

## Impact of Marijuana on the Cardiovascular System

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### **Abstract:**

The study has demonstrated the negative impact of rapid consumption of cannabis on the cardiovascular and nervous systems of individuals. The study also helps individuals to know that there are 3.8% youth population has been addicted to cannabis. Rapid consumption of marijuana definitely leads to the formation of hypertension, dizziness, and psychological issues, specifically cardiovascular problems.

**Keywords:** cannabis, cardiovascular system, THC, CB1, CB2, MAPK pathway

### **INTRODUCTION**

The cardiovascular system of human beings contains blood vessels, the heart, and blood. The fundamental function of the cardiovascular system is to transfer oxygen-loaded blood and important nutrients to each corner of the body. The cardiovascular system is also responsible to carry back the deoxygenated blood to the lungs. Hence, any kind of abnormalities in the CVD system may cause the malfunction of the other parts of the body along with serious health issues. The study will shed light on the effect of marijuana on the cardiovascular system of individuals. Marijuana can be denoted as a plant-based drug, which is made up of the leaves and buds of the plant named Cannabis. Therefore, marijuana mainly expands through the parasympathetic and sympathetic nervous systems of humans and directly causes myocardial infarction. The study is going to discuss the role of marijuana to evolve thrombosis, and inflammation in the cardiovascular system.

### **ABOUT CANNABIS**

In these recent years, there are huge changes happened regarding the usage of marijuana for medical purposes. By the year 2017, there are near about 3.8 % of the young population of the US (ages between 15 to 18 years") have noticed to use of marijuana for recreational purposes [1]. In the year 2017, the government of the United States already legalized marijuana for consumption. Cannabis is mainly known as a medicinal plant that belongs to the family Cannabaceae. The cultivation of the Cannabis plant can be observed in several parts of Central

Asia, and in recent years, other countries also showed interest to cultivate it for its medicinal benefits. There are two types of flowers that can be observed male and female, hence female plants are responsible to produce lots of seeds. The male plants of Cannabis are generally tall, whereas female cannabis plants are comparatively less tall. The leaves of cannabis plants are generally green, and elongated and after drying those leaves, people can smoke them as a form cigarette. Therefore, "cannabis" is the scientific name of this plant, however different countries have known this plant with distinct names such as "weed", "grass" or "pot". In the year, 2018, there were near about 11.8 million students from the US were reported, to smoke or consume marijuana for relaxation [2]. People from all over the world consume marijuana in several ways, including vaporizing, smoking, cooking, and mixing it with other materials.

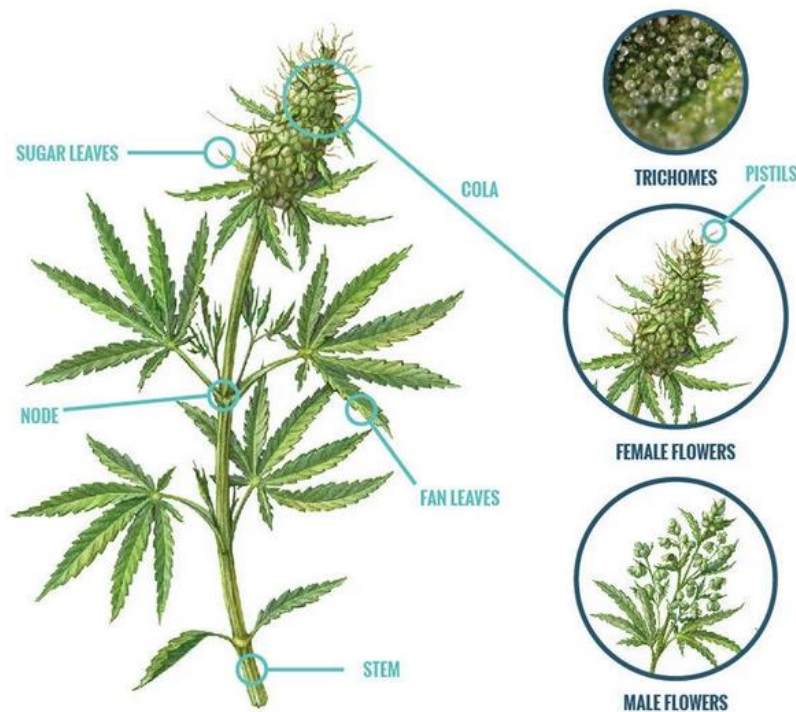


Figure 1: Cannabis plant

Source: [1]

