrogen levels of males and females through aromatization

Potential Benefits of Alcohol Intake

- Moderate alcohol intake may:
 - Reduce stress and anxiety
 - Episodically
 - Stimulate appetite and increase dietary intake in elderly
 - Lower the risk of cardiovascular disease
 - Lower LDL
 - Increase HDL
 - Decrease platelet aggregation
 - Red wine's phytochemical, resveratrol
- Moderate drinking
 - 1 drink per day or fewer for women
 - 2 drinks per day or fewer for men

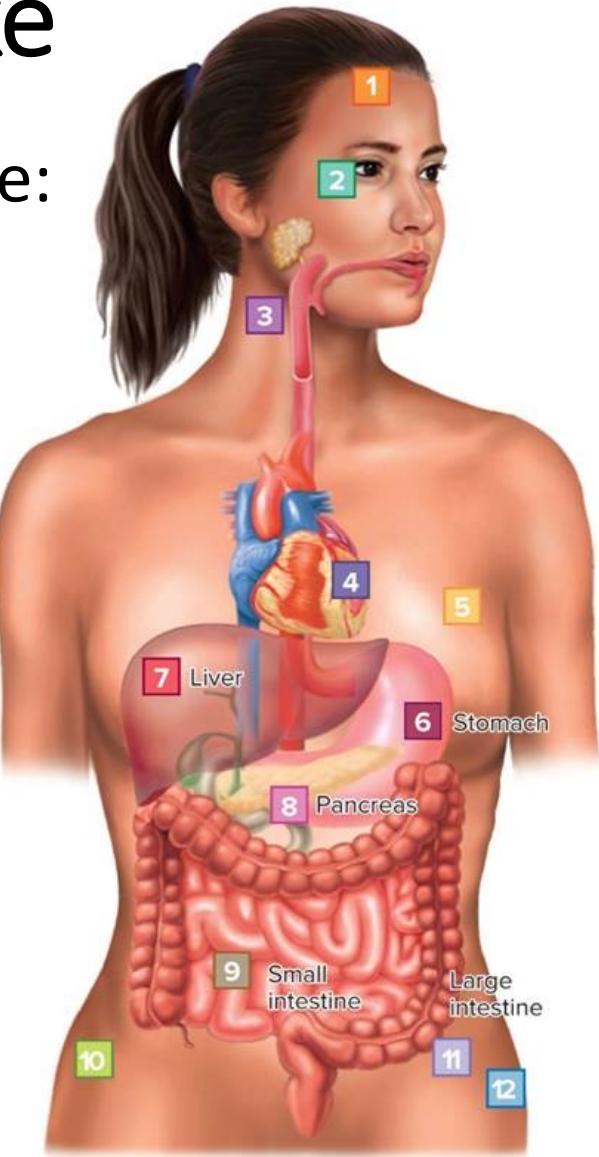


Risks of Excessive Alcohol Intake

- Contributes to 5 of the 10 leading causes of death in North America:
 - Heart failure; arrhythmias
 - Some cancers: Oral cavity, pharynx, larynx, esophagus, liver, breast, colon, rectum
 - Cirrhosis of liver
 - Motor vehicle and other accidents
 - Suicide

Excessive Alcohol Intake

- Excessive alcohol intake can cause:
 - High blood pressure and stroke
 - Cognitive impairment
 - Inflammation of stomach lining
 - Intestinal bleeding
 - Pancreatitis
 - Suppression of immune system
 - Sleep disturbances
 - Impotence
 - Hypo- or hyperglycemia
 - Abdominal obesity
 - High triglycerides
 - Nutritional deficiencies



- 1 Cognitive deficits: difficulties with memory, learning, and problem solving
- 2 Vasodilation and flushing of the skin
- 3 Cancer of the oral cavity, throat, larynx, and esophagus
- 4 Increased blood pressure, heart muscle damage, and resulting heart failure
- 5 Breast cancer
- 6 Irritation of the stomach lining (gastritis) and stomach cancer
- 7 Fatty infiltration of the liver, alcoholic hepatitis, cirrhosis, liver failure, and liver cancer
- 8 Impaired pancreatic function and related hypoglycemia, pancreatic cancer
- 9 Malabsorption of nutrients in the small intestine
- 10 Abdominal fat deposition and fluid accumulation (ascites)
- 11 Cancer of the colon and rectum
- 12 Decrease in bone mineral density and increased vulnerability to hip fracture

