THE EFFECT OF ALCOHOL USE DISORDER ON DIFFERENT PARTS OF THE BRAIN USING CT SCAN AND IT'S EFFECTIVENESS ON BEHAVIOR OF THE DRUG ADDICTS.

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Abstract:
Alcohol use disorder is one of the biggest problems in India specially in Punjab.The effect ofalcohol on the brain is by affecting the brain reward system, in addition to affecting the concentrations of Dopamine, Glutamate, GABA and Glutamate neurotransmitters in the brain. The focus of this research is to know the effect of alcohol use disorder on the structural changes that occur in the brain by using the CT scan and relate its effectiveness on the behavior of the alcohol addicts. The AUDIT test was the test that determines the subjects that would participate in the research. The test was given to participants then the subjects that fulfilled the inclusion criteria underwent brain CT scan, and their behaviors were observed.The behavioral changes of the patients which were observed arerestlessness, irritability, anxiousness and being hostile.It was found that in 70% of the patients the changes that occur in the brain are almost the same, the changes were the presence of mild diffuse cerebral atrophy.In addition, 10% showed ischemia, cerebellar atrophy and the demyelination. 20% of the patients showed the presence of ethmoid sinusitis which might also be caused by the alcohol use disorder and might be related to the behavioral changes that were observed in these patients.

Keywords: Alcohol, Alcohol Use Disorder, Brain, Behavioral changes, aggression

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INTRODUCTION:

Alcohol use disorder is one of the biggest problems in India specially in Punjab according to several studies including the findings of a study done by the Indian institute of medical research. It was proved that Punjab is of the highest burden of alcohol use disorder compared to other states. People seek for alcohol for different reasons, some people use alcohol to relieve their stress and forget about their problems, other people use it occasionally for fun until all of a sudden they find themselves stucked into addiction. In addition to the socio-economic status of the individuals might have a great influence on being an alcohol addict. Besides some people who suffer from mental health problem like depression or anxiety seek alcohol to suppress their bad feelings and symptoms. The harmful use of alcohol not only harms the user but also it harms the other people around them, such as family members, friends, co-workers and even strangers. It became essential nowadays to understand more about alcohol, how it affects the brain and how is the behavior affected. Alcohol in the beverages is called ethyl alcohol or ethanol its chemical formula is C_2H_5OH or CH_3CH_2OH. It is made by a process known as fermentation which is done by the yeast, the yeast ferments the sugar in the vegetables, fruits or grains and accordingly different types of alcoholic beverages are obtained. The effect ofalcohol on the brain is by affecting the brain reward system, in addition to affecting the concentrations of Dopamine, Glutamate, GABA and Glutamate neurotransmitters in the brain. There is an important pathway in our body which is known as the reward pathway or reward circuit. This pathway is located in the limbic system.The limbic system is responsible for the behavioral and emotional changes especially those who are responsible for our viability. The reward circuit pathway connects some brain structures which are responsible for controlling and motivating our ability to feel the pleasure. This enjoyment motivates us to repeat behaviors such as eating and other actions that are important for our survival and persistence. The major reward pathways are present on the Ventral Trigmental Area (VTA) in the mid brain. There are long projections in the VTA that go to another part known as Ventral Striatum (VS), the activation of cells reaches a part in the VS known as Nucleus Acumbens (NA) which is known as the Brain Pleasure Center. When the NA is activated each cell generates an electrical signal, that electrical signal causes the cell to release NT that react as chemical messengers which are received by other cells, this is how cells communicate together in an activated neural circuit. The brain has many different NT; but the reward activates the cells in the VTA. In the brain reward pathway, the Dopamine neurons are responsible for releasing the dopamine neurotransmitter in the synaptic space The dopamine attaches to specific receptors known as the dopaminergic receptors, these receptors are presenton the surface of the receiving target cell leading to the pleasurable feelings and the rewarding effects. After that the dopamine is removed by the dopamine transport. Alcohol indirectly excites the dopaminergic neurons which are responsible for producing the dopamine in the ventral trigmental area (VTA) so they produce more action potential, the release of dopamine in very high levels leads to prolonged and extended euphoria. Continuous and repeated exposure to dopamine surges leads to desensitization of the reward system, the system will no longer be responsive to everyday stimuli, the only thing that will be rewarding is the alcohol or drug in case of drug addicts. This is how addiction changes the person's everyday priority and after sometime the person will need to increase the amount to achieve the rewarding effect, leading to overdose. The short term alcohol consumption increases the inhibitory functions and decreases the excitatory functions. This is done by the interaction alcohol with the GABA system. GABA is a major inhibitory neurotransmitter, when the GABA Neurotransmitter binds to GABA receptor this allows more negative chloride ions to go inside the neurons leading to inhibition. This mechanism of alcohol is like the anesthetic drugs. In addition, alcohol interferes with the glutamate system, glutamate is a major excitatory neurotransmitter, normally when the glutamate binds to glutamate receptor this allows the positively charged ions like sodium and calcium to enter inside the neurons, so this makes it more positively charged inside the cell leading to excitation. Alcohol works by inhibiting this glutamate system by reducing the glutamate channel permeability, and this lowers the cation influx. By the interference of alcohol with both the GABA and Glutamate systems this leads to increasing the inhibition and decreasing the excitation. Depending on the amount of alcohol in the body the inhibitory effects can range from drowsiness to blackouts to respiratory depression and finally death. That's why alcohol is one of the leading causes of several diseases and death. The long term use of alcohol consumption will increase the excitatory effects and decreases the inhibitory effects because the sustained inhibition caused by prolonged alcohol exposure activates the brain, this is known as Adaptation response, it is done by the