### Psychological effects of marijuana on the autonomic nervous system

The excessive use of marijuana can impact the malfunction of the autonomic nervous system of individuals from all over the world. The autonomic nervous system is the part of peripheral nerves, that is responsible to regulate the working procedures of nervous systems. In this context, it can be observed that the autonomic nervous system also maintains blood pressure, heart rate, and digestion process. Three major parts of the autonomic nervous system are, "sympathetic", "parasympathetic" and "enteric". The widely used cannabis contains more than 400 chemical components named "Tetrahydrocannabinol" (THC) [3]. The CB1 and CB2 receptors present in

the brain react with THC and form a psychotropic effect on the central nervous system. The receptors named CB1 and CB2 are gradually activated due to the binding of the ligand named amantadine. The presence of THC components forced the CB1 receptor to bind with G protein throughout the entire brain including the medial and frontal temporal lobe.

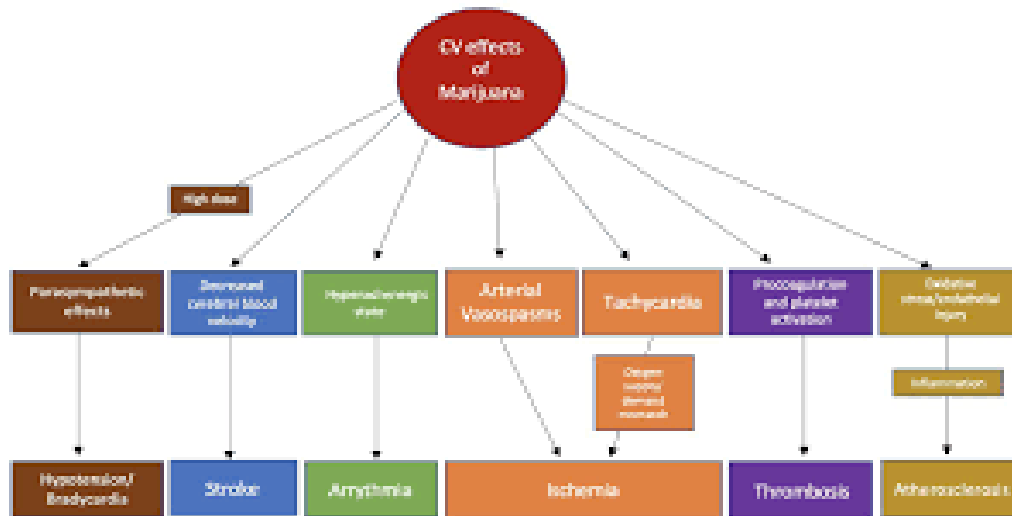


Figure 2: Effect of Marijuana

Source: [3]

In order to evaluate the impact of marijuana on the cardiovascular system, it is required to gather sufficient information on the endocannabinoid system (ECS). Two main components of endocannabinoid systems are “2-arachidonylglycero” and “endocannabinoids anandamide”. In that case, the impact of cannabis can be observed in both the sympathetic and parasympathetic nervous systems. Excessive smoking can lead to the immediate raise of supine blood pressure and 20% to 100% heart rate. After 15 min inhalation of marijuana, the heart rate enhances and stays for at least 3 hours, at that time the CB1R activates and induced tachycardia in the parasympathetic nervous system [4]. After using a high dose of marijuana for a long time, it can cause the formation of dizziness and hypotension. The reduction of cerebral blood velocity can be observed after inhalation of marijuana and orthostatic hypotension is another impact of marijuana consumption. It can be observed that marijuana also has a prolonged relationship with cardiovascular impairment.

