

# A Small Dose of Alcohol Or An Introduction to the Health Effects of Alcohol

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## Dossier

**Name:** Ethyl Alcohol (CH<sub>3</sub>-CH<sub>2</sub>-OH)

**Use:** solvent, commonly found in beverages

**Source:** home, industry, pharmacies, and alcoholic beverages

**Recommended daily intake:** none (not essential)

**Absorption:** readily absorbed by intestine, food will delay absorption

**Sensitive individuals:** fetus (Fetal Alcohol Spectrum Disorder (FASD))

**Toxicity/symptoms:** developing nervous system very sensitive to low levels of exposure; kids – lowered IQ, learning and behavioral problems; adults – memory loss, inebriation, liver disease, cancer

**Regulatory facts:** government agencies recommend women not consume alcohol during pregnancy; blood alcohol regulated by local governments when operating a motor vehicle

**General facts:** long history of use, consumed world wide, 9.1 infants per 1000 affected by FASD worldwide

**Environmental:** voluntarily consumed

**Recommendations:** do not consume alcohol during pregnancy, otherwise limit consumption and do not drive a motor vehicle after drinking

## Case Studies

“Alcohol is the number one drug of choice among our Nation’s youth. Yet the seriousness of this issue does not register with the general public or policymakers.”

Enoch Gordis, M.D. Past Director, National Institute on Alcohol Abuse and Alcoholism.

"You will conceive and bear a son...now then be careful to take no wine or strong drink and to eat nothing unclean".

–13 Judges 3-4

### **Fetal alcohol syndrome disorder**

Despite its long history of use, the effects of alcohol on the developing fetus were not recognized until the early 1970s. Fetal Alcohol Syndrome Disorder (FASD) is the result of maternal consumption of alcohol during pregnancy and is one of the leading causes of permanent learning disabilities and physical growth deficiency. Some believe that 1% of the U.S. population may be affected and more worldwide (see below CDC website Fetal Alcohol Spectrum Disorders (FASDs) Prevalence of FASDs). FAS is identified by characteristic changes in facial features particularly around the mouth and eyes. A milder form without the facial deformities, but with associated with leaning disabilities and CNS dysfunction is called Fetal Alcohol Effect (FAE) or Alcohol-Related Neurodevelopmental Disorder (ARND). In the U.S., it is estimated that 4 million infants are born each year with an estimated between 1,300 and 8,000 infants suffer from FAS and 36,000 children have milder forms of alcohol related disabilities. Worldwide, as many as three infants per 1,000 births have FAS, and an unknown number are afflicted with milder forms of disability related to maternal alcohol consumption. Some believe that some European countries might number as high as 1 to 5 per 100 school children (or 1% to 5% of the population.) The effects of alcohol on the infant illustrate the sensitivity of the developing fetus to the chemical exposure. The tragedy is twofold: 1) the effects of alcohol on the fetus are preventable and 2) the effects last a lifetime, robbing the individual of the opportunity to express their full genetic potential.

## Alcohol and the Liver

Alcohol has a range of effects in addition the effects on the developing fetus: for some, desirable acute effects; and with long-term consumption, effects on the liver and other organs. In the U.S., over 2 million people experience alcohol related liver disease. Effects of alcohol on the liver are dose related; the more consumed the greater the effects. Early on there is an accumulation of fat in the liver as a result of the metabolism of alcohol. Some heavy drinkers develop an inflammation (alcoholic hepatitis) of the liver. Metabolites of alcohol, produced by the liver, are toxic to the liver cells. As consumption continues, the liver becomes less functional and a process starts that can lead to cirrhosis or scarring of the liver. Continued drinking can result in death, but if the drinking stops functioning of the liver can improve; however, the underlying damage is not reversible.

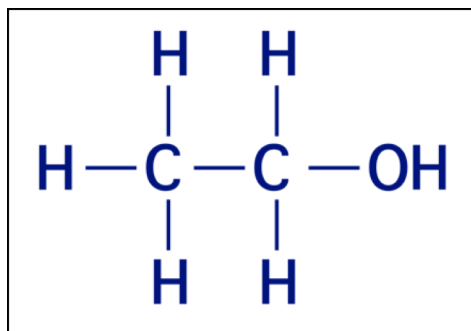
## Introduction and History

'T is not the drinking that is to be blamed, but the excess.

