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ALCOHOL ABUSE & ITS EFFECT ON BRAIN – ANALYSIS OF VOLUMETRIC CHANGES IN BRAIN REGION OF INTEREST

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Abstract:

The advent of Magnetic Resonance Imaging paved the way for in depth study of brain anatomy of subjects suffering from substance abuse disorder, particularly the chronic alcoholics. Research studies indicates that the chronic alcoholism affects the brain tissues, this affects are in terms of neuronal decay or atrophies in the brain cortical areas or ROI (Region of Interest). The asymmetry in brain ROI volumes have been noted in past studies. Theses alterations in the volumes area chief cause of neurobiological affects which may be the major cause of craving for alcohol [1].Magnetic Resonance (MRI) studies are useful in detection of structural changes and can clearly distinguishes between the brain images of normal healthy subject not being alcoholic and who is chronic alcohol consumer. The de-generative effect of alcoholism can be seen in the superior frontal, thalamus, hippocampus and cerebellum ROI of the affected brains [2].Various postmortem studies have shown that there is a drastic reduction in the white matter including some of the grey matter spaces. Alcohol consumption widely affects the white matter volumes of the brain. Semi-automated online platforms are used to measure the volumes of ROI and comparative analysis of the healthy and abnormal brain also reveals the asymmetry. This article is intended to specify the role of MRI and volumetric quantification of brain ROI in assessment and detection of alcohol abuse disorder as well as other neurological disorders associated with alcoholism. This report suggests of use of advanced neuro-imaging techniques such as MRI and computational psychiatry in the diagnosis of structural brain alterations and possible prognosis through proper abstinence and medicare.

Key-words: MRI, alcohol abuse, mental disorders, volumetric quantification, ROI

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1. Introduction

As per World Health Organization report approx 30% Indians consume alcohol & around 13% population out of 30% consume alcohol daily, similarly, inUSA around 20 million adults and 70 million youths are involved in consuming alcohol. The serious fact to note about percentage of the road accidents post consumption of alcohol and driving the vehicle in India is estimated to be approx 25%. In 2010 around 200 million people were affected with alcohol abuse disorder all over the world and 1,39,000 succumbed to death due to alcohol abuse.). The present research indicates that the group of alcoholics , who have been drinking for more than five years exhibits gradual shrinkage of brain as compare to normal subjects brain who are non drinkers[3].However, the basic question remains as to why someone get addicted to alcohol? This is obviously an open question!!! The research studies in this field are indicative of a causal relationship between neuronal cells of brain. The effect of chronic alcohol consumption is that alcohol affects the pathways connecting neuronal bases.Post-mortem studies and biopsies of non-human brain lesions resulted into the role of chemical transmissions across the pathways, in that the prominent role of dopamine, which is a neurotransmitter has been documented at large as underpinnings for consistent addictive behaviours, which is primarily due the continuous want of craving for alcohol [Fig 1] [4]. The recent advances in MRI technology, particularly in the field of functional MRI (fMRI) which uses BOLD technology to determine the blood oxygen level in the ROI (Region of Interest) of the brain. It is postulated that, the frontal region of the brain is largely affected due to alcohol intake. These effects are generally related to alteration of volumes due to atrophy during initial phase and it can be seen during withdrawal period too [5]. If we see the cases of chronic alcoholics, we can visualise the reduced volumes in the brains of drinkers as compare to non-drinkers, these changes can be view grossly as a shrunken anatomical structure[6]. In the cases of heavy drinkers, mostly the cortical areas of the brain in the frontal lobe are subjected to deterioration. This further affects the cognitive ability of person in terms of rational thinking, memory and decision making[7]. The gait of person is controlled by the posterior part of the brain i.e., the cerebellum, which is considered as the deep structure of the brain[8].Chronic alcoholism causes severe depression of the cerebellum [9]. The researchers have been using the structural MRI modality for visualizing the living human brain anatomy since the 1980's [10]. MRI scanning provides in-depth images of the brain that denote the hyper or hypointense structures of regions of interest (ROI) in the brain. This differentiation is possible due to the presence of water in different brain tissues such as white matter (WM), grey matter (GM), and the cerebrospinal fluid (CSF) in different proportions [11].

Visual presentation of the brain in MRI can be done through various planes of view such as theaxial view (from bottom to top), sagittal view (from left to right), and coronal view (from front to back). It can be viewed from an oblique angle to the above-mentioned planes also. It facilitates a greater accuracy in alignment of images with internal landmarks which is a mandatory and essential requisite for ensuring the consistency of data from scanning images and further for the 3D reconstruction of images.