### Impact of marijuana on myocardial oxygen demand

Excess smoking of marijuana can cause the hindrance of supplying oxygen in the myocardial portion according to the demand of an individual’s body. The enhanced rate of myocardial oxygen may lead to the formation of tachycardia and a mismatch of the regulation can be observed due to the creation of high carboxyhemoglobin in the body. As a result, transient myocardial ischemia generates after smoking marijuana for a long time. Due to the consumption

of marijuana, the enhancement of carboxyhemoglobin can be noticed and it turns into fewer activities of oxygen supply [5]. Huge cardiac output is also related to the smoking of cannabis and the increase rate is nearly about 4% to 9%. Other factors that are highly associated with marijuana inhalation are “stroke”, “ventricular ejection time”, “ejection fraction” and “diastolic volume”.

### Impact of marijuana on thrombosis

Smoking cannabis regularly can cause the activation of blood platelets; hence the chances of blood clotting generally arise. Therefore, a link can be observed between smoking cannabis and thrombosis formation. In the case of young people, it leads to the formation of acute myocardial infarction. The toxic substances present in marijuana exhibit the prolonged effects named “pro coagulation effect”. The human blood platelets contain CB1R and CB2R, which activates after the entering of THC and selected glycoprotein. The activation of the CBR1 receptor can be considered one of the fundamental causes of endothelial dysfunction [6]. The MAPK pathways are always activated by the stimulation of CB1R. As a result of the MAPK pathway, the reactive oxygen gradually releases and it leads to cell death.

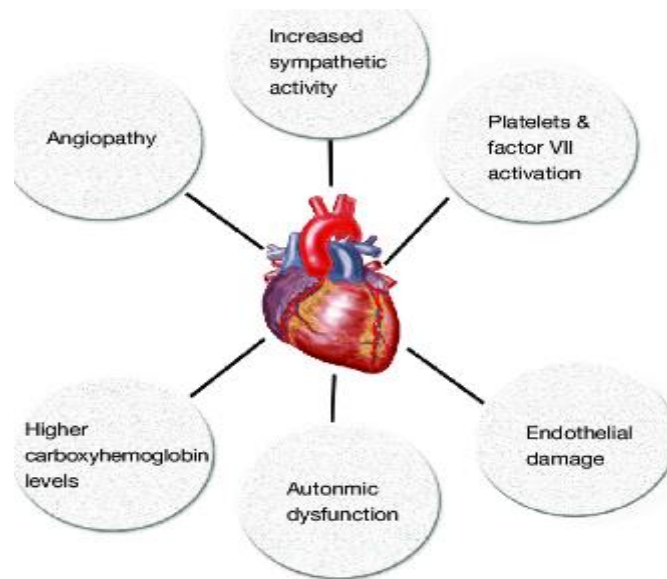


Figure 3: Impact of Marijuana  
Source: [6]

### Impact of marijuana on the inflammatory and atherosclerotic pathway

Atherosclerosis can be explained as an inflammatory disease that mainly occurs in the vascular system of a human being. In the case of the responding system, there are several pathways related to atherosclerosis, which are “NLRP3 inflammasome”, “proprotein convertase” and “toll-like receptors”. The excessive accumulation of cholesterol was the main factor that promotes the

formation of atherosclerosis after the retention of lipoproteins. Hence, the receptors present in the body always act as scavengers, and intake of LDL and infiltration can be noticed. The inflammatory pathway named “NLRP3” is always monitored by the “cytokine interleukin-1 $\beta$ ” [7]. There are lots of antigens that are associated with this mechanism and ultimately cause inflammation by generating oxidized LDL and as a result, cells may undergo the process named apoptosis. In the case of some other patients, the activation of CD4+ T cells leads to the signaling of “interleukin-1 $\beta$  (IL-1 $\beta$ )”.

