

Physiological Anthropology

Unit d) Impact of smoking, alcohol, air pollution and occupation on cardio-respiratory functions.

- **Definition of cardio-respiratory-** Pertaining to the heart and the respiratory system.

1. Smoking:

1.1 Impact of Smoking on Respiratory Functions:

A healthy respiratory system is designed to deliver oxygen for cell growth and vital functions throughout the human body. Also, protect the lungs from occasional inhalation of smoke, dust and other harmful substances. Smoking not only damages its protective mechanism but continues to assault it with harmful material daily. Passive smoking carries similar dangers.

During normal breathing, air is ingested through the nose or mouth and travels through the bronchial tubes to the lungs. There, the oxygen collects in the alveoli, or air sacs, and diffuses into the bloodstream, to be pumped by the heart to the brain and body. Cigarette smoking upsets this balanced process, to the detriment of the respiratory system. The major health problems caused by smoking affect the airways, blood vessels and lungs in the human respiratory system.

i) Effects on the Mouth, Larynx and Pharynx

Hot gases and particulate inhaled during cigarette smoking contact the tissue and mucous membranes that surround the mouth, larynx (voice box) and pharynx. These areas suffer continual irritation from smoking, and smokers may develop symptoms such as hoarseness, coughing and wheezing due to inflammation. As the National Institutes of Health report, cigarette smoke contains more than 60 cancer-causing compounds.

ii) Effects on the Bronchi

Chemicals and particulate from tobacco use continue on to the bronchi, the airways that lead to the lungs. There, the smoke acts on the cilia, tiny hairs that sweep away debris to keep the airways clear. When damaged cilia can no longer function, excess mucus and foreign matter clog the bronchial space. The American Lung Association (ALA) relates that symptoms of chronic bronchitis arise to compensate for this health problem.

iii) Effects on the Lungs

The alveoli of the lungs suffer from smoking, eventually breaking down and losing their effectiveness in transferring oxygen to the blood. This is known as emphysema. Emphysema is characterized by shortness of breath and difficulty in exhaling. It further restricts exercise tolerance, making everyday activities more difficult and strenuous exercise impossible for many individuals.

iv) Effects on the Pulmonary Blood Vessels

Smoking causes atherosclerosis, or clogging of the blood vessels. When the arteries and veins between the lungs and heart are affected and high blood pressure results, the condition is called pulmonary hypertension. Studies suggest that this health problem can lead to arrhythmia, heart failure, blood clots and pulmonary embolism, all of which can be fatal.

1.2 Effect of Smoking on Cardiovascular System:

Nicotine and other substances in tobacco smoke immediately affect the cardiovascular systems of smokers and those who inhale the passive smoke. According to American Lung Association active cigarette smoking elevates the heart rate and blood pressure for up to 20 minutes after tobacco use. Similar effects occur when smoke is inhaled passively. Various health problems occur due to smoking:

i) Atherosclerosis-

Smoking increases blood cholesterol levels, causing a buildup of arterial plaque that narrows the blood vessels over time. Further, this reduces circulation and causes health problems in many parts of the body. Atherosclerosis is a specific type of arteriosclerosis (or hardening of arteries). Atherosclerosis refers to the buildup of fats, cholesterol and other substances in and on your artery walls (plaque), which can restrict blood flow. Also, vascular damage from smoking can also give rise to abdominal aortic aneurysm, an arterial bulge that may rupture and cause death.

ii) Blood Clots-

Smoking makes blood platelets sticky and prone to clotting. As the American Heart Association, or AHA, explains, blood clots in the narrowed vascular space can easily cause partial or total obstructions. Interrupted blood flow to the heart or brain may result in serious health problems including arrhythmias, paralysis or memory loss. Less room for blood to flow within the blood vessels that lead to the heart and brain leaves smokers more vulnerable to heart attack and stroke. Completely blocked blood flow can cause death in a matter of seconds.

iii) Low Blood Oxygen

Studies suggest that oxygen levels are compromised in smokers, who ingest carbon monoxide and other gases in cigarette smoke. These toxins displace part of the normal load of oxygen that the lungs transfer to the bloodstream. The heart then circulates them to the rest of the body. Many studies report that a heart damaged by cigarette smoking may not be able to pump more blood to get a greater volume of oxygen to the cells. A resulting condition called congestive heart failure can severely restrict tobacco users' tolerance for exercise, making physical activity difficult or raising the risk for heart attack and stroke due to exertion.

2. Alcohol

2.1 Effects of Alcohol on Cardiovascular functions:

Alcohol can be beneficial or harmful to the cardiovascular system, depending on the amount consumed and the characteristics of the consumer.

a) Effects of moderate drinking on Cardiovascular system: of the numerous cellular and molecular mechanisms that are thought to explain the beneficial effects of moderate drinking, the major four involved are:

i) High density lipoproteins-

- There are several different types of lipoproteins present in the body, of which two are known to have particular relevance to the formation of arterial plaque deposits: high density and low density lipoproteins. In the simplest terms, high levels of high density lipoproteins (HDL) and low levels of low density lipoproteins (LDL) are desirable.
- Epidemiological studies show an association between alcohol consumption and increased plasma HDL levels. The biochemical mechanisms for alcohol-induced increases in HDL levels are largely unknown, however.

ii) Cellular signaling-

- Cells in the endothelium send out chemical signals that trigger an inflammatory process in response to the formation of fatty streaks in the arteries.
- Several theories have been suggested to explain how alcohol possibly thwarts this inflammatory process and provides protection against atherogenesis.
- Another hypothesis is that LDL oxidation leads to the formation of fatty streaks prompted the speculation that antioxidants in wine may contribute protective effects. Red wine and, to a lesser extent, other alcoholic beverages contain several flavonoids and phenolic compounds with significant antioxidant properties.