A photograph of two men in a bar. One man on the left has a mustache and is wearing a dark sweater over a light blue shirt. He is holding a pint glass of beer. The other man on the right has a beard and is wearing a maroon baseball cap with a white logo and a brown corduroy jacket. He is also holding a pint glass of beer. They are both looking towards each other, and their glasses are nearly touching in a toast. In the foreground, there is a wooden table with plates of food, including salads and what looks like nachos. In the background, there are other people at tables and a bar counter. The lighting is warm and dim, typical of a bar atmosphere.

*What are sources of
alcohol?*

Sources of Alcohol

- Alcoholic beverages vary in alcohol and calorie content
 - Most beers contain 5% alcohol or less
 - IPA, double IPA can be higher (7-10%)
 - Wine contains 5 to 14% alcohol
 - Fortified wines contain 15 to 22% alcohol
 - Distilled spirits:
 - More than 22% alcohol
 - Alcohol content listed as “proof”
- Any other sources of alcohol?



**NANNY
STATE**

**LESS THAN 0.5%
ALCOHOL/VOLUME**

21 CALORIES

4.3G CARBS

PER 12OZ CAN

Many fermented foods contain alcohol

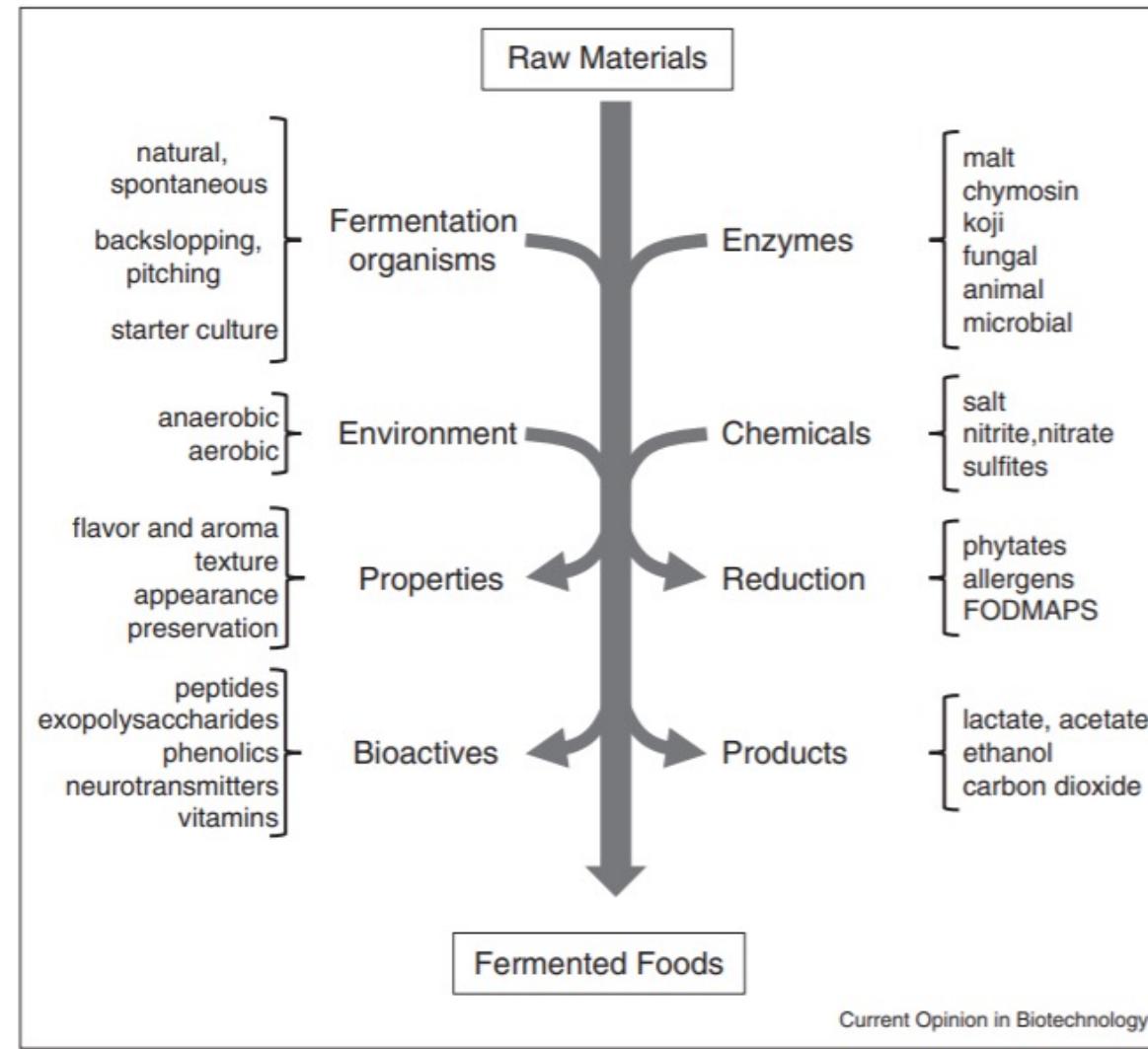


What is Fermentation?

- Ancient process to preserve food
- During the process, microorganisms (bacteria, yeast or fungi) convert sugars and starches into alcohol or acids
 - Ex. Starches and sugars in vegetables are converted to lactic acid
- Promotes growth of beneficial bacteria
- Produce distinctive, strong, slightly sour flavor



“As a result of the multitude of food-microbe combinations, there are thousands of different types of fermented foods and beverages.”



Auto-brewery Syndrome (Gut Fermentation)

Kelly Painter; Barbara J. Cordell; Kristin L. Sticco.

