Original article

Neuroimaging Markers for predicting treatment response in obsessive-compulsive disorder

Connor Benjamin[1], Peter Timms[2]

[1] *Center for Genomic Medicine, Massachusetts General Hospital, Boston, MA, USA.*

[2] *European Molecular Biology Laboratory, European Bioinformatics Institute, Wellcome Genome Campus, Hinxton, UK.*

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ABSTRACT

The investigation of neuroimaging methods as prediction tools has been prompted by the search to improve the treatment results of obsessive-compulsive disorder (OCD), a complicated mental health illness. The development and promise of neuroimaging indicators in predicting treatment response are summarized in this abstract. OCD, which is characterized by upsetting obsessions and repeated behaviors, shows a range of reactions to therapies, calling for customized strategies. The structure, connections, and neurochemistry of the brain may be studied using neuroimaging techniques such as functional magnetic resonance imaging (fMRI), structural MRI, diffusion tensor imaging (DTI), positron emission tomography (PET), and magnetic resonance spectroscopy (MRS). Potential prognostic indicators include aberrant patterns discovered by fMRI, changed brain areas shown by structural MRI, and disturbed white matter connections discovered by DTI. Serotonin abnormalities, particularly those shown by PET and MRS, provide a biological component to prediction. Predictive models are developing as a result of fusing these insights with machine learning and combining various data to improve the accuracy of treatment estimates. Complexity of the disorder, the requirement for standardized protocols, and the integration of diverse data sources are obstacles, nevertheless. In spite of obstacles, the convergence of neuroimaging and OCD therapy prediction offers personalized therapies, less suffering, and enhanced quality of life. The possibility of a paradigm change in psychiatric treatment is becoming more apparent as this field develops.

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Keywords: neuroimaging markers (NM), Predicting treatment response (PTR), obsessive-compulsive disorder (OCD), E-views Software

Introduction

The mental disorder characterized by psychiatric problems and severe chronic mental disability is termed OCD. This disorder's prevalence rate among the general public is two to three percent. OCD is a disorder in which a person develops time-consuming obsessions. Also, distressing obsessions are seen in people having OCD. These compulsive behavioral-based obsessions in OCD people are treated using CBT therapies[1]. Cognitive-behavior therapies neutralize the distress among people having OCD. Various symptoms associated with OCD are shown by people having this disorder but, in some people, certain symptoms are masked because of the other prominent OCD symptoms. The symptom's severity increases if a person with OCD does not get proper treatment timely. OCD people face family or social life-based functional impairment due to their disorder's complexity. the quality of life of people having OCD becomes poor. Moreover, the psychiatric problems faced by OCD patients are because of the dysfunctionality of their cognitive control activities[2]. Although these results are encouraging, it's vital to keep in mind that the science is still in its infancy and that there isn't yet a clear neuroimaging signal that can accurately predict treatment response in OCD. The intricacy of the condition itself, the necessity for bigger and more standardised investigations, and replication of findings across other groups are among the difficulties. It can be difficult to predict each patient's reaction to treatment using neuroimaging because of the varied nature of OCD and the several treatment options available (medication, cognitive-behavioral therapy, deep brain stimulation, etc.). Clinicians and academics are attempting to increase the accuracy and therapeutic value of these approaches. Advanced neuroimaging methods have revolutionised our capacity to examine the intricate relationships between brain shape and function, providing new information on the neural circuitry and neurochemical imbalances that underlie OCD. Researchers have been able to examine functional connectivity patterns within and between brain networks due to one of the most used methods, functional magnetic resonance imaging (fMRI). The default mode network (DMN), which is linked to self-referential thought, and the salience network, which is involved in identifying and directing attention to important stimuli, both showed changes during resting-state fMRI investigations. Such abnormal connection patterns have been associated with the intensity of OCD symptoms and may be used to predict how well a therapy will work. By treating their psychiatric problems a patient with OCD can recover easily. Most OCD-affected patient feels insecure

Address for correspondence: Connor Benjamin, Center for Genomic Medicine, Massachusetts General Hospital, Boston, MA, USA.

about sharing their disorder-related psychiatric problems with other people because of the social stigma. This hesitation and insecurity factors faced by OCD patients make their disorder treatment more complex and their symptoms keep on getting severe with time.