While focusing on the importance of MRI by specifically focusing on the malady of mental disorder, it was found that it is used as an essential tool by the neuro markers. It produces images of the brain which are scanned by scientists and experts to indicate the functioning or dysfunction within the brain. It also includes the use of other techniques such as EEG, ERP, and PET that also help in determining the brain images along with MRI. However, scientists claim that MRI provides the most precise images of brain activity that helps professionals to compare the differences present in the mental state of the individuals[12].

For example, fMRI (Functional Magnetic Resonance Imaging) measures brain activity by detecting changes associated with blood flow.As a result, it becomes easy for experts to analyse movements in the brain and ascertain the functioning of the brain in the case of individuals suffering from mental illness. For this, the radiologist collects these images and compares them using a computer to mark the significant differences between the images. It helps in identifying the changes occurring in the brain activities over time and also determines the health status of the brain.

In addition to this, a statistical analysis program is also performed with the help of scanners so that the functioning of different parts of the brain is identified informing which part of the brain is working extensively and which part is showing the least activity. All these factors help the neuro markers to frame a chart and identify the characteristics that are associated with normal behaviour and abnormal behaviour of individuals [13].

The magnetic Resonance Imaging process is highly used by health care professionals in the detection of mental disorders because it works efficiently and provides information about all the sensitive changes that are occurring in the brain.

Due to the efficiency in the working of MRI and the ability of the process to provide information about all the sensitive changes that are occurring in the brain, it is used extensively by health-care professionals in the detection of mental disorders.

Additionally, the process can be used with a combination of other techniques such as PET, and electromagnetic measurements, magneto encephalography which helps in attaining more valuable information about the functioning of the brain. It identifies the chemical and neuronal changes with respect to the brain workings and specifies the alterations that are mainly linked with psychiatric illness. Hence, it can be said that MRI is highly useful in analyzing mental disorders among individuals suffering from mental illness.[14]

The past research described the application of quantitative image analysis techniques to obtain a brain volume estimate from MR images.[15] In the present condition, all three methods are based on the conventional MRI scanning process and analyze the entire brain or its parts depending on the disease and treatment requirement. In addition to this, the quantifications in brain regions of mentally ill individuals are highly impacted by several factors such as the application of segmentation methods, estimation of the pulse sequence, and the resolution dimensions of the variables selected for the attainment of the diagnosis of the intensity of the disease. To classify

specific brain disorder we need to have accurate analysis of tissue structure received trhough MRI imaging platform.[16] For example, a manual technique is used when the structure of the brain allows taking recording related to brain volumes or conduct estimations. However, it consumes a lot of time.

A semi-automated volumetric quantification technique is used to get fast responses in comparison to manual technique. The semi-automated technique performs better than the manual technique because it uses 3D volume segmentation and algorithm process.[17] It provides more intricate learning about brain movements and précised images**.** It helps in the early identification of the mental illness among the individuals and enables healthcare professionals to initiate the treatment process at earliest. On the other hand, fully automated methods are used just like semi-automated techniques. The only difference between them is that fully automated makes estimations are related to specific regions along with the entire portion while semi-automated is related to the specific body part. It is completely user-based which provides more intercalate information about the size, shape and other aspects of the brain. Moreover, the estimations that are produced with the help of automated technology are more accurate in comparison to the manual technique used for the volumetric quantifications of brain regions.[18]

2. Objectives

MRI & detection of mental disorders is available in a huge amount of literature. This argument, however, cannot be made viable in India, since the scarcity of work was highlighted in an extensive literary review. The literary review shows that there has been a good discussion of a variety of complex variables, such as belief and methodologies and evaluations. The variables in defining the efficacy of MRI, and the development of the new technique is certainly recognized as a significant repercussion for the health system. In the available literature (particularly in India) there is a clear lack of significant analysis of these variables. This is an important motivation for this study. The main aim of this analysis is to examine how these variables influence the efficacy of the MRI.