► Author Information

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Introduction

Auto-brewery syndrome or gut fermentation syndrome is a condition in which ethanol is produced through endogenous fermentation by fungi or bacteria in the gastrointestinal (GI) system. Patients with auto-brewery syndrome present with many of the signs and symptoms of alcohol intoxication while denying an intake of alcohol and often report a high-sugar, high-carbohydrate diet.

The production of endogenous ethanol occurs in minute quantities as part of normal digestion, but when fermenting yeast or bacteria become pathogenic, extreme blood alcohol levels may result. Auto-brewery syndrome is more prevalent in patients with co-morbidities such as diabetes, obesity, and Crohn disease [1][2] but can occur in otherwise healthy individuals.[3] Several strains of fermenting yeasts and rare bacteria are identified as the pathogens. While auto-brewery syndrome is rarely diagnosed, it is probably underdiagnosed.[4]

Go to:

Etiology

Various yeasts from the *Candida* and *Saccharomyces* families are commensals turned pathogenic that cause auto-brewery syndrome. Two strains of bacteria are also known to ferment ethanol.

- Fermenting yeasts such as *Saccharomyces cerevisiae*, *S. boulardii*, and various strains of *Candida*, including *C. glabrata*, *C. albicans*, *C. kefyr*, and *C. parapsilosis* are identified as causes of this condition. The bacteria

What is a standard drink?

A standard drink provides 14 g of alcohol

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12 fl oz of
regular beer

8–9 fl oz of
malt liquor
(shown in a
12 oz glass)

5 fl oz of
table wine

1.5 fl oz shot of
80-proof spirits
("hard liquor"—
whiskey, gin, rum,
vodka, tequila, etc.)