All over the world, OCD Is regarded as a disorder related to neurodevelopmental changes. The alternation in the neurodevelopmental process induces OCD in people. The neuropsychological basis behind OCD is determined using technology-based techniques. Neuroimaging is the technology applied in clinical trials to assess the neuropsychology underlying OCD. The neuroimaging technology predicts that an alerted neural mechanism is involved in developing abnormal Corrtico-Striato-Thalmo-Corticol networks[3]. These networks play an important role in the neurodevelopmental process but alternation in neural mechanisms also alters these networks. The defects in other brain models induce OCD. like the defect in DMN and FPN results in disturbance in neural mechanisms and thereby develops OCD condition in normal people. Brain networking maintenance holds great value for maintaining mental stability[4]. Obsessive-compulsive disorder (OCD), a crippling mental health illness characterised by intrusive thoughts and repeated behaviours, has been the subject of recent advances in the field of neuroimaging that have opened up new perspectives for understanding and forecasting treatment outcomes. Researchers are investigating neuroimaging techniques as possible tools for finding indicators that might assist predict individual responses to various treatment modalities in light of the complex brain foundations of OCD and its varied clinical presentations. The search for accurate indicators of treatment success holds great potential for customising therapies to specific patients, enhancing therapeutic efficacy, and reducing the significant burden of OCD on both individuals with the condition and society as a whole. Any alternations in brain functioning change its role and develop abnormalities. These abnormalities result in the development of different types of mental health disorders in people. OCD is among the mental health disorders caused due to such brain abnormalities. Neuroimaging studies predict that using pharmacotherapy along with psychotherapy helps in minimizing the risk of OCD severity. Both these therapies are provided simultaneously to OCD patients to enhance their normal neural mechanism and to stop this mechanism from getting altered [5].

Using neuroimaging technology in the mental disorder assessment and diagnosing process holds great importance. Neuroimaging is a visual technology that provides visual information about various brain parts of mental disorder-affected patients. The information provided by neuroimaging technology not only provides complete information about the neural mechanism involved in OCD onset but also determines the type of therapy used for treating OCD[6]. Neuroimaging acts as a biomarker for understanding the neurobiological basis behind OCD and identifying the treatment response of a person having OCD. Various assessment tests are used by psychiatrists treating OCD to understand the complexity of this disorder. Clinical-based assessment tests are preferred by psychiatrists for identifying the mental health problems associated with psychiatric disorders. The neuroimaging technique predicts the structure as well as functional abnormalities of the brain of OCD patients by comparing it with a normal person's brain structure and function[7]. Millions of people worldwide are afflicted by the complex and diverse mental disease known as obsessive-compulsive disorder. OCD symptoms can range in severity from mild to severe, with obsessions appearing as uncomfortable intrusive thoughts and compulsions as ritualistic actions used to lessen the misery. Despite the availability of pharmaceutical therapies and psychotherapy modalities like cognitive-behavioral therapy (CBT), a sizable proportion of OCD sufferers do not respond to treatment in a way that is satisfying to them. This sobering truth has inspired researchers to expression into the brain underpinnings of the illness in order to identify possible elements that may be responsible for inconsistent treatment results. The comparison makes the abnormalities assessment process easier for health professionals Also, due to more advancements in technology models they are used in assessing mental disorders. The support vector machine model as well as the MVPA model are based on advanced technology and predict the psychiatric problems faced by different OCD patients[8]. Combining these advanced technology-based models with neuroimaging technology helps in predicting the neurobiological difference between a normal and OCD person.

First-line defense against OCD is essential for saving the OCD from getting worse. The first line of treatment for OCD involves the use of SSRIs along with CBT. The neurobiological studies explained that neural circuit mechanism gets improved in a person having OCD. The use of SSRIs and Exposure-based preventive therapies plays a significant part in overcoming the cognitive dysfunctionality problem faced by an OCD person[9]. using SSRIs is effective but at the same time, it provides only thirty percent effectiveness against OCD in some people. The response of individual OCD patients to effective therapies is explained through various research studies. These studies explain that using SSRIs during the initial course of the disorder is effective but when the severity becomes more its effectiveness decreases. Moreover, using fluoxetine for treating OCD symptoms proves effective. At different stages of OCD patient's brain is examined through neuroimaging technology to predict the improvement in OCD patient brain functionality During treatment [10].most of treatment therapies against OCD proceed slowly while some people show faster recovery from OCD. The functional impairment results due to OCD are treated through another treatment technology known as fMRI. This technology works on the neuroimaging principle and provides effective treatment against the disorder as it reveals potential information about the impairment patterns of the brain.