Null Hypothesis H0: U1 = U2 It indicates that no difference in variance between Control(U1)& Alcohol abuse disorder group (U2)

Alternative Hypothesis H1: U1 =/ U2 It indicates that there exist a difference in variance between Control(U1) & Alcohol abuse disorder group (U2)

The significance value P set at 0.01. Therefore, at $P < 0.01$, then the null hypothesis H0 will be rejected & If $P > 0.01$, then the null hypothesis H0 will be accepted. [19]

3. Methods

The MRI imaging studies detects the atrophy in amygdala and alterations in the volume in comparison with normal group. There found to be considerable changes in the volume of prefrontal cortex and hippocampus of the alcohol intake group [20]. In majority of alcoholic misuse/ abuse cases it is observed that the addiction is of relapsing nature and prominently

characterized by two behavioral aspect (i) Compulsive urge or craving for alcohol and (ii) Manipulation of environment around or behavior in a such a way that, subject can full fill his / her urge of consuming alcohol or consume larger quantity. The animal studies indicates that, the neurons releasing dopamine neurotransmitter get triggered, in the VTA, whenever an animal come across addiction stimuli. The released dopamine is received by the receptors on the dendrites of nucleus accumbence as well as it is also received by the receptors of limbic region and prefrontal cortex region [21]. The impact of conditional learning about stimuli leads to prediction of rewards, which further diminishes the release of dopamine. Numerous changes happen in the CNS when subject consumes alcohol. The primarily, neural stimulations occur which triggers the brain to think about the alcohol and alcohol related facts. Several neuro anatomical structures in the circuitry get activated during addiction. Interconnections of these neuro anatomical ROI of the brain are very important in the entire circuitry. Any dysfunction in the regulation of these regions is also triggers the craving and considered as, one of the underlying causes behind alcohol abuse. The regions also said to be important in the brain reward circuitry. The regions are as follows[22]: -

i) Ventral Tegmental Area (VTA)
ii) Nucleus accumbens
iii) Anterior cingulate
iv) Orbit frontal cortex
v) Hippocampus
vi) Amygdala

The adverse effect of alcohol consumption on human brain resulting in impairment of cognitive and functional abilities thus exerts enormous burden on family & society as well. It is therefore essential to diagnose the malady at the earliest possible level so as to avoid further deterioration of subjects psycho – social level.

4. Study design

For the purpose of this research study, The radiologist and team of MRI technicians was discussed at Ruby Medical MRI centers at Satara, Karad, Baramati, Indapur, and Phaltan. All technical staff was informed about the project and requirement of samples for the project, The information regarding such project was disseminated to physicians from each area, including government general hospitals, and specifically to psychiatrist in the respective area so that the targeted samples can be obtained. In the current study which is related to the efficacy of MRI in the detection of Alcohol abuse disorder or possibility of developing substance abuse related disorders in future, the quantitative research approach was used with the positivist research paradigm. The study also includes descriptive research design and a deductive research approach so that hypothesis testing and graphical presentation of facts are done effectively. It includes databases from 37 normal individuals and 30 individuals who are suffering from Alcohol abuse disorder. All the participants are male and belong to the age category of 40 to 50 years. On the other hand, the MRI database was collected by taking 30 male individuals affected by alcohol abuse disorder who belonging to the age group of 18-50 years. (Table 1)

Setting

The collection of MRI imaging data was started May 2017 –Oct 2019. were called at 3 Tesla MRI center of Ruby Hall Clinic Services Pvt Ltd at Satara , Maharshtra. All patients were requested to submit the informed consent prior to study. The data of MRI of the patients suffering from the above mental diseases and a normal group was measured by the following process.

5. **Sample size**: a total of 67 subjects were included in the study. Out of which 37 were of normal group and 30 patients for alcohol abuse disorder group**.**

Participants

All patients / subject referred by local physicians, acquaintance, relatives, and peripheral centers.

Exclusion/Inclusion Criteria of Patients

Subjects with mental disorder satisfying the Diagnostic and Statistical Manual of Disorders (DSM) DSM-V criteria were allowed in the study. Following subjects were excluded whenever one of the following things was applicable to them. Informed consent was obtained from all subjects underwent research study.

- Subjects having a current or past history of a major medical illness; previous head injury or prolonged unconsciousness.
- Subjects undergoing migraine treatments.
- Subjects were required to be clinically stable with no significant changes in their psychotropic medications in the previous two months.
- Age of the subject must be between 18 and 50 years.

6. **Variables**

This list of variable was identified on the basis of a survey of literature and views of experts.In order to ensure a feasible sample size for the study, a significant amount of respondents were contacted. Hence, it presents a response rate of approximately forty-six percent. Convenience sampling method was used for collecting the information. To provide a statistical base, this study evaluates mean scores for the selected variable. To ensure a substantial analysis of data, some statistical tools like T-test and descriptive statics were used. From the above discussion, one can say that this study will definitely help the practitioners in devising strategies owing to impact of MRI in identifying the mental disorder. In addition to this, informative strategies can also be devised depending on the development of the new technology.