John Selden (1584–1654) In “Table Talk” 1689

Viewed through the lens of toxicology, alcoholic beverages provide a fascinating window into our relationship with a substance that many of us consume because of its intoxicating properties. Our love/hate relationship with alcoholic beverages began over 10,000 years ago with the accidental fermentation of beer. The production of wine soon followed and cultivation of vineyards is documented by about 3,000 BC. The ancient ruler of Babylon, Hammurabi, commented on

the purchase and sale of wine in rules set down in 2,000 BC. Followers of the Greek god of wine, Dionysus, taught the cultivation of vines and frolic in 1,500 BC. The unfortunate combination of lead and wine may have helped hasten the end of the Roman Empire where wine was stored and served in lead containing vessels. Being slightly sweet, lead was even added to the wine. The use of alcoholic beverages is shaped by the technology of the era and various attempts by society to regulate its consumption. But despite our great familiarity with the use of alcohol, it was not until the early 1970s that we realized that alcohol consumption during pregnancy severely affected the developing infant with no apparent harm to the mother.



Whiskey – Water of life (Gaelic uisge beatha) – Alcohol was once thought to be a cure for many illnesses, including the common cold.

The word alcohol comes from the Arabic, *al-kuhul*, originally referring to a white powder of antimony used as eye makeup. Alchemists of the 16<sup>th</sup> century began referring to alcohol as the essence from distillation, thus the essences of wine. It was not until the middle of the 18th century that alcohol took on its current meaning of the fermented and intoxicating ingredient found in many common beverages.

Alcohols are a large class of chemical compounds characterized by an OH (oxygen and hydrogen) group attached to a carbon atom. The simplest alcohol is methanol or wood alcohol (CH<sub>3</sub>-OH). Methanol is highly toxic and an undesirable contaminant of some homemade alcoholic beverages. Ethyl alcohol, the intoxicating form of alcohol, a product of fermentation and found in many beverages, is CH<sub>3</sub>-CH<sub>2</sub>-OH.

Fermentation – Sugar ferments to Alcohol and Carbon dioxide



The accidental fermentation of grain probably produced the first beer. Fermentation occurs when microorganisms such as yeast, fungi, or bacteria break down complex molecules to produce energy in the absence of oxygen. Most often, fermentation produces unpleasant acids, but fermentation can produce useful products such as yogurt, cheese, sauerkraut, and black tea. During fermentation, certain strains of yeast produce ethyl alcohol and carbon dioxide in their quest for energy from available sugars. Below is a list of common fermentation starting points and the end products either as a direct result of fermentation or from further distillation.

- Cereal grains → Beers and whiskeys
- Honey → Mead
- Grapes → Wine and brandy
- Root vegetables → Vodka
- Sugar cane → Rum

Beer fact – The dark porter beers were first developed in London, England in 1722 to nourish potters and heavy laborers. An Irish brewer named Guinness refined this process in the late 1700's to produce a beer that still bears his name.