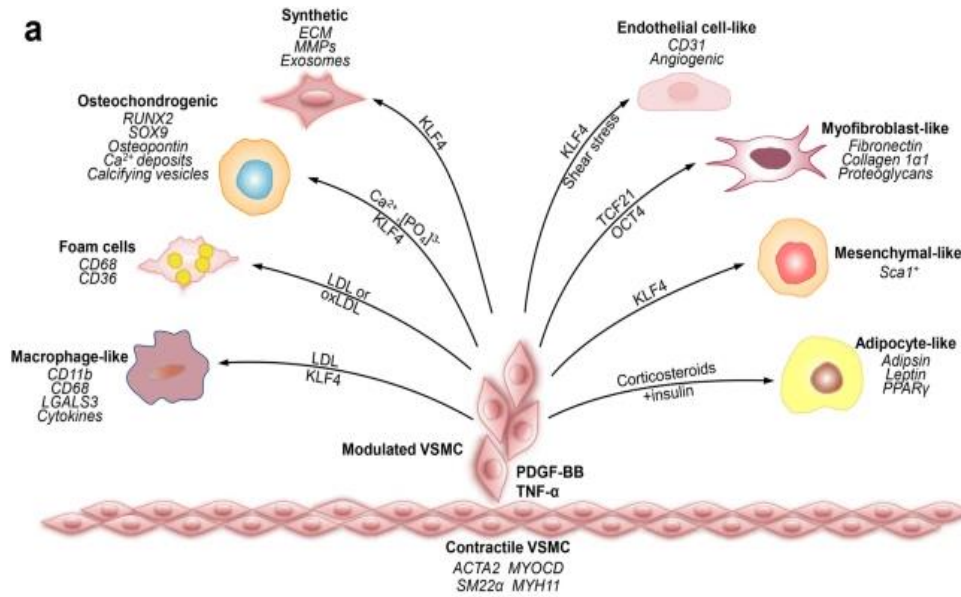


Figure 4: Atherosclerosis pathway

Source: [7]

### Impact of marijuana on vascular tissue

Smoking cannabis is the main reason for generating vasodilatory responses after the activation of some "transient receptor potential ankyrin type 1" (TRPA1). Vasoconstriction can be observed in different parts of the human body such as the cerebral, peripheral artery, and coronary systems. The effect of cannabis happens in the different vascular tissues and the mechanisms are also distinct from each other. Therefore, endocannabinoids are strongly related to myocardial blood flow. In this study, the inhibition of THC occurs in the endothelium and as a result, vasorelaxation occurs. Due to the formation of vasorelaxation, the production of THC leads to the occurrence of aortic rings [8]. This activity initiates the availability of nitric oxide hydrogen peroxide and superoxides. Hence, Cannabis is also responsible for constraining the activities of the "Voltage-gated calcium channel" through a different chemical reaction.

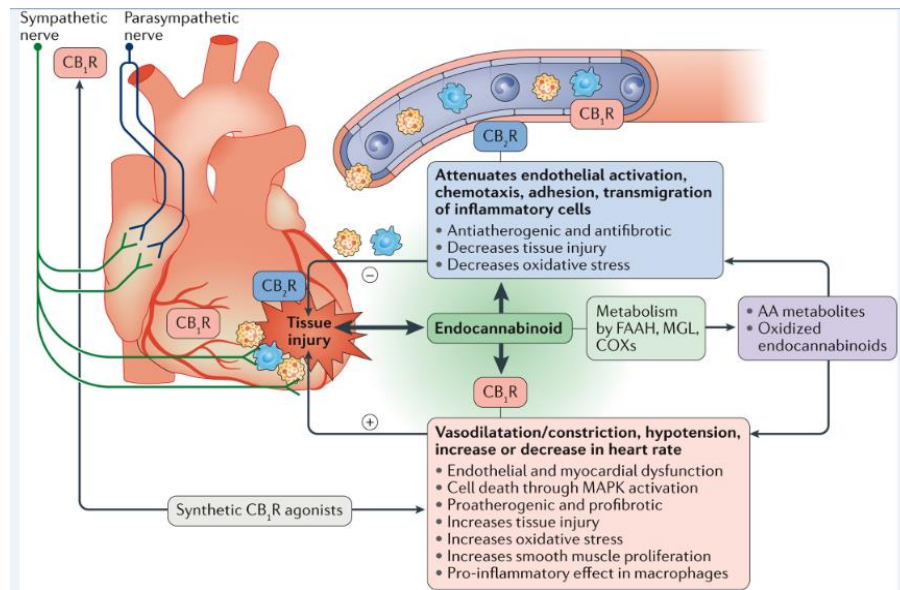


Figure 5: Effect on the cardiovascular system

Source: [8]