body as an attempt to restore the equilibrium as a result the GABA NT will decrease and the Glutamate NT will increase to compensate the alcohol effects, as the balance moves towards excitation more and more alcohol is needed to get same inhibitory effect so this leads to overdrinking and withdrawal systems will start to occur if alcohol consumption is stopped because the brain will be in hyper excitation if not balanced by the inhibitory effect of alcohol. Brain atrophy is a common disease in alcoholics, according to the national institute of neurological disorders and stroke in the USA. Cerebral atrophy is the degeneration on the neurons and the connections in the brain leading to shrinkage of the brain. In other words, the brain will be smaller in size relative to the size of the normal brain.Cerebral Atrophy can affect different areas. It can either be localized or generalized. If atrophy is generalized this means that it affects the cells of the whole brain but if it is focal or localized this means that it affects specific regions in the brain and impairs the functions of these areas. If the 2 lobes of the cerebral hemispheres are affected, then conscious thought as well as the voluntary actions which are done intentionally will be hampered. The symptoms of cerebral atrophy vary depending on which area of the brain is affected. The affected area determines which symptoms will be present. The symptoms vary from Dementia, Disorientation, Seizures, communication problems, loss of memory, Loss of coordination, Localized weakness, loss of sensation, or paralysis, blurred hazy vision to disturbances in speaking and understanding language which is known as aphasia. In case of the AUD the cerebral atrophy will mostly be generalized. From the literature review, many researches were conducted to show the relationship between alcohol addiction and the changes that happen to the brain. **Spindle, et.al (2022),** fromHamburg, Germany conducted a meta-analysis to check the alterations of the white matter in the brain in patients with Alcohol use disorder (AUD). They found that there were changes in the white matter especially in these areas; the corpus callosum, the anterior cingulum,the posterior cingulum, the fornix, and the right posterior limb of the internal capsule. They believed that that these changes in the WM lead to disturbances in the cognitive function as well as the motor, perceptual and emotional functions in the AUD. Also **Guo, et.al (2022),** from China conducted a 4-year pilot study to investigate the consequences of drinking patterns of alcohol on the structure and the function of the brain relating it to the cognitive accomplishment and achievements in the youthdrinkers. They reached that drinking alcohol harms certain regions in the brainwhich are the major components of the SMN, DAN, VAM and VN which play an essential role in cognition. These regions are the temporal lobe, theoccipital lobe, the parietal lobe, the frontal cortex, the cingulate cortex and the thalamus. Besides **Thomas, et.al (2021)** from the National Institute on Drug Abuse, USA conducted an experiment to know the effect of alcohol on the amount of oxygen in the brain and check if it causes brain hypoxia and decrease the amount of oxygen in the brain under the injection ofheroin intravenously. They concluded that using alcohol and heroin or any opioid drug together is very dangerous as this leads to decrease of the amount of oxygen in the brain leading to serious health problems such as coma which may lead to death. In addition to **Pfefferbaum, et.la (1995)**from California from the department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, USA. Performed a longitudinal study to check the brain volumes of the alcoholic patients who had quit drinking and those who relapsed using the MRI technique.This study found that in early quitting of alcohol there is an enhancement in the volumes of cortical gray matter and the sulci, in addition when there is continued quitting of alcohol, improvement in third ventricular volume is shown. **Harper, et.al (1985),** from Australiaperformed a quantitative study on patients with chronic alcohol use in order to check the cerebral shrinkage. It was found that in the patients with chronic alcohol use there is prominent shrinkage and loss in the brain cells, this loss of brain tissues was obvious in the patients who are chronic alcohol users and having vitamin deficiency due to malnutrition or any liver disease.

