CEU Quiz

Alcohol

Drink to your health?

Alcohol is a unique energy-supplying substance linked with several aspects of human life. It is consumed for social, spiritual, emotional, psychological and physiological reasons. It is suggested that in the United States alcohol actually accounts for 6-10% of total energy intake. According to the National Clearinghouse for Alcohol and Drug Information 51% of people over 12 years of age consumed alcohol in the last 30 days. The spectrum of alcohol consumption covers a broad range, from those who completely abstain from its use to those who become physiologically dependent alcoholics. But for most Americans alcohol is a social product used to relax or celebrate, or as a pleasant accompaniment to a meal. So what actually is alcohol and what role does it play in health, if any?

If you were to ask a chemist, alcohol would be defined as a class of chemical compounds ending in "– ol" such as ethanol, methanol and iso-propanol. Alcohols have a dramatic affect on living organisms because they act as lipid (fat) solvents. Alcohol easily penetrates a cell's outer lipid membrane and can rapidly denature proteins to the extent of actually destroying the cell, as seen in the effects common antiseptics and disinfectants have on bacterial cells. The alcohol found in beverages such as beer, liquor and wine is ethanol. It is less toxic than other alcohols with the key word being less. In most cases of human consumption the alcohol is significantly diluted and its actions reduced, often causing a pleasant euphoria for the consumer. When ethanol is consumed in high concentration, its effects can be deadly. So with regards to the use of alcohol in the body for a positive outcome, the amount consumed will play a major role on the impact it will have.

Before identifying any positive role alcohol may have on the body it is important to analyze any negative outcomes of alcohol consumption to determine if the negatives actually outweigh the positives. For the purposes of this review the consumption quantity will be consistent with what is accepted as moderate consumption; 6-15 drinks per week (=1-2 per day).

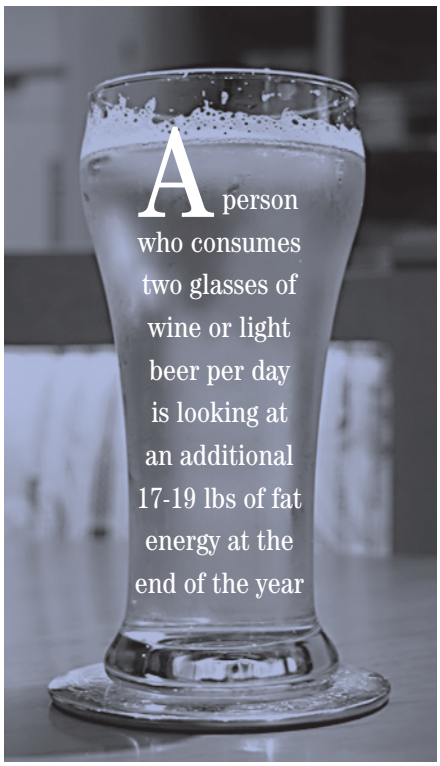
The first possible consequence of alcohol consumption is the added calories to the diet. Due to the fact that alcohol has the second highest energy yield of calorie containing substances at seven (7) calories, it would make sense that monitoring this intake would be prudent for the purposes of weight management. Many critics of alcohol suggest that consuming alcoholic beverages contributes to obesity. They are probably correct in some cases. Alcohol has the potential to increase adiposity in several ways. The first way it can add unwanted weight is simply by contributing to a positive caloric balance. Alcohol containing drinks are often very high in calories. A mixed drink with soda or orange juice is often between 200-400 calories depending on size and mixer. A regular beer is 150-200 calories per 12 ounces and light beer reaches 100 calories per serving. Even with the added marketing, the low-carb, light beers are around 95 calories a piece. The reality is that light beer was low in carbs before the commercials. Other alcoholic beverage manufacturers have hopped on this marketing ploy including those that produce vodka and rum, but almost all the calories come from alcohol, so the low-carb means little to nothing with regards to calories. Wine is a bit more reasonable at 80-100 calories per four (4) ounces, but much higher in caloric content when compared ounce to ounce with beer. A person who consumes one glass (4 oz) of wine per day will have little concern with weight gain. But when alcohol is consumed at the normal two-three servings, the calories can really add up.

If a person consumes two drinks per day at the end of the week the calorie tilt may lean to the positive side if physical activity does not counter balance the shift.

Daily Consumption	Total Calories
1-2 glasses of wine	= 595 – 1190 extra calories/wk
1-2 light beers	= 665 – 1330 extra calories/wk
1-2 regular beers	= 1050 – 2100 extra calories/wk
1-2 wine coolers	= 1183 – 2366 extra calories/wk
1-2 servings liquor	= 1225 – 2450 extra calories/wk
1-2 mixed drinks w/soda	= 1379 – 2758 extra calories/wk

A person who consumes two glasses of wine or light beer per day is looking at an additional 17-19 lbs of fat energy at the end of the year (fat energy calculated by dividing total calories consumed by the 3500 calories in a pound of fat). This is one reason alcohol in moderation makes more sense. This is particularly true with weekend binge drinkers. Many people feel if they abstain from alcohol all week they have earned the right to consume all their dietary alcohol in a two or three day period. This thought process may lend itself to a social life but has negative consequences with regards to metabolism.