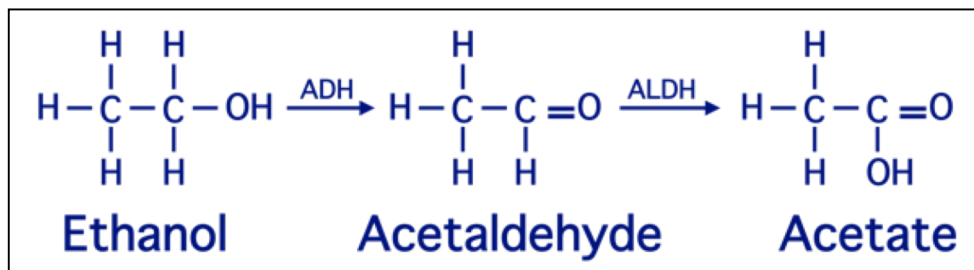
## Biological Properties

Alcohol is an excellent and widely used solvent, appearing in many products from gasoline to drugs and of course common alcoholic beverages. Industrially, it is produced by chemical reactions using acetaldehyde or petroleum byproducts and more recently from biomass, such as corn or sugar cane. In the United States, the annual corn ethanol production for use in fuel has grown from 175 million gallons in 1980 to nearly 9.3 billion gallons in 2008. World wide production is estimated at over 16 billion gallons and is expected to continue to grow. Approximately 25% of U.S. corn croplands are used for ethanol production. According to the U.S. Department of Energy in 2018, out of 14.62 billions of bushels of corn produced, 5.60 billions of bushels were used to produce corn based ethanol. The use of food based products for ethanol fuel production is contributing to increased food costs world wide.

Alcohol is readily absorbed from the stomach and the intestine. Elapsed time from the last drink of alcohol to the highest blood level is about 30 minutes. As direct experience will bear out, alcohol absorption is slowed by the presence of food in the stomach; however, once it reaches the small intestine, alcohol absorption is rapid. Alcohol vapors can be inhaled and absorbed by the lungs and can be a significant industrial hazard were alcohols are used in commercially.

After consumption and absorption, the majority of alcohol distributes into body water, and like most solvent and anesthetics some distributes into fat. It is excreted in the urine and breath, hence the utility of the taking breath samples to evaluate alcohol exposure. Your breath alcohol level is directly related to your blood alcohol level. The majority of alcohol in your body is metabolized in the liver. An enzyme, alcohol dehydrogenase (ADH), metabolizes alcohol to acetaldehyde. Acetaldehyde is toxic, with elevated levels causing flushing, headache, nausea, and vomiting. Acetaldehyde is in turn quickly metabolized to the less toxic metabolite acetate by another enzyme acetaldehyde dehydrogenase (ALDH) (Figure 3.1).

Figure 3.1 Metabolism of Alcohol



Humans have varying amounts and types of ALDH which affects their ability to metabolize the toxic metabolite acetaldehyde. For example, of approximately 50% of people of Asian heritage have a single base change in a gene that encodes for ALDH resulting in an inactive form of ALDH, which, which makes alcohol consumption very unpleasant. Antabuse (disulfiram), a common drug prescribed to discourage alcohol consumption, blocks ALDH causing blood levels of acetaldehyde to rise and the subsequent toxic side effects discourage continued alcohol consumption. Disulfiram was a chemical originally used in the rubber industry. Workers inadvertently exposed to disulfiram accidentally discovered its effects when they became sick after drinking alcoholic beverages.

The metabolism of most drugs or chemicals is proportional to the concentration of the compound in the blood. This allows us to calculate the rate of metabolism or a half-life. However, ethanol is different; its metabolism is relatively constant over time and the rate of metabolism does not increase with rising blood concentrations. We also know that metabolism is proportional to body weight; thus, the bigger you are, the higher the rate of metabolism, but on average, ethanol is metabolized at a rate of 120 mg/kg per hour or about 1 oz (30 ml) in 3 hours.

Ethanol is easily measured in the blood and reported as milligrams per milliliter (mg/ml) of blood. Current laws regulating driving after drinking specify specific blood alcohol concentration (BAC) as unacceptable when operating a motor vehicle. Most states set limit of 0.08 or 0.1, which is equivalent to 80 mg/100 ml or 80 milligrams per deciliter (mg/dL) of blood. Alcohol content of exhaled breath is about 0.05% of the BAC.

Another factor that influences blood alcohol concentrations and thus the effects of alcohol is gender. Drink for drink, a female will have a higher BAC than a male. First, women tend to be smaller, so by body weight they receive a higher dose of alcohol. Second, women metabolize less alcohol in the intestine than men, which results in great absorption of alcohol and a higher BAC. Finally, women usually have a greater proportion of body fat per body weight, which results in lower volume of fluid by weight. An average male of medium weight (160-180 pounds) must consume almost four drinks in an hour to reach a BAC of 0.08, whereas an average female weighing 130 to 140 pounds requires on only 3 drinks within one hour to reach a BAC of 0.08. The exact number of drinks to reach a BAC of 0.08 of course depends on many variables not the least of which the percent alcohol in the drink.