7. **Data sources/ measurements**

Prior to participating in scanning procedures, the medical records of all subjects will be scrutinized The Demographic Inventory will be prepared based on preliminary psychiatric diagnosis, period of symptoms etc., Substance abuse and Nicotine Dependence will be

ascertained ,Brief family interview will be conducted (as subjects would be already referred by either Psychologist or Neurologist)

Technical Details of Equipment The scanner manufacturer, model, field strength, and other technical details about scanner are summarized in the table given below. There was a 3T scanner included.

(Table: Technical details of equipment)

Site	Field	Kspace	Head Coil	Visual Display	Software Used and Computer system
Ruby Hall Clinic Svc. Pvt Ltd, Satara	3T	Linear	16 Channels MagnetomSpecra	SIEMENS. SYNGO PLATFORM	*MRI – NUMARIS/ 4 *MRI cro GL – For Conversion *VOL brain – For Volumetric Quantification

Scanning Protocols

Sites in Structural imaging, biomedical informatics research network provided the best results for their scanners as determined by their usual protocols.

(Table --Structural imaging Scanning Protocols)

SR NO	SEQUE.	TR	TE	SLICE THICK	TIME	B VALUE.	NO. SLICE
1	FLAIR AXIAL	9000	77	5	03:02		22
2	DWI	4400	72	5	02:00	1000	22
3	HEMO	530	19	5	01:53		22
4	T2 AXIAL	6000	101	5	02:08		22
5	T1 AXIAL	600	10	5	02:18		22
6	FLAIR COR	9000	72	5	02:44		22
7	T1 SAG	460	10	5	02:06		22

All patients / subject selected for the study underwent MRI scanning on SIEMENS 3 Tesla, 16 channel Magnetom Spectra machine. For all patient same brain coil was used throughout the experiment. The study performed was "MRI Brain Plain" for all subjects. The sequences applied for the examination of MRI brain are as follows:

- Flair Axial: TR- 9000, TE – 77, slice thickness – 5mm, Time required for sequence 3.02 min, no of slice – 22
- DWI (Diffusion Weighted Image):TR- 4400, TE – 72, slice thickness – 5mm, Time required for sequence 2.00 min, no of slice – 22
- Hemo:TR- 530, TE – 19, slice thickness – 5mm, Time required for sequence 01.53 min, no of slice – 22

N	Study Group	Male	Female
37	Control – Healthy Male+ Female (Control healthy)	23	14
30	Experimental – Alcohol Abuse Disorder(ALC)	30	0

T2 Axial: TR- 460,TE – 10, slice thickness – 5mm, Time required for sequence 02.44 min, no of slice – 22

- T1 Axial: TR- 600, TE – 10, slice thickness – 5mm, Time required for sequence 02.08 min, no of slice – 22
- Flair Cor: TR- 530, TE – 19, slice thickness – 5mm, Time required for sequence 01.53 min, no of slice – 22
- T1 SAG (Sagital): TR- 530, TE – 19, slice thickness – 5mm, Time required for sequence 02.06 min, no of slice – 22

8. **Quantification of Image Data Obtained From MRI**

Independent t-test &levene's test are statistical inferential used for determining the equality of inequalities for a variable measured for two or more classes. The independent t-test is an inferential statistical test that decides if there is a statistically significant difference between the means of two non-related groups and also called the two-sample t-test, independent sample-tests t-test or student's t-test.

Table 1:-(Participant (N=67) Characteristics)

MRIcro GL is one of the most widely used software package for converting the DICOM data to NiFTi Format. After getting Data in .rar /.gs/.nii the VOLbrain open platform on line SW will be used to get the volumetric data of Brain for examining neural activity as well as for analyzing the MRI data.

volBrain system is online platform for measuring the volumes of ROI of the brain. The primary purpose of this system is to assist the researches in the field of neuropsychiatry so as to extract the brain's volumetric data automatically. The important feature of this platform is, no need of additional software or hardware required to be installed for the purpose of volumetric assessments. The usage of this platform is completely on non – medical and non- commercial basis.