Long, et.al (2022) performed a study comparing the changes that occur in both the brain and the behavior in the children who are exposed to low amount of alcohol before being born with those of well-matched controls with no alcohol exposure before birth , and it was proved that the children who were exposed to alcohol even in small amounts showed more behavioral problems in addition to changes in the brain structure which were shown as lower FA when compared with a well-matched control group.**Hees L. et.al, (2021),** from Belgiumconducted a study on adolescent males and females mice to assess the short- and the long-term consequences of adolescent alcohol exposure (AAE), the study showed that consuming alcohol willingly during the adolescent period didn't cause any change in the immunity in the prefrontal cortex, besides the findings suggest that

binge drinking alcohol willingly by the mice caused lagging in the behavioral abnormalities to occur in adulthood.**Tanabe, et al (2021**), from USAconducted a research to investigate how the behavior in addition to cerebral blood flow and the inflammatory cytokines are affected by the use of acetate. This study found that the reaction of the brain to acetate is changed according to the brain region and this depends on the degree of alcohol addiction.**E. Wiers, et al (2020), from USA)** conducted an experiment on detoxified subjects with their matched controls to examine the effect of persistent alcohol useon the levels of the glutamate neurotransmitter in the different parts in brain (the thalamus part and the anterior cingulate cortex (ACC)part) and how is it related to being involuntary impulsive.The study interpreted that the degree of alcohol dependence is correlated with the increase of the glutamate levels in the thalamus and the decrease in the parallel factor analysis. **Abbasi, et.al (2020),** conducted a study to investigate how the amalgamation of both ethanol and modafinil drug will affect the behavior of the rats, the results of this study showed that the degree of neurological side effects, mobility , and being anxious are related to the increased dose and It also showed that there was a great enhancement in the neuroprotection by the improvement of mobility and neurological activities by the amalgamation therapy of modafinil with the dose100 mg/kg and ethanol with the dose 1.5 g/kg. **Lanquetin, et.al (2021),** from Franceconducted a study aiming to investigate the links between inflammation of different body parts in the periphery, liver damage and changes that occur in the Central nervous system especially the brain in both alcoholic patients and animals. The findings of this research aims to find new therapeutic strategies that will be able to treatthe peripheral organs in order to minimize the brain injury in addition to curing the peripheral organs. **Mechtcheriakov, et al. (2006),** from Austria performed a study aiming to look for the patterns of brain shrinkage patterns in alcoholic patients. The findings in this study proved that alcohol use disorder led to significant changes in the density of both the gray matter and the white matter in certain parts in the brain. **Xu, et al. (2021),** from USA conducted a research on alcohol preferring female rats which prefer drinking alcohol to water. It showed that thepersistent drinking of alcohol led to behaviors similar to those of anxiety. Also it was found that the levels of several chemical transmitters besides the levels of some other factors that are essential for survival were changed. It was also found that alcohol led to the degeneration of the neurons in different parts of the brain. In addition, alcohol decreased the systemic level of thiamine besides leading to oxidative stress.**Hu, et al**., investigated the unpredictable change in the microglia in the hippocampus area in mice who took alcohol in an irregular manner. The results of this study showed that when the mice took alcohol for 14 days at irregular interval of time and followed by a clean 21 days period with no alcohol this led to behavioral problems in addition to degeneration of the microglia in the hippocampus. **Li, et al.,** analyzed some data on the study of the gray matter in alcoholics. In conclusion the study showed that the degeneration of the Gray Matter occurred in different parts of the brain such as the cingulate gyrus andthe insula, in addition the loss of the gray matter was also affected by the duration of alcohol quitting, the age of the patient and gender.**L.Folco, et al.** conducted a research on women who are suffering from alcohol use disorder and control women to check if there will be a difference in decision taking concerning the sexual activity. The study showed that the alcohol cues were similar to the visual sexual cues which suggests that there is a similar mechanism for both alcohol cues and sexual cues in alcoholic women.Besides this study related both the sexual decisions in women and alcohol declaring that the dangerous unsecure sexual choices in alcoholic women is aligned with alcohol use. **Sullivan, (2021)** conducted a research which focused on the effect of alcohol on both the neurological and the psychological health and it aided in analyzing the changes that occur in the structure by changing the intervals of drinking, quitting and recurrence.**Ewing, et al. (2014),**reviewed the literature to see how the developing brain of youth is affected by alcoholism. It was found that remarkable changes occurred in their brain due to alcohol consumption, these changes were not only changes in the structure of the brain but also changes in its function. **Bracht et al.,** conducted a study to investigate both the physiological changes of the reward system by observing the changes in its structure and function, besides observing the craving. The study found that craving was highly related to IncreasedFunctional Connectivityin the both areas in the brain the OrbitofrontalCortex andNucleus Accumbens areasand may contribute to the behavior of being inquisitive and probing to alcohol