How alcohol effects the central nervous system is still not completely clear. For some time, researchers thought that the depressant affects of alcohol, like other anesthetic agents, was caused by dissolving the cells lipid membranes and disrupting the function of various proteins. More recently, researches have focused on specific receptors such as

glutamate (excitatory) and GABA (inhibitory). Despite intensive research, the mechanism by which alcohol effects the developing fetus is still unknown.

## **Health Effects**

By any measure, alcohol has an enormous impact on our society: it contributes to at least 100,000 premature deaths with economic costs estimated to be over \$275 billion a year, including medical expenses, lost worker productivity, automobile accidents, crime, and other costs. The toxic effects of alcohol have resulted in efforts and laws to control and regulate its consumption. While alcohol affects the individual consumer, two areas are of particular concern for the greater society: 1) the effects of alcohol on the developing infant from maternal alcohol consumption and 2) the death and injury caused by driving motor vehicles following drinking. This section is divided into the health effects of alcohol on children and adults to emphasize the sensitivity of fetal exposure to alcohol during pregnancy.

Before starting, it is necessary to define what a drink means. This is not as straightforward as it might seem given the wide range of beverages that contain varying concentrations of alcohol. One common definition of a drink is a beverage that contains 0.5 oz or 15 ml of ethanol.

**A drink is defined as - 0.5 oz (15 ml) of ethanol.**

One 12-oz (360 ml) bottle of beer

One 5-oz (150 ml) glass of wine

1.5 oz (45 ml) of 80-proof distilled spirits

Because the percent ethanol in a beverage varies, the volume to achieve 0.5 oz of ethanol also varies. For example, wine can range from approximately 8 to 15 % ethanol.

## Children

Despite alcohol's long history of use, the association of adverse effects of maternal alcohol consumption on the developing fetus was only first described in 1968 by French researchers at the University of Nantes. In 1972, the cluster of effects was further described and named Fetal Alcohol Syndrome (FAS) by researchers at the University of Washington, Seattle, WA, U.S. FAS is characterized by physical and facial abnormalities (Figure 3.2), slow growth,

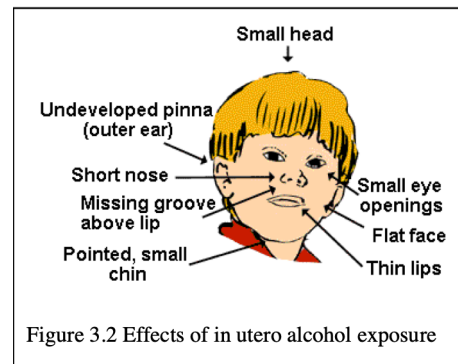


Figure 3.2 Effects of in utero alcohol exposure

central nervous system dysfunction, and other disabilities. The related brain damage can be severe, leaving the child with serious learning and functional disabilities that have life long impacts. Another form of alcohol related effects is Fetal Alcohol Effect (FAE) which designates children born with learning or memory disabilities, but without the characteristic physical abnormalities. The disabilities associated with fetal alcohol exposure are not described as Fetal Alcohol Spectrum Disorder (FASD) which recognizes the range of effects alcohol has on development. In addition, alcohol consumption during pregnancy also causes an increase in stillbirths and spontaneous abortions. It is extremely important to recognize that Alcohol consumption during pregnancy results in the largest number of preventable mental disabilities in the world.

In 1981, the US Surgeon General first advised that women should not drink alcoholic beverages during pregnancy because of the risks to the infant. In 1989 warning labels were mandated on all alcoholic beverages sold in the United States, and since 1990 the US government policy has clearly stated that women who are pregnant or planning to become pregnant should not drink alcohol.

It is difficult to determine exactly how many young children and subsequent adults are handicapped by fetal exposure to alcohol because the diagnosis of less severe forms of the disease is imprecise. Worldwide, alcohol consumption affects between 1 and 3 out of 1,000 infants. In the United States, 4,000 to 12,000 infants per year are born with FAS and as many as three times with minor disabilities. Recent studies in the United States estimate that from 14 to 22.5 percent of women report drinking some alcohol during pregnancy. An additional concern is that a woman is often not aware they are pregnant during the first few very vulnerable weeks of pregnancy.