Bias

Single MRI center has been utisedthrough out the project The reason behind this efforts were to maintain the uniformity in imaging quality because of variety of MRI systems with different magnetic power are operating in above mentioned centers. the same radiologist have been employed throughout the study so that possibility of individual bias can be ruled out.

9. **Participants**

Table -- (Participant (N=67) Characteristics)

Participant (N=67) Characteristics) **:**Total of 67 Patients underwent MRI scanning. Out of 37 (Healthy Male + Female)control Patients having normal MRI brain scans were chosen as a control group And 30 patients being referred by local physicians who have been diagnosed under the category of alcohol abuse disorder.The automated open platform for evaluation of brain volume was done the quantification was based on each individual T1 W MRI image of the brain. The different ROI (Region of Interest) of both hemispheres (Left (L) & Right (R) of the brain anatomy were considered as variables for measurement of volumes such as Grey Matter, White Matter, White Matter, Lateral Ventricles, Thalamus, Hippocampus, Amygdala, Caudate, Putamen, Global Pallidus, and Nucleus Accumbens area structures were measured volumetrically. The above-said area is associated with alcohol abuse mental disorders.

10. **Statistical methods**

Brain – Volume measurements were normally distributed. The evaluation of associations between brain Region of Interest (ROI), normal healthy control and brain ROI of psychiatric disorder group was carried out. The statistics required for the test were constructed from the ranks in each category of mental disorder for each respective Region of Interest (ROI) in brain anatomy separately In order to measure the efficacy of the MRI for measuring the volumetric changes in the region of interest of brain it was necessary to identify if there was a difference between the ROI's volumes of normal group and the mentally ill groups. For getting a more scientifically proven difference it is always needed to employ some statistical technique which gives the significance of that difference and explains the % of confidence level for the results. In our study following statistical tests were employed computed on **SPSS23** which is a tool for statistical analysis:

Independent t-test &Levene's test are statistical inferential used for determining the equality of inequalities for a variable measured for two or more classes. The independent t-test is an

inferential statistical test that decides if there is a statistically significant difference between the means of two non-related groups and also called the two sample t-test, independent sample-tests t-test or student's t-test.

Null and alternative t-test hypotheses

The null hypothesis of independent t test is that the population mean of the two unrelated groups is the same: H_0: u1 = u2

In most cases, we try to demonstrate whether we can reject the null hypothesis and consider the alternative, which is that the means of the population are not equal:

H_1: u1 ≠ u2

To that end, we must set a degree of significance that either rejects the alternative hypothesis or supports it (also called alpha). This value is normally set to 0.05. or 0.01

Results

Patient characteristics in Table '1'. Total 67 patients were underwent MRI imaging examination out of 67 subjects ,37 subjects were normal healthy control and 30 subjects were affected from alcohol abuse disorder.The results for independent samples t-test for normal group compared (N=37) with patients of Alcohol abuse (N= 30). The results shows that at p<.001 level of significance test shows that there is a significant change in the Lgrey, R grey, total grey matter, L/R lat.ventri, R thalamus, L/R hippocampus, L/R amygdala, L/R caudate, and L/R accumbens. In the above table 1 means significant alteration and 0 means no significant alteration in brain regions of interest

Table "2" The automated open platform for evaluation of brain volume was done the quantification was based on each individual T1 W MRI image of the brain. The different ROI (Region of Interest) of both hemispheres (Left (L) & Right (R) of the brain anatomy were considered as variables for measurement of volumes such as Grey Matter, White Matter, White Matter, Lateral Ventricles, Thalamus, Hippocampus, Amygdala, Caudate, Putamen, Global Pallidus, and Nucleus Accumbens area structures were measured volumetrically. The above-said area is associated with, Alcoho abuse disorder. All the aforementioned variables were compared between Healthy control group & Alcoholic disorder group (ALC) (**Chart -I**) To analyze the significant volumetric differences among normal healthy group against alcohol abuse disorder group in volumes of 22 Region of Interest (ROI). The ascertained values (U) are when the significance of the p-value was less than **.001**. Hence, it can be said that there was no significant difference in G1 vs Normal G2 (Table "2")

Normal (Male + Female) Vs. Alcohol abuse Group.