about 5%
alcohol



about 7%
alcohol



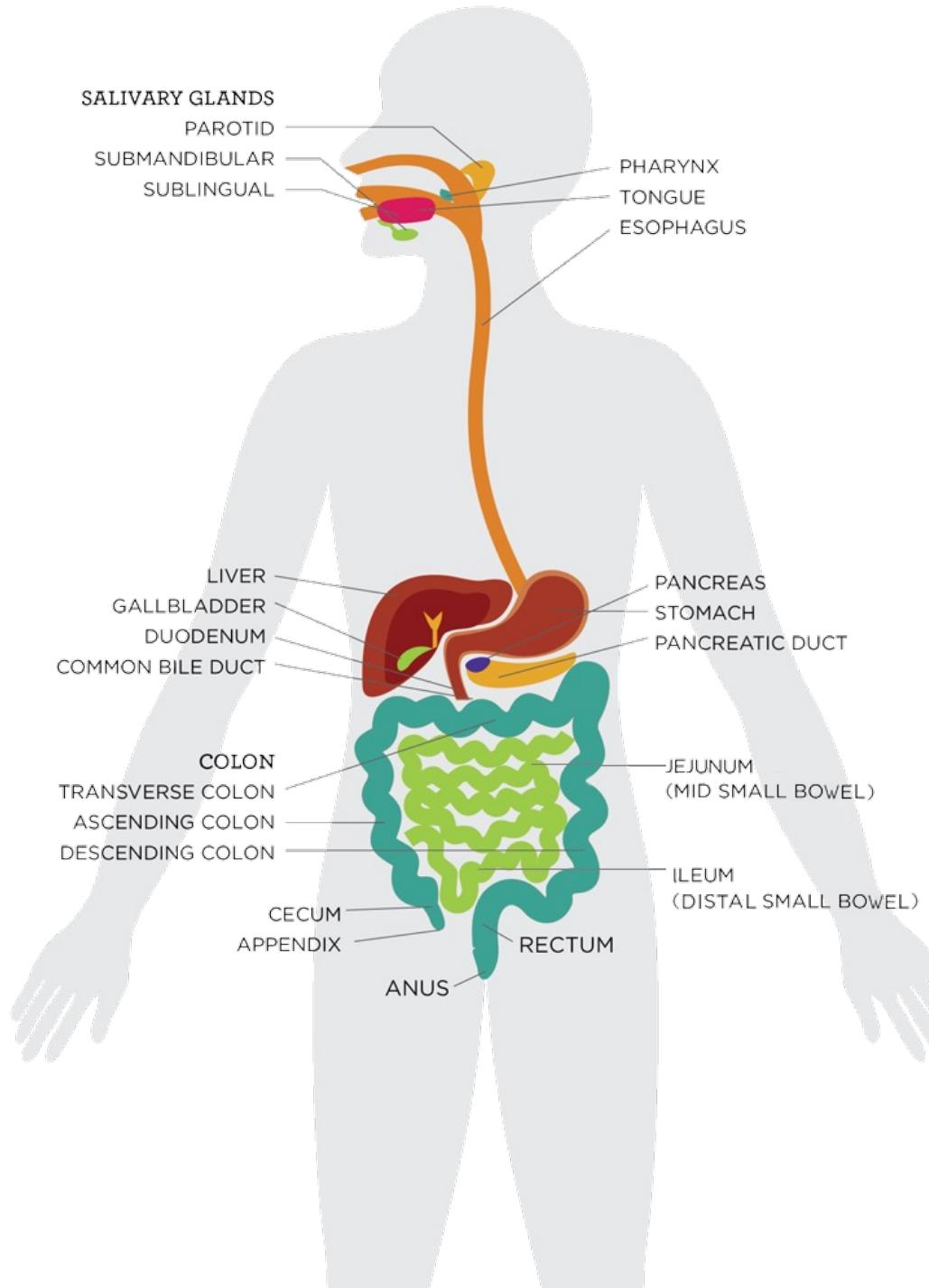
about 12%
alcohol



about 40%
alcohol

Alcohol Absorption & Metabolism

- Alcohol requires no:
 - Digestion
 - Specific transport mechanisms
 - Receptors
 - Rapidly absorbed through G I tract by simple diffusion
 - Carbonation increases rate of absorption
- Stomach absorbs 20%
 - Remainder absorbed in small intestine