The consequences of maternal alcohol consumption are tragic and last a lifetime for the exposed infant. In 1989, Michael Dorris described the life of his adopted son Able, who had FAS, as that of a drowning man, one "conceived in an ethanol bath" unable to find the shore.



## Adults

Alcohol, a toxic solvent, flows freely in our society. Because it is heavily advertised, easy to make, easier to purchase, widely consumed across all ages because of its neuroactive properties, we struggle to address adverse health consequences of consumption. In the United States the legal drinking age is 21 years, but illicit consumption of alcoholic beverages often starts much earlier. This has not always been the law when I grew up the drinking age was 18 years old. In Europe and other parts of the world the legal drinking age is generally 18 and sometimes 16 years of age.

The main acute effect is inebriation, which in turn spawns violence, spousal and child abuse, crime, motor vehicle accidents, workplace and home accidents, drowning, suicide, and accidental death.

The acute effects of alcohol consumption are associated with mild nervous system effects such as relaxation and reduced inhibitions that many people find desirable. Additional consumption results in sleepiness and reduced motor and reaction time, which effects in the ability to operate a motor vehicle or engage in complex tasks. Continued consumption can result in drunkenness, which is often associated with uncontrolled mood swings and emotional responses and sometimes violence. Excessive alcohol consumption can result in violence, spousal and child abuse, crime, motor vehicle accidents, workplace and home accidents, drowning, suicide, and accidental death. Rapid consumption of large quantities of alcohol sometimes seen on college campuses can result in respiratory depression, coma, and possibly death due to depressed respiration. Vasodilation also occurs especially in vessels near the skin, which gives the drinker false feeling of warmth. Contrary to popular belief, sexual function is decreased for both men and women after alcohol consumption.

The chronic effects of alcohol consumption include alcoholism, liver disease, various cancers, brain disorders, cardiovascular disease, absence from or loss of work, family dysfunction, and malnutrition. Chronic consumption of alcohol can result in a tolerance to its overt effects, but it still affects functional ability, such as that required to drive a vehicle. Tolerance can develop to such an extent that an individual can have very high alcohol levels (300 to 400 mg/dl) and still not appear to be physically affected. However, the ability to tolerate high blood alcohol levels does not change the level necessary to produce death from acute consumption.

### Alcohol Withdrawal Effects

- Tremor
- Nausea
- Irritability
- Agitation
- Tachycardia
- Hypertension
- Seizers
- Hallucinations

Chronic excessive consumption of alcohol can result in physiological dependence or alcoholism. There is often a steady progress in the need to consume alcohol, so that the person starts drinking early in the day to maintain blood alcohol levels and avoid withdrawal effects. Alcoholism often results in a variety of organ system effects, some of which are related to accompanying malnutrition. Treatment for alcoholism must address the withdrawal effects as well as associated vitamin deficiencies associated with any malnutrition.

Alcohol affects a number of organs, but the liver is most commonly affected. Initially there is accumulation of fat in the liver. Cellular damage appears to be associated with increased levels of acetaldehyde. This in turn results in a scarring or hardening of the liver called cirrhosis. All these changes to the liver result in decreased ability to metabolize alcohol as well other drugs or will even enhance the toxicity of some drugs, such as the pain reliever Tylenol (acetaminophen).

The International Agency for Research on Cancer (IARC) classifies “alcoholic beverages are *carcinogenic to humans* (Group 1) and concluded that the occurrence of malignant tumors of the oral cavity, pharynx, larynx, esophagus, liver, colorectum, and female breast is causally related to alcohol consumption”.

. Alcohol is also associated with a general increase in cancer of other organs and interacts synergistically with smoking, putting smokers who drink at a greater risk for developing cancer. There is increasing evidence that alcohol consumption by women increases the risk for breast cancer.