Calories aside, alcohol can contribute directly to fat gain because the body metabolizes alcohol preferentially to fat. Presented with both energy-yielding substances, the body will store the comparatively harmless fat and rid itself of the toxic alcohol by burning it off as fuel. Alcohol related studies suggest that alcohol consumption increases risk of central adiposity, hence the "beer belly". Since alcohol is burned as a fuel and released in small amounts through the skin and respiration the net caloric contribution is often equated to each gram of alcohol having the physiological impact of .5 grams of fat. Simplified, for every 100 calories of alcohol consumed 50 calories of potential fat storage exists. This fact is compounded by the foods that often accompany alcoholic beverage consumption. High in fat and salt, nuts and chips often represent finger food when drinking, and most bar menus are loaded with additional calories, often very high in fat. These calories will be preferentially stored as the body tries to burn off the alcohol. This is not to suggest avoiding food when consuming alcohol, but rather lends itself to better food decision making when drinking alcoholic beverages. The irony is the alcohol often reduces our natural inhibitions and tends to lead us to the wrong decision.



The liver works very hard to metabolize the alcohol to get back to normal metabolic homeostasis. The liver is armed with two weapons that deal with alcohol metabolism. The main weapon is the enzyme alcohol dehydrogenase (ADH), which accounts for 80% of the metabolic activity. The secondary weapon comes in the form of additional enzymes known as the MEOS which handle up to 10% of the metabolic function. This accounts for only 90%, the other 10% is excreted through the breath and perspiration. The alcohol in the breath is directly proportional to the alcohol in the blood. This is how breathalyzers work to identify levels of intoxication in field sobriety tests. The processing speed of alcohol is dependent upon the ADH concentrations in the liver. Some ADH exists in the stomach but at far less concentrations than found in the liver. Women produce less ADH than men relative to body size so they absorb nearly 1/3 more alcohol than men.

ADH goes to work at a diligent pace, metabolizing approximately one drink every 60-90 minutes, depending on the amount of alcohol in the drink, food in the stomach at the time, and on physical size and consumption experience of the individual. As a person continues to consume alcohol at a pace faster than the body can metabolize it, the extra alcohol has to wait in circulation. It circulates in the blood contributing to elevations in blood alcohol content (BAC).

The liver works very hard to contend with alcohol to the point that it alters normal metabolic function. Alcohol metabolism interferes with the distribution of nutrients and oxygen to the liver, in particular speeding up the synthesis of fatty acids producing excess fat in the liver. When this occurs routinely it is the first stage of liver deterioration (fatty liver). The presence of alcohol also alters amino acid synthesis. This can impede upon the formation of proteins important for the immune system. This is particularly detrimental to recovery from physical activity. Additionally, the body experiences increased uric acid as alcohol contributes to the build up of acid in the body.

Routine drinking above that considered moderate will dramatically affect the body's ability to utilize nutrients. Alcohol has significant effects on the absorption of essential nutrients, in particular, Vitamin B1 (Thiamin) and Folate. Thiamin is used in the formation of energy from carbohydrates and therefore can affect cells of the nervous system which rely solely on glycolysis for energy. Furthermore, thiamin is needed for the synthesis of acetylcholine which is the neurotransmitter used in cognitive processes in the brain, such as with memory, and the chemical messenger from motor nerves to muscles to stimulate contraction. Since alcohol inhibits the absorption and storage of thiamin, alcoholics often suffer from thiamin-deficiency; a disease called Beriberi. Symptoms can include confusion, blurred vision, and impairments of both heart and skeletal muscles.

Alcohol increases excretion of folate, lowering levels in the blood and liver. The alcohol-induced reduction in this essential vitamin has been linked to increased levels of homocystine in alcoholics, a byproduct of the amino acid methionine which is highly reactive and contributes to

vascular oxidative stress, endothelial dysfunction and is a significant risk factor for cardiovascular disease and many cancers. Folate is essential is the methylation of homocystine back to methionine. Moreover, folate plays a critical role in DNA, RNA, and protein synthesis and therefore is important during times of rapid growth and metabolism (e.g. pregnancy, lactation, and exercise). Indeed, folate deficiency in pregnant women is associated with a greater-risk of low birth weight and a premature infant. It also increases the risk of spina-bifida and neural tube defects.