Methods:

This research is ex-post facto research. The variables of this research are alcohol, the brain structural changes and the behavioral changes. This

research was done in cooperation with ANR Neuropsychiatric hospital in Jalandhar city, Model Town. In which 30 alcohol consuming patients were chosen to participate in the research their case histories were taken after that the 30 participants were asked to perform the AUDIT test (Alcohol Use Disorder Identification Test). Participants who scored more than 8 were included in the study, while the participants who scored less than 8 were excluded from the study. After performing the AUDIT 20 participants scored less than 8, so they were excluded from the study on the other hand only 10 participants scored more than 8.The 10 participants who matched with the criteria of inclusion, were admitted to the then asked to undergo Brain CT scan in order to be able to check for the structural changes in the brain.

Observation and Discussion:

The aim of this research is to see the effect of alcohol use disorder on the structural changes that occur in the brain and how these structural changes will affect the behavioral changes of the alcohol addicts. This will be done using CT scan, which will help to show very clear images of the brain structures. Persons who consume alcohol performed Alcohol Use Disorder Identification Test (AUDIT) those who scored 8 or more in the test were diagnosed with alcohol use disorder and they underwent CT scan and their behavior was observed.This research is also aiming to help the community by various ways, first it can help to fill the research gap by relating the brain structural changes with the behavioral changes and this may help to find new treatments of alcohol use disorder which is considered to be one of the most difficult types of addictions in detoxification and withdrawal. New treatments that can work on different affected parts of the brain can be discovered based on the findings of this research. In addition, the research aims to help those who are interested in alcohol addiction to understand more about it and understand more about the effect of alcohol on the brain and how is this related to their mental health and behavior. Besides this research can help further studies and researchers to be able to study the affected brain parts and this might help them in researches for the study of recovery of those who are in de addiction hospitals and rehabilitation centers. This research can also help in awareness for the alcohol use disorder as many of the population especially those who are of low socioeconomically standard and uneducated people aren't aware about the harmful side effects of alcohol on the body and the brain and the damages which are caused by alcohol consumption. So the findings of the research can also help in alcohol awareness campaigns. Alcohol is like any drug when it enters the body it will affect it and can be toxic. Alcohol affects many parts of the body, it can affect the brain, the liver, the kidneys, the lungs and the eyes. A CT of the brain is a type of imaging procedure that is used in diagnosis of brain structural abnormalities. It uses special types of X-rays measurements to give horizontal, or axial, images of the brain as a product. The products are known as slices. Brain CT scans provides a more detailed information about brain tissue and brain.

AUDIT test was performed for 30 patients and those who scored more than 8 were included in the research, these were 10 patients a case history was taken, CT scan for the brain was done and their behavior was under observation especially restlessness, irritability, anxiousness and being hostile.

It was found that in 70% of the patients the changes that occur in the brain are almost the same, the changes were the presence of mild diffuse cerebral atrophy seen as prominence of ventricular system, cortical sulcal spaces, Sylvain fissures and basal cisterns which indicates loss of the cells of the brain resulting into brain shrinkage which affected the behavior and the cognitive ability of the patients in addition 30% showed the ischemia and demyelination in the frontal periventricular white matter which indicates a brain injury and neurodegeneration and axonal damage which has been found in their CT Scan as cerebral and cerebellar atrophy. This ischemic demyelination maybe the reason for the changes that occurred in the memory, behavior and cognition.20% of the patients showed the presence of ethmoid sinusitis which is the inflammation of the sinuscausing obstruction which mightalso be caused by the alcohol use disorder and might be related to the behavioral changes that were observed in these patients.

Conclusion:

After doing this research on the patients of alcohol use disorder, it was found that there is a great relation between the alcohol consumption and the structural changes that occur in the brain. As 70% of the patients showed the same structural changes which is cerebral atrophy, and that might be related to a great extent to the behavioral changes that was observed on them. As the findings of this research proved that alcohol consumption affects the brain negatively and hence the behavior, so awareness to alcoholic patients and their families about the

harmful consequences of alcohol on brain and behavior must be taught to them. In addition to school campaigns and youth campaigns can also be made for awareness as a prophylactic against alcohol use and consumption.

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