Following table represents the results obtained from the statistical analysis of the quantified volumetric data of Normal &Alcohol abuse group – in the following table

1 – Control group is indicate by fig "1"

2- alchohal abuse group is indicated by fig " 2"

Table 2:Group Statistics (Alcohol abuse group V/S Normal Male + Female Control)

Group Statistics					
	VAR00001	N	Mean	Std. Deviation	Std. Error Mean
LEFT. Grey Matter	1.00	37	280.21973	43.364419	7.129067
	2.00	30	246.53333	1.041661	.190180
RIGHT. Grey Matter	1.00	37	278.15081	42.468599	6.981795
	2.00	30	246.80000	1.270352	.231933
Total. Gray Matter	1.00	37	558.37054	85.580477	14.069344
	2.00	30	493.26667	1.981524	.361775
LEFT. White matter	1.00	37	217.57973	35.438415	5.826039
	2.00	30	215.53123	.265592	.048490
RIGHT.White matter	1.00	37	228.95243	64.816980	10.655846
	2.00	30	216.43107	.265393	.048454
Total White Matter	1.00	37	446.53216	94.285550	15.500449
	2.00	30	431.96230	.530945	.096937
LEFT. LatVentri.	1.00	37	4.84027	4.197441	.690055
	2.00	30	12.91913	.046050	.008408
RIGHT. LatVentri.	1.00	37	4.02000	3.109139	.511139
	2.00	30	11.26853	.059809	.010920
LEFT. Thalamus	1.00	37	168.33649	992.278752	163.129622
	2.00	30	6.89447	.045602	.008326
RIGHT. Thalamus	1.00	37	5.24216	1.186658	.195085
	2.00	30	6.99863	.046849	.008553
LEFT. Hippocampus	1.00	37	2.89892	1.079032	.177392

	2.00	30	4.32900	.021229	.003876
RIGHT. Hippocampus	1.00	37	2.97459	.999449	.164308
	2.00	30	4.55900	.042292	.007721
LEFT. Amygdala	1.00	37	.83676	.241616	.039721
	2.00	30	1.81387	.022471	.004103
RIGHT. Amygdala	1.00	37	.87324	.311859	.051269
	2.00	30	1.82513	.021313	.003891
LEFT. Caudate	1.00	37	2.76108	.804203	.132210
	2.00	30	3.91487	.022512	.004110
RIGHT. Caudate	1.00	37	2.76973	1.011815	.166341
	2.00	30	3.92637	.021914	.004001
LEFT. Putamen	1.00	37	4.87216	1.263921	.207787
	2.00	30	4.82780	.031892	.005823
RIGHT. Putamen	1.00	37	4.83892	1.105760	.181786
	2.00	30	4.83930	.033341	.006087
LEFT.GLOBUS PALLIDUS	1.00	37	1.42946	.378021	.062146
	2.00	30	2.00000	.000000	.000000
RIGHT.GLOBUS PALLIDUS	1.00	37	1.39054	.316833	.052087
	2.00	30	2.00000	.000000	.000000
LEFT.Accumbens area	1.00	37	.26703	.275206	.045244
	2.00	30	.53467	.013578	.002479
RIGHT. Accumbens area	1.00	37	.20703	.117517	.019320
	2.00	30	.54367	.012452	.002273

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Table 3: Independent Samples T- Test (Alcohol abuse group V/S Normal Male + Female) Control

Brain region of interest	Levene's Test for Equality of Variances		t-test for Equality of Means			Significance (At p<.001) for given t values
	F	Sig.	T	Degree of freedom	Sig(two tailed)	
L grey	54.121	.000	4.253	65	.000	1
R grey	55.892	.000	4.030	65	.000	1
Total grey	56.377	.000	4.155	65	.000	1
L white	14.278	.000	1.057	65	.295	0
R white	49.882	.000	.316	65	.753	0
Total white	25.924	.000	.845	65	.401	0
L lat.ventri	30.576	.000	-10.526	65	.000	1
R lat.ventri	43.030	.000	-12.749	65	.000	1
L thalamus	3.421	.069	.890	65	.377	0
R thalamus	29.289	.000	-8.090	65	.000	1
L hippocampus	51.712	.000	-7.247	65	.000	1
R hippocampus	72.242	.000	-8.664	65	.000	1
L amygdala	40.670	.000	-22.041	65	.000	1
R amygdala	30.602	.000	-16.663	65	.000	1
L caudate	74.776	.000	-7.844	65	.000	1
R caudate	56.967	.000	-6.251	65	.000	1
L putamen	32.195	.000	.192	65	.848	0
R putamen	44.943	.000	-.002	65	.999	0
L palladious	54.301	.000	-6.667	65	.000	1
R palladious	75.213	.000	-8.772	65	.000	1
L accumbens	10.613	.002	-5.314	65	.000	1
R accumbens	49.377	.000	-15.597	65	.000	1

(We have assumed that variances were equal. The test statistic t with assumption of equal variances will decide if there is any significant difference exist or not. The level of significance is p<.001. Hence of in the above table if asymp. Sig< .001 then we can say a significant difference exists otherwise not.)