## PHARMACOKINETICS AND TOLERANCE

### *Pharmacokinetics*

The study depicts that, there are different methods present to consume cannabis, and the most common processes include vaporization and smoking. Therefore, the administration process can be accomplished properly if the THC concentration is high in the cannabis user's body. The metabolism observed after the consumption of cannabis, there are a total of 18 types of chemicals that can be observed. Other chemical components include “terpenes”, “amino acids”, “hydrocarbons”, “nitrogenous compounds” and “carbohydrates” [9]. After the activation of the Cytochrome P450 enzyme, The THC component reacts in the liver and metabolizes by oxidation and hydroxylation. In phase 1 of metabolism in the liver, the result of oxidation leads to the activation of a “Psychoactive compound” known as “11 hydroxy THC”. After that, the psychoactive compound further metabolite and leads to the formation of the “CYP450 2C9 enzyme”. The fundamental outcome of this metabolism is “THC-COOH” and its by-products such as “glucuronic acid conjugates”.

### *Tolerance*

The study illustrates that, after smoking or consuming marijuana for a long time, it deliberately enhances the heart rate. However, if individuals stop the usage of marijuana, they may develop a tolerance to cardiovascular effects rapidly. In that case, healthcare practitioners prefer to use oral THC to cure the effect of marijuana. After providing drugs, it can be observed that the abnormal heart rate diminished and blood pressure can be controlled by them easily. Hence, the



sympathetic activities of cannabis users become decrease, whereas the parasympathetic activities become enhanced a lot [10]. It can clearly explain the developed tolerance after the usage of cannabis on a regular basis. On the other hand, repeatedly consuming marijuana can cause the enhancement of plasma volume and it may cause the retention activities of sodium and water. The impact of marijuana can be stopped after 48 hours of ceasing the consumption of cannabis.

## DISCUSSION

The continuous usage of marijuana has long-term effects on the cardiovascular system and it has the ability to alter normal functions of the heart. After intaking THC, it leads to the formation of hypertension while sitting in some place and also cause hypotension. The duration and frequency of consuming marijuana may cause different heart rates and blood pressure for each individual [11]. Other risk factors of rapid usage of cannabis are "dizziness" and "orthostatic hypotension". Lots of physical therapists have been evaluating the modes of the severity of cannabis after observing the decreased circulatory response and the rise of blood volumes. Due to the enhancing amount of catecholamine in the body of users, a formation of heart disease can be noticed.

The CB1R and CB2R are generally responsible for induced signals with the help of Adenyl Catalase. On the other hand, the "Mitogen-activated protein kinase" pathway (MAPK) reacts with the nuclear light kappa chain and that enhances the formation of B cells. The reduction of cAMP formation happens due to the stimulation of CB1R, which activates the "Adenyl cyclase inhibitor subunit of G-proteins" [12]. This mechanism can be considered the fundamental cause of turning on the calcium channels that bind with the G protein receptors. After the coupling, both can rectify the potassium channel inhibitor. In the MAPK signaling pathway, the activation of CB1R can cause the emergence of cell proliferation with the help of some enzymes known as "c-Jun N-terminal kinase" and "extracellular signal-regulated kinase" [13]. The term "c-Jun N-terminal kinase" can be explained as a type of protein kinase that plays an essential role in signaling pathways and also causes cell death. The signal can be sent via G protein receptors and it can be observed that "β-arrestin" plays an important role after being associated with G protein in the GPCR desensitization. Therefore, it can be observed that marijuana impact negatively on the neurological situation of individuals. Due to the presence of THC, Marijuana impacts directly on the central nervous system of individuals.