iii) Stimulation of blood clot dissolution-

- Normally, a balance exists between the compounds involved in blood clot formation and dissolution (i.e., fibrinolysis).
- Plasmin, the enzyme responsible for degrading the clot component fibrin and its precursor (i.e., fibrinogen), circulates in the form of its inactive precursor (i.e., plasminogen).
- Epidemiological studies have reported a positive association between alcohol consumption and fibrinolytic activity in men and women.
- Moderate alcohol consumption decreases fasting plasma concentrations of triglycerides

b) Effects of heavy drinking on cardiovascular system: Although light-to-moderate drinking can protect against coronary artery disease, heavy alcohol consumption can damage the cardiovascular system, resulting in maladies such as cardiomyopathy, high blood pressure, and strokes.

i) Cardiomyopathy:

- “cardiomyopathy,” encompasses any chronic disorder affecting the heart muscle. Dilated cardiomyopathy is characterized by low cardiac output and enlargement of the heart (i.e., hypertrophy) and its chambers (i.e., dilatation) and eventually leads to congestive heart failure (CHF).
- A variety of factors can cause dilated cardiomyopathy, including prolonged heavy drinking (i.e., alcoholic cardiomyopathy).
- Alcoholic cardiomyopathy accounts for 20 to 50 percent of all cases of cardiomyopathy in Western countries.
- The biochemical basis of alcohol induced cardiomyopathy also involves disturbances in cardiac energy metabolism. For example, high blood concentrations of alcohol reduce the oxygen supply to the cardiac muscle and interfere with oxygen-requiring (i.e., aerobic) metabolism in the heart. This effect decreases the level of the high-energy molecules that power the contraction process (i.e., adenosine triphosphate [ATP]) as well as the level of another energy source, phosphocreatine.

ii) Hypertension

- Numerous epidemiological studies have established an association between chronic alcohol consumption and hypertension.
- This association has been observed with alcohol consumption in excess of two drinks per day and described in white, black, and Asian men and women who reported daily intake of three or more drinks.
- Several mechanisms have been advocated to explain how alcohol induces hypertension, including the following:
 - Increased activity of the sympathetic nervous system (Russ et al.1991). The sympathetic nervous system plays a major role in cardiovascular regulation by constricting blood vessels and increasing the contractile force of the heart, thus raising blood pressure.
 - Increased plasma levels of compounds involved in transmitting impulses from nerves to muscles (i.e., catecholamines). Catecholamines (e.g., adrenaline and noradrenaline) help maintain blood pressure and will cause hypertension if present in excess.

iii) Stroke

- Stroke is an acute cerebrovascular disorder that encompasses two major types: ischemic stroke, in which plaque buildup or a blood clot impairs blood flow to the brain, and hemorrhagic stroke, in which a ruptured artery interrupts blood from reaching the brain. Ischemic stroke comprises 80 percent of stroke cases, whereas hemorrhagic stroke accounts for the remaining 20 percent.
- Heavy alcohol consumption, has precipitated ischemic strokes caused by blood clots (i.e., ischemic strokes)
- Alcohol also has been associated with an increased risk of bleeding within the cerebrum (i.e., intracerebral hemorrhage) and, less frequently, within the space surrounding the entire brain and spinal cord.

2.2 Effects of Alcohol on respiratory functions:

- The most common and identifiable alcohol-associated health problems include liver cirrhosis, pancreatitis, cardiomyopathies and dementia. However, the lung also is adversely affected by alcohol abuse, a fact often overlooked by clinicians and the public.
- It is clear that heavy drinkers are more likely to have pneumonia, tuberculosis (TB) and acute respiratory distress syndrome (ARDS)

i) **Bacterial Pneumonia:** One of the most common and deadliest conditions afflicting heavy drinkers is bacterial pneumonia. According to the Centers for Disease Control and Prevention (CDC), heavy drinkers are 10 times more likely to develop pneumococcal pneumonia and 4 times more likely to die from pneumonia than non-drinkers.

ii) **Tuberculosis (TB):** Bacterial pneumonia is not the only infectious disease with an increased risk among heavy drinkers. Lung infections with *Mycobacterium tuberculosis*, the underlying pathogen of TB, also occur at higher rates in heavy drinkers.

- TB is the second-leading cause of death worldwide, accounting for 1.3 million deaths in 2012. The disease is spread from person to person through the air, when infected people cough, sneeze, speak, or sing, thereby releasing *M. tuberculosis* into the air.
- Interestingly, not everyone infected with *M. tuberculosis* becomes sick. The infection can remain latent for years while the host's immune system is able to combat it. The infected individual will have no symptoms and is not infectious to others. However, latent TB may become active when the immune system is weakened. Alcohol abuse is therefore a risk factor for active TB

iii) **Acute respiratory distress syndrome (ARDS)**

- Heavy drinkers who experience any type of lung injury—be it caused by infections with bacteria or by non-infectious events such as trauma, pancreatitis, or burns—are at high risk for developing ARDS.
- During ARDS, robust lung inflammation results in increased accumulation of fluid and inflammatory cells in the alveolar spaces. This causes impaired gas exchange in the lung, resulting in decreased oxygenation of the blood and multiple organ failure caused by the insufficient oxygen levels.
- Alcohol abuse also has been identified as an independent risk factor that increases the odds of at-risk individuals to develop ARDS.
- ARDS is two to four times more common in heavy drinkers than in non-drinkers.