11. **Sources: Authors Calculation**

The above table gives the results for independent samples t-test for normal group compared (N=37) with patients of Alcohol abuse (N= 30). The results shows that at p<.001 level of significance test shows that there is a significant change in the Lgrey, R grey, total grey matter, L/R lat.ventri, R thalamus, L/R hippocampus, L/R amygdala, L/R caudate, and L/R accumbens. In the above table 1 means significant alteration and 0 means no significant alteration in brain regions of interest.

12. **Discussion**

The research shows that there is a significant change in the Lgrey, R grey, total grey matter, L/R lat.ventri, R thalamus, L/R hippocampus, L/R amygdala, L/R caudate, and L/R accumbens.
The focus of present study is to evaluate the volumetric changes and its significant relevance with the predisposition of targeted disorder. Among subjects of various disorders we had 30 samples of the subject who are alcoholic and referred by the local physicians. The habit of drinking alcohol started with curiosity and turned to attained the severity, so as to describe it as a disorder. It is essentially un natural way of behavioural motive amongst the drinkers which not only affect their health but socio-psychological impairment is also associated withe disorder. The affected individual primarily becomes a burden on the family and society and organisations as, their economic degrading continue due to reduced production capability and thus loss of employment, which necessarily brings stigma to the family members.Alcohol is most harmfull drug than cocaine and heroin [23]. As alcohol consumption affects individuals socio –psycho – economical state, it does affect its brain too. In the present study we have detected the Region of interest, that have underpinnings behind craving for alcohol and thus understanding the significant relationship of these structural deformities will lead to foresee the catastrophe and corrective measures can be applied. The focus of present study is to evaluate the volumetric changes and its significant relevance with the predisposition of targeted disorder. Among subjects of various disorders we had 30 samples of the subject who are alcoholic and referred by the local physicians. The habit of drinking alcohol started with curiosity and turned to attained the severity, so as to describe it as a disorder. It is essentially un natural way of behavioural motive amongst the drinkers which not only affect their health but socio-psychological impairment is also associated withe disorder. The affected individual primarily becomes a burden on the family and society and organisations as, their economic degrading continue due to reduced production capability and thus loss of employment, which necessarily brings stigma to the family members.Alcohol is most harmfull drug than cocaine and heroin [24]. As alcohol consumption affects individuals socio –psycho – economical state, it does affect its brain too. In the present study we have detected the Region of interest, that have underpinnings behind craving for alcohol and thus understanding the significant relationship of these structural deformities will lead to foresee the catastrophe and corrective measures can be applied. Symptomatically, the addicts of alcohol exhibit following observations:

(i)	Urge to drink	
(ii)	Abstinence from social life, work etc	
(iii)	Slur speech	
(iv)	Defective spatial vision	Physical.
(v)	Imbalance in gait and walking	
(vi)	Hepatitis	
(vii)	Cirrhosis	
(viii)	Gastrointestinal abnormalities	
	Impaired coordination ability	
(i)	Inability to learn and adapt	Cognitive.
(ii)	Impaired rational thinking	
(iii)	Inclination to dangerous / risky behaviour	
(iv)	Aggressiveness	

In addition , The present study evaluated the region of interest (ROI) earmarked as significant neuro imaging correlates for the underlying cause behanid alcoholism , The research carried out by Oscar, Berman .,2000,Ryabinin 1998 and Sulivan 2000 indicates that , The regions of the are specifically associated in alcoholism are cerebral cortex, ,limbic system, thalamus, basal dorebrain, hypothalamusand the cerebellum.[25] Grey matter volume reduction has been reported in subjects suffering from alcohol abuse, the specisific concentration of grey matter (GM) reduction is in subcortical deep brain, dorsal lateral frontal & parietal lobes [26] The empirical literature consistently maintains that the subject suffering from severe alcoholism exhibits decreased volumes in the hippocampus region with memory dysfunction [27]. In another study, it is indicated that the white matter (WM) volumes and corpus callosum has been decreased in the subject consuming regular alcohol [28]. The GM reduction in caudate and putamen has also been reported which are associated with alcoholic groups[29]. There exist abundant literature regarding the volumetric alteration in brain region of interest in alcoholic brains, the present study also replicates the similar region of interest which are significantly differ in volumetric measurements thus from the neuro biological point view the corresponding increment or reduction is due to the destruction or atrophies of the neuronal cells in respective ROI which are associated with the aetiology of alcohol consumption cravings.