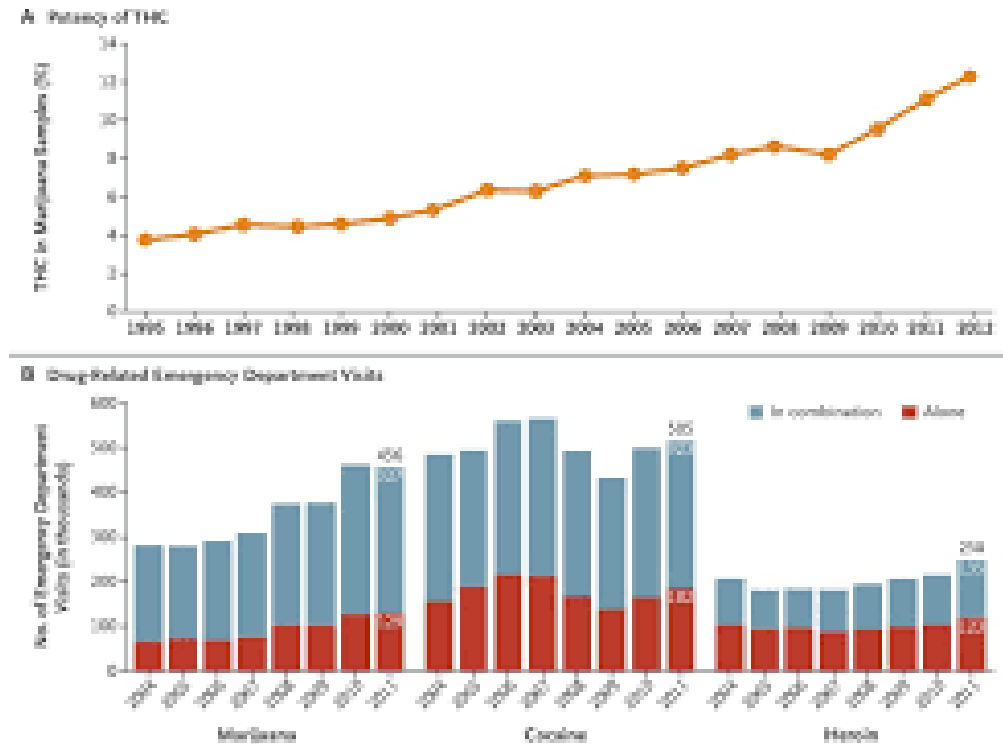


Figure 6: Health effects of marijuana

Source: [13]

## CONCLUSION

The study successfully demonstrated the negative impact of marijuana on the cardiovascular system of individuals. In the initial phase, marijuana mainly attacks the sympathetic and Parasympathetic nerves of users. The cannabis plant is a tall and shrub-like structure with male and female flowers, additionally, these plants can be easily cultivated in every part of the country. Widely used cannabis contains more than 400 chemical components named "Tetrahydrocannabinol" (THC). The component THC is mainly responsible for the activation of CB1 and CB2 receptors. Excessive consumption of cannabis leads to the formation of high blood pressure and dizziness. In this context, it can be observed that the age group between 15 years to 25 years is mostly addicted to marijuana smoking, however, an immediate impact cannot be observed in most cases. Due to the inhalation of Marijuana for a long time, chest pain and cardiac disease can be observed after the age of 40 years. In that case, men between 45 to 65 years have been showing severe heart-related issues.

## AUTHOR CONTRIBUTIONS

The study has been accomplished by gathering information from authentic sources, hence the secondary data collection method can be considered one of the best approaches to collecting



data. In this context, some information has been collected from the "IJFANS International Journal of Food and Nutritional Sciences". This website provides open access to users and individuals can gather authentic information from this journal. Therefore, "The IJFANS International Journal of Food and Nutritional Sciences" does not charge anything regarding printing or downloading information. The website is beneficial for other researchers as well, who have been searching for genuine data free of cost. The International Journal of Food and Nutritional Sciences” promised to provide the most updated information to the users; hence they are publishing scholarly content with the help of metadata.