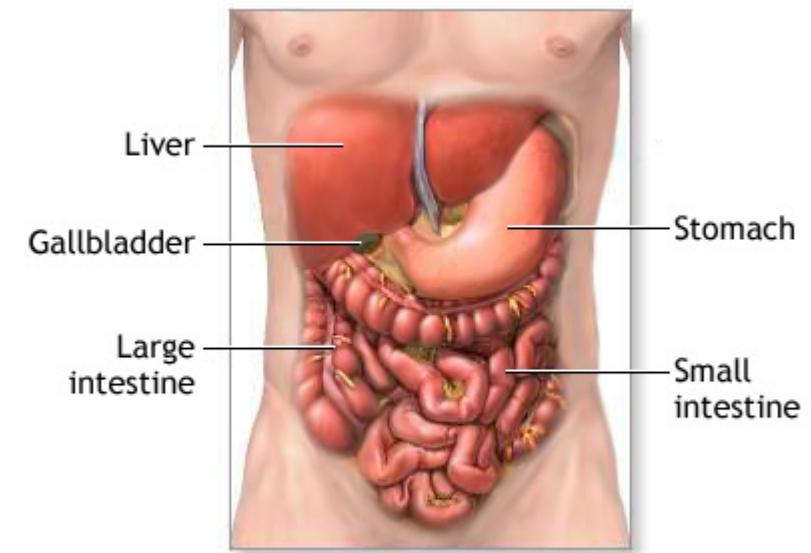
Alcohol Absorption & Metabolism

- If ingested with food, especially high fat foods, absorption is slowed
- Alcohol is found wherever water is distributed in the body
- Easily moves through cell membranes, damaging the proteins in membranes
- Absolute priority is to metabolize, as it cannot be stored in the body



Alcohol Metabolism: 3 Pathways

1. Alcohol dehydrogenase (A D H) pathway
 - Low to moderate intakes
2. Liver activates microsomal ethanol oxidizing system (M E O S) to help
 - During moderate to excessive alcohol intake, A D H pathway cannot keep up
 - As intake increases overtime, M E O S is more active
 - Allows for efficient metabolism and greater tolerance
 - More alcohol is required to produce same effects
 - Capacity for drug metabolism is decreased
3. Catalase pathway
 - Minor contribution to alcohol metabolism



Alcohol Metabolism Summary

Alcohol Metabolic Pathway	Main Location of Pathway Activity	Alcohol Intake That Activates Pathway	Extent of Participation in Alcohol Metabolism
Alcohol dehydrogenase pathway (A D H)	Stomach Liver (mostly)	Low to moderate intake	Metabolizes about 90% of alcohol
Microsomal ethanol oxidizing system (M E O S)	Liver	Moderate to excessive intake	Increases with increasing alcohol intake
Catalase pathway	Liver Other cells	Moderate to excessive intake	Minor

Factors Affecting Alcohol Metabolism

- The ability to produce enzymes is key to alcohol metabolism

Ethnicity:

- Individuals of Asian descent have low activity of aldehyde dehydrogenase
- Results in build up of toxic acetaldehyde

Gender:

- Women produce less alcohol dehydrogenase
- Women are smaller and have more body fat (less total water)

Age



Problems with the Liver

- The liver is the main organ for alcohol metabolism.
- Long-term alcohol abuse causes liver damage.
- **Fatty liver**
 - First change seen is the response of increased fat synthesis and trapping of fat in liver
 - Reversible
- **Alcoholic hepatitis**
 - Inflammation of liver
 - Occurs if alcohol consumption persists
 - Symptoms include: nausea, poor appetite, jaundice (yellow-orange coloration of skin and whites of eyes)
 - Frequently progresses to cirrhosis, but is reversible
- **Cirrhosis**
 - Loss of functioning hepatocytes, as the synthesis of proteins decreases
 - Ascites is a common complication, resulting in fluid retention in the abdomen
 - Not reversible and liver failure develops
 - 50% chance of death in 5 years
 - Associated with excessive alcohol for 10-year or longer