13. Limitations

The study was limited to patients undergoing MRI. The study was limited to 67 patients samples, so generalization of study findings could not be possible. So for future research can be analyse with more number of sample size .

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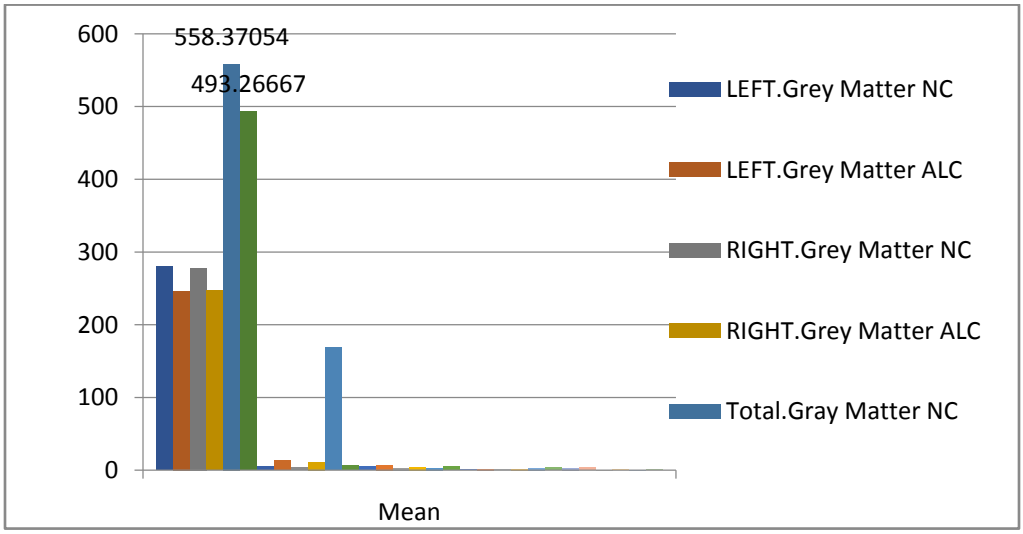

Chart -I : Significant volumetric asymmetry of different Region of Interest (ROI) of brain between normal Control group and alcohol abuse group. ALC – Alcohol group, NC – Normal control group)

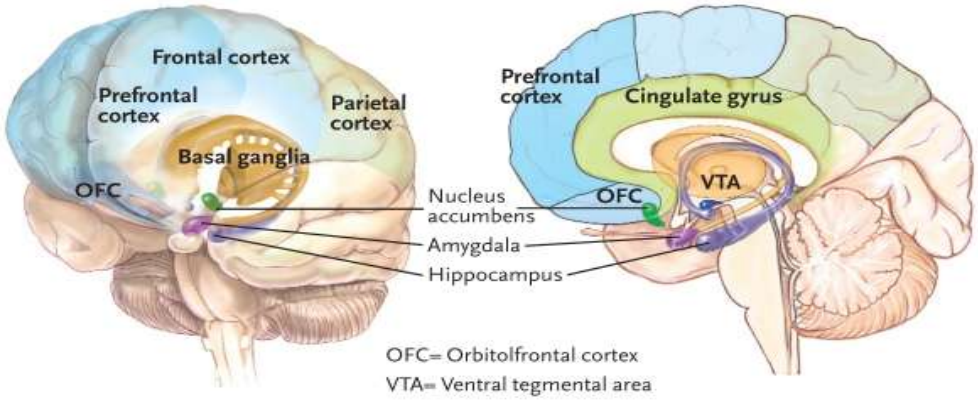

Fig 1 :Role of the Brain Region of Interest in addiction.

The various areas responsible for executive functions , such as (PFC) Prefrontal cortex, (NAc) Nucleus accumbens and (VTA) Ventral tegamental area , Hippocampus , Thalamus which are primarily responsible for cognition and planning, Rewardsystem & coordination of memories , drives and emotions.

(Ref: - NEUROANATOMY by Dr. Ronald L. Green MD , Robyn L. Ostrander MD)

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