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## CONFLICTS OF INTEREST

The assessment also includes a case study of a 48-year-old male patient from the local region. That man was suffering from serious health issues and his history depicts that, the patient has angina, 10 years ago after bypass surgery, “irregular heart rhythm” and “bleeding from that area” [14]. That patient was sent to the hospital after a cardiac arrest during smoking and others thought it was due to cigarettes. However, in the later phase, healthcare practitioners noticed that smell was like tobacco cannabis.

## Reference:

- 1. Bondarenko, A.I., 2019. Cannabinoids and cardiovascular system. *Recent Advances in Cannabinoid Physiology and Pathology*, pp.63-87.
- 2. Brown, J.D., 2020. Potential adverse drug events with tetrahydrocannabinol (THC) due to drug–drug interactions. *Journal of clinical medicine*, 9(4), p.919.
- 3. Daniela, M., Catalina, L., Ilie, O., Paula, M., Daniel-Andrei, I. and Ioana, B., 2022. Effects of Exercise Training on the Autonomic Nervous System with a Focus on Anti-Inflammatory and Antioxidants Effects. *Antioxidants*, 11(2), p.350.
- 4. Gelmi, T.J., Weinmann, W. and Pfäffli, M., 2021. Impact of smoking cannabidiol (CBD)-rich marijuana on driving ability. *Forensic sciences research*, 6(3), pp.195-207.
- 5. Ghosh, M. and Naderi, S., 2019. Cannabis and cardiovascular disease. *Current atherosclerosis reports*, 21(6), pp.1-6.

- 6. Jivanji, D., Mangosing, M., Mahoney, S.P., Castro, G., Zevallos, J. and Lozano, J., 2020. Association between marijuana use and cardiovascular disease in US Adults. *Cureus*, 12(12).
- Johnson-Sasso, C.P., Tompkins, C., Kao, D.P. and Walker, L.A., 2018. Marijuana use and short-term outcomes in patients hospitalized for acute myocardial infarction. *PLoS One*, 13(7), p.e0199705.
- 7. Kicman, A. and Toczek, M., 2020. The effects of cannabidiol, a non-intoxicating compound of cannabis, on the cardiovascular system in health and disease. *International journal of molecular sciences*, 21(18), p.6740.
- 8. Latif, Z. and Garg, N., 2020. The impact of marijuana on the cardiovascular system: a review of the most common cardiovascular events associated with marijuana use. *Journal of clinical medicine*, 9(6), p.1925.
- 9. Leshner, G., Stevens, E.M., Cohn, A.M., Kim, S., Kim, N., Wagener, T.L. and Villanti, A.C., 2021. Cognitive and affective responses to marijuana prevention and educational messaging. *Drug and alcohol dependence*, 225, p.108788.
- 10. Page, R.L., Allen, L.A., Kloner, R.A., Carriker, C.R., Martel, C., Morris, A.A., Piano, M.R., Rana, J.S. and Saucedo, J.F., 2020. Medical marijuana, recreational cannabis, and cardiovascular health: a scientific statement from the American Heart Association. *Circulation*, 142(10), pp.e131-e152.
- 11. Rabino, M., Mallia, S., Castiglioni, E., Rovina, D., Pompilio, G. and Gowran, A., 2021. The endocannabinoid system and cannabidiol: Past, present, and prospective for cardiovascular diseases. *Pharmaceuticals*, 14(9), p.936.
- 12. Stupinski, J., Bible, L., Asmar, S., Chehab, M., Douglas, M., Ditillo, M., Gries, L., Khurram, M. and Joseph, B., 2020. Impact of marijuana on venous thromboembolic events: Cannabinoids cause clots in trauma patients. *Journal of Trauma and Acute Care Surgery*, 89(1), pp.125-131.
- 13. Tawfik, G.M., Hashan, M.R., Abdelaal, A., Tieu, T.M. and Huy, N.T., 2019. A commentary on the medicinal use of marijuana. *Tropical Medicine and Health*, 47(1), pp.1-4.
- 14. Tola, D.H., 2019. Marijuana use in the anesthetized patient: history, pharmacology, and anesthetic considerations. *AANA journal*, 87(6), p.451.