Jaundice

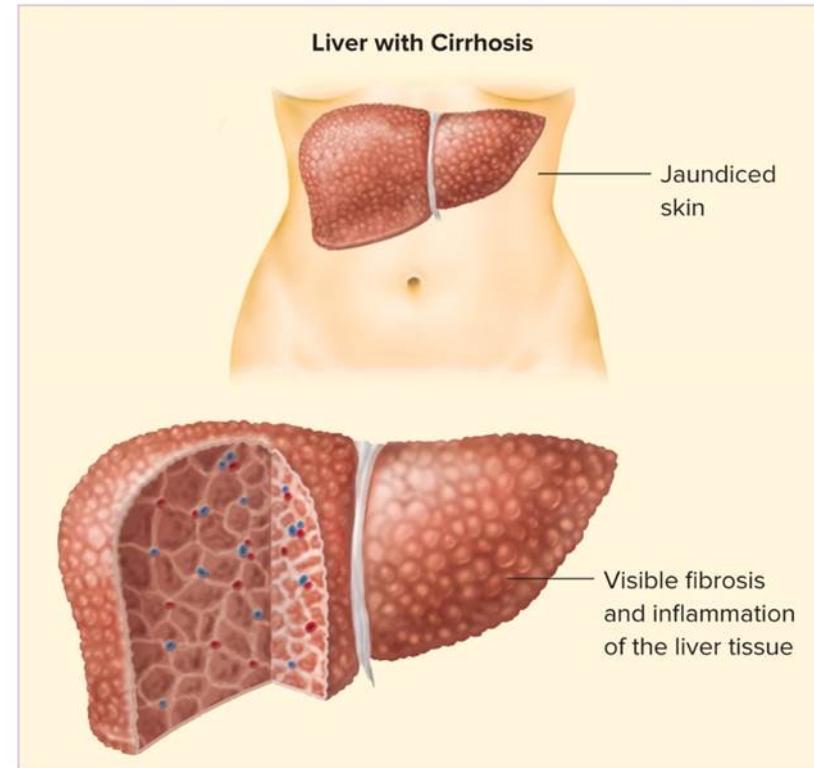
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Healthy Liver versus Liver with Cirrhosis

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Effects of Alcohol Abuse on Nutritional Status

- Alcohol abuse can lead to poor nutritional status and development of nutrient deficiencies.
- Alcohol may replace food in the diet
 - If relied on for majority of energy needs, protein-energy malnutrition develops, with symptoms similar to kwashiorkor
 - Deficiencies of vitamins and minerals can also occur
 - Decreased intake
 - Impaired absorption
 - Altered metabolism
 - Alcohol-related tissue damage



Effects of Alcohol Abuse on Nutritional Status

- Water-soluble vitamin deficiencies:
 - Thiamin: Wernicke-Korsakoff syndrome (significant changes in brain and nervous system)
 - Riboflavin
 - Niacin (needed for alcohol metabolism)
 - Vitamin B-6 (more lost to urine)
 - Vitamin B-12 (impaired absorption)
 - Folate
- Fat-soluble vitamin deficiencies:
 - Chronic alcohol use can damage liver and pancreas
 - Impairs the ability of the liver to make bile and the pancreas to secrete fat-digesting enzymes, resulting in poor absorption of fat and fat-soluble vitamins

Fat Soluble Nutrients

- Vitamin A is stored in liver cells
 - When cells are damaged, stores are lost
 - Liver also makes less of the protein required to transport vitamin A
 - Alcohol decreases amount of beta-carotene
 - As a result, alcoholics often have night blindness
- Vitamin K
 - Alcoholic liver disease results in less production of vitamin-K-containing compounds needed for blood clotting
- Vitamin D
 - Liver plays a role in converting vitamin D to its active form
 - Because vitamin D is needed for calcium absorption, osteoporosis can occur

Minerals

- Calcium
 - Low because of lower production of active form of vitamin D
- Magnesium
 - More likely to be lost in urine
 - Symptom of deficiency is tetany (involuntary muscle contractions)
- Zinc
 - Less is absorbed; more is lost in urine
 - Symptoms include loss of taste, smell, appetite, and impaired wound healing
- Iron
 - Excessive bleeding
 - Malabsorption