Furthermore, memory is a process by which we synthesize new synaptic connections in specific regions of our cerebral cortex via protein synthesis. The possibility exists that alcohol's reduction in folate may be associated with inefficient protein synthesis during memory formation since translation of RNA is needed to code amino acids in specific sequences to form new synaptic connections that we can recall when consciously selected (e.g. trying to remember events that happened the night before, or the order of those events, etc.). Memory loss and fetal alcohol syndrome are just some examples of how alcohol can inhibit the synthesis of nascent proteins and therefore may seriously affect the formation of both contractile and enzymatic proteins in response to exercise training. In addition, liver cells become less efficient at vitamin D activation and experience a reduced capacity to process vitamin A, at the same time the kidneys excrete important minerals including magnesium, calcium, potassium and zinc which can lead to acute deficiencies.

While the liver metabolizes the alcohol, the circulating alcohol in the blood bombards the brain. In fact the alcohol reaches the brain rapidly upon consumption. Brain cells are particularly sensitive to alcohol and actually shrink upon exposure, with the actual response being dose specific. The alcohol has many effects on the brain's function. One key function that is inhibited is the production of anti-diuretic hormone. The loss of this hormone increases urine production which consequentially leads to dehydration. The fluid loss also takes valuable minerals including magnesium, potassium, calcium, and zinc, often decimating the body's reserves of these minerals. These minerals are essential to fluid balance and muscle coordination.

The last negative factor under this review is the effect the alcohol has on the body when all the previously mentioned factors run their course. Most people know this phenomenon as a hangover. The headache, nausea, and general feeling of discomfort are caused by several contributing factors. One component of the hangover is from the toxins released from the congeners. Congeners are compounds that accompany the alcohol when distilled or are added for taste or preservation. Different alcoholic beverages have different congeners which is why a person may experience different levels of a hangover with the same quantity of alcohol consumption.

The second key factor to a hangover is dehydration of the brain. Headaches are often caused by the impact of brain cell re-hydration on nerve cells from the swelling back to normal size. Additionally, the hangover symptoms are further fueled by formaldehyde which is formed from methanol (an alcohol) as part of a normal function in the body. The formaldehyde is then converted to carbon dioxide and water under normal conditions by the same liver enzymes that metabolize ethanol. The problem that arises is these same enzymes metabolize ethanol 20x more aggressively than formaldehyde. So the formaldehyde is ignored and builds up during bouts of alcohol consumption. The detoxification of the build up contributes to a hangover. Another problem stemming from the dehydration is the loss of blood plasma used to hydrate the brain cells. This causes the body to have difficulty moving the thickened blood through circulation. Which in turn leads to blood pressure and heart rate variations, and is one reason why exercise the next day is so difficult. A hangover can really only be cured by hydration and time.

The extent of each of these problems is dependent upon the quantity of alcohol consumed. Again one drink is very different than three or four with regards to the body's ability to manage the alcohol. These facts identify the powerful effect alcohol can have on the body and the rationale for moderation, particularly when using alcohol for health benefits.

So the question begs, with all these negative consequences, "can moderate alcohol use benefit health?" Most people have heard that one or two alcoholic beverages a day have a positive health effect. Consumption in this quantity has been credited with reduced risk in heart disease in individuals over sixty with risk factors. There have been several studies which support this claim, but there have also been long term (20 year) studies analyzing alcohol consumption and mortality from heart disease showing no beneficial relationship. Some doctors suggest that red wine is much preferred over general alcohol consumption for health benefits. Red wine has been well received for its health supporting properties to the extent that U.S. wine bottles may include on their label pre-approved statements of health benefits. But many scientists have not been completely sold on the benefits of red wine over its non-alcohol counterpart.

Grape juice has a high potassium content and may positively affect blood pressure. But when alcohol is consumed in larger amounts it raises blood pressure. So it may be more beneficial to consume grape juice than wine if you are hypertensive. Non-alcohol wine also facilitates the absorption of potassium, calcium, phosphorus, magnesium, and zinc. In the alcohol version the beneficial absorption properties may be neutralized by the increased effect alcohol

has on the excretion of these minerals from the body.

Wine has been acclaimed for its containment of phenols and phytochemicals that may act as antioxidants that serve to be cardio-protective, defending the tissue against damage from oxidative stress. This possible effect is used to explain the reduced mortality from heart disease in red wine drinking countries such as France. But alcohol itself has been linked to oxidative stress, so again the non-alcohol red wine may better serve for this purpose. Red wine has also been studied as a sleep aid. If benefits of a more restful night's sleep do exist, as it would seem from these studies, the grounds for the benefit from the consumption of wine are more alcohol related than that of any unique chemical.

It would seem that although alcohol is damaging to body cells there may be some beneficial components, particularly in wine, that may warrant using it in conjunction with healthy lifestyle habits. The article did not review the social and emotional benefits, as it is outside the scope of the paper, but there have been links of well-being tied to moderate alcohol use in socially comfortable settings. A person's decision to consume alcohol is solely based on their own discretion and therefore may, or may not be, a consideration for their personal health.