## **Reducing Exposure**

Reducing exposure is easy in concept but is usually more difficult in practice. Most importantly, women who are planning on becoming pregnant or are pregnant should not consume alcohol. Men need to support and encourage no alcohol consumption during pregnancy. For many who consume alcohol, it is important to learn how to manage exposure. Food consumption slows alcohol absorption, so eat when drinking and do not to consume alcohol on an empty stomach. There is a great amount of variability in the percent of alcohol in drinks. It is a good practice to consume fewer drinks that have high alcohol content.

## **Regulatory Standards**

Advice or regulation related to alcohol consumption during pregnancy was slow to arrive even after the fetal works were well documented and more still needs to done to discourage alcohol consumption during pregnancy.

- 1981 - U.S. Surgeon General first advised that women should not drink alcoholic beverages during pregnancy.

- 1988 - U.S. requires warning labels on all alcoholic beverages sold in the United States.
- 1990 - U.S. Dietary Guidelines state that women who are pregnant or planning to become pregnant should not drink alcohol.
- 1998 - 19 states require the posting of alcohol health warning signs where alcoholic beverages are sold.

## **Recommendation and Conclusions**

Alcohol is readily available a toxic chemical that can yield pleasurable experience or disastrous effects that can cause enormous suffering. The most tragic effects occur when a woman consumes alcohol during pregnancy, producing irreversible harm to the developing fetus. The consumption of alcohol during pregnancy is the single greatest cause of preventable birth defects, and learning and performance disabilities. Alcohol is associated with motor vehicle accidents and a range of other detrimental effects. While government regulatory agencies and policy responses have worked to reduce the adverse health and societal effects, over \$1 billion is spent every year advertising the consumption of this chemical. In conclusion, consume with caution and beware of your individual sensitivity.

## **More Information and References**

### **Slide presentation and online material**

A Small Dose of Alcohol slide presentation material and references are online:

### **European, Asian, and international Agencies**

- England – Department of Health (DOH). Alcohol and drug misuse prevention and treatment guidance. Online: <  
<https://www.gov.uk/government/collections/alcohol-and-drug-misuse-prevention-and-treatment-guidance>> (accessed: 03 March 2020).  
The DOH England provides extensive information on the health alcohol and drug misuse prevention and treatment guidance effects of alcohol
- International Council on Alcohol and Addictions (ICAA). Online:  
<<http://www.icaa.ch/>> (accessed: 03 March 2020). Lausanne, Switzerland  
“ICAA is dedicated to preventing and reducing the harmful use and effects of alcohol, tobacco, other drugs and addictive behaviours on individuals, families, communities and society.”

## **North American Agencies**

- Health Canada – Fetal Alcohol Spectrum Disorder (FASD). Online: <<https://www.canada.ca/en/public-health/services/diseases/fetal-alcohol-spectrum-disorder.html>> (accessed: 04 March 2020).  
About FASD, its cause, signs and symptoms, health effects, prevention, support and information for professionals.
- U.S. Centers for Disease Control's "Fetal Alcohol Syndrome Disorders". Online: < <https://www.cdc.gov/ncbddd/fasd/>> (accessed: 04 March 2020).
- U.S. The Bureau of Alcohol, Tobacco, Firearms and Explosive (ATF), Department of Justice. Online: <<http://www.atf.gov/>> (accessed: 04 March 2020).  
ATF's unique responsibilities include protecting the public and reducing violent crime and enforce the Federal laws and regulations relating to alcohol and tobacco diversion, firearms, explosives, and arson.
- U.S. National Institute on Alcohol Abuse and Alcoholism (NIAAA). Online: <http://www.niaaa.nih.gov> (accessed: 04 March 2020).  
“The NIAAA supports and conducts biomedical and behavioral research on the causes, consequences, treatment, and prevention of alcoholism and alcohol-related problems.”
- U.S. National Institute of Health – National Institute on Drug Abuse – Alcohol. Online: <https://www.drugabuse.gov/drugs-abuse/alcohol> (accessed: 04 March 2020).  
The NIDA has extensive information on a range of drugs including alcohol.

## **Non-Government Organizations**

- Alcoholics Anonymous (AA). Online: <<http://www.aa.org/>> (accessed: 04 March 2020)  
An international organization dedicated to helping people with alcohol consumption concerns.
- Center for Science in the Public Interest (CSPI). Online: <<http://www.cspinet.org/>> (accessed: 04 March 2020).  
“CSPI is an advocate for nutrition and health, food safety, alcohol policy, and sound science.”
- Mothers Against Drunk Driving (MADD). Online: <<http://www.madd.org/>> (accessed: 04 March 2020).

“MADD's mission is to stop drunk driving, support the victims of this violent crime, and prevent underage drinking.”

- Nordic Studies on Alcohol and Drugs | SAGE Publications Ltd  
<https://uk.sagepub.com/en-gb/eur/nordic-studies-on-alcohol-and-drugs/journal202614> (accessed: 03 March 2020).  
Nordic Studies on Alcohol and Drugs is a fully peer-reviewed, open access journal for social science research on alcohol and drugs.
- Rutgers, The State University of New Jersey Center of Alcohol & Substance Use Studies. Online: <http://alcoholstudies.rutgers.edu> (accessed: 04 March 2020).  
The Center of Alcohol & Substance Use Studies (CAS) is a multidisciplinary institute dedicated to addiction research, education and training. We are a center in the Graduate School of Applied and Professional Psychology (GSAPP).
- National Organization on Fetal Alcohol Syndrome. Online: <http://www.nofas.org/> (accessed: 04 March 2020).  
“NOFAS works to prevent prenatal exposure to alcohol, drugs, and other substances known to harm fetal development by raising awareness and supporting women before and during their pregnancy, and supports individuals, families, and communities living with Fetal Alcohol Spectrum Disorders (FASDs) and other preventable intellectual/developmental disabilities.”
- Alcohol and Drug History Society (ADHS). Online: <https://alcoholanddrughistorysociety.org> (accessed: 04 March 2020).  
ADHS mission is to promote scholarship and discussions about the history of alcohol and drug use, abuse, production, trade and regulation across time and space.
- Fetal alcohol syndrome - Symptoms and causes - Mayo Clinic. <https://www.mayoclinic.org/diseases-conditions/fetal-alcohol-syndrome/symptoms-causes/syc-20352901> (accessed: 03 March 2020).  
Provides detailed description of FAS. States: “There is no amount of alcohol that's known to be safe to consume during pregnancy. If you drink during pregnancy, you place your baby at risk of fetal alcohol syndrome.”

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Astley, S.J. (2004). Diagnostic Guide for Fetal Alcohol Spectrum Disorders: The 4-Digit Diagnostic Code. Seattle: University of Washington. PDF available at FAS Diagnostic and Prevention Network. Ranks the four key features of FASD on a Likert scale of one to

four. Available: <https://depts.washington.edu/fasdpn/pdfs/guide2004.pdf> > (accessed: 05 March 2020).

Fetal Alcohol Syndrome – Diagnosis, Epidemiology, Prevention, and Treatment. Kathleen Stratton, Cynthia Howe, and Frederick C. Battaglia, Editors; Committee to Study Fetal Alcohol Syndrome, Institute of Medicine, Washington, DC. 1996. The National Academy Press. Online: <[http://www.nap.edu/catalog.php?record\\_id=4991](http://www.nap.edu/catalog.php?record_id=4991)> (accessed: 05 March 2020).

WHO Global Status Report on Alcohol 2018. World Health Organization, Released September 21, 2018. Online: <<https://communitymedicine4asses.com/2018/09/22/global-status-report-on-alcohol-and-health-2018/>> (accessed: 05 March 2020).

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Riley, E.P., Infantem M.A. and Warren, K.R. (2011) Fetal Alcohol Spectrum Disorders: An Overview Neuropsychology Review volume 21, Article number: 73 (2011).

Cook, JL, Green, CR, CM Lilley, SM Anderson etal... (2016) Fetal alcohol spectrum disorder: a guideline for diagnosis across the lifespan. Canadian Medical Association CMAJ February 16, 2016 188 (3) 191-197; DOI: <https://doi.org/10.1503/cmaj.141593> Online: < <https://www.cmaj.ca/content/188/3/191.short>> (accessed; 05 March 2020).