Using any technology system in the medical and health sector to improve the mental health of mental disorders-affected patients holds immense significance. Neuroimaging, fMRI, and other intervention therapies used in various treatment process improves the course of the treatment process and make the recovery journey easier for the patients[11]. The neurochemical abnormalities that underlie OCD can be assessed using positron emission tomography (PET). Researchers may explore serotonin receptors and transporters using PET imaging since serotonin malfunction has long been linked to the condition. Research into serotonin transporter density and serotonin receptor binding may reveal if these neurochemical indicators might distinguish between treatment responders and non-responders, opening the door to customised therapeutic strategies. By revealing details about the concentrations of neurochemicals in particular brain areas, magnetic resonance spectroscopy (MRS) gives a distinctive viewpoint. Studies on neurotransmitters including glutamate and gamma-aminobutyric acid (GABA) have showed promise in identifying possible neurochemical markers linked to OCD. Researchers want to know if measuring the levels of these

neurotransmitters before starting treatment helps predict how the patient will respond. All these technology-based treatment procedures and therapies are specially used to locate the damaged areas of the brain due to mental disorders. Each mental disorder affects different parts of the brain and identifying which of the brain gets damaged due to OCD is done using neuroimaging. Furthermore, various medications are prescribed to OCD patients by professional psychiatrists to decrease the depression in these patients. Some medications are used for the short-term use while some medications are used for the long-term depending upon the patient's mental health condition. Also, the brain structure alternation of OCD patients is treated through the use of medications as they help in rearranging the altered structure of the patient's brain.

Research objectives:

This research paper explains the Neuroimaging makers for predicting treatment responses in obsessive-compulsive disorder. Moreover, the use of neuroimaging for predicting various brain defects in OCD patients has also been discussed above.

Literature review:

Researchers claim that obsessive-compulsive disorder involves various neural mechanisms. This mechanism correlates with developing compulsive behavior in individuals having OCD. For assessing the behavior of neurotransmitters involved in neurotransmitter-based inhibitory processes, the proton magnetic resonance spectroscopy technique is used in clinical processes.

The proton magnetic resonance spectroscopy technique helps in predicting the level of glutamate and GABA present in the anterior cingulate cortex of OCD patients [12]. In recent years, there has been a lot of interest in the combination of these various neuroimaging modalities with advanced machine learning algorithms. Predictive models have been created with the aim of stratifying patients depending on their likelihood of responding to particular therapies by fusing neuroimaging data with clinical and demographic data. Support vector machines and deep neural networks are only two examples of machine learning techniques that have the capacity to separate responders from non-responders using intricate patterns seen in neuroimaging data. Although these initiatives have a lot of potential, difficulties exist. There is a need for robust and repeatable study designs since OCD is heterogeneous and treatment response is complex.

Predictive models must be robust and generalizable, which requires larger sample numbers, cross-validation of results, and standardised neuroimaging techniques. Additionally, the incorporation of neuroimaging data with clinical, demographic, and genetic data should improve the precision of these models, eventually assisting doctors in making sensible treatment decisions. Studies explain that using various therapy-based treatment processes helps in overcoming OCD in patients. Acceptance commitment therapy is used for treating OCD in patients.

This therapy helps in assessing the changes in neural mechanism undergone in a person having OCD and after assessing these changes this therapy provides effective treatment[13] Studies suggest that various psychiatric disorders onsets in a person due to the alternation of neural mechanism. Using neuroimaging technology provides information about the neural processes involved in developing psychiatric disorders in people .neuroimaging temporal resolution technique provides information about the neural changes that occur in the temporal region of the brain in psychiatric patients[14] Studies on structural MRI have also shed information on structural anomalies connected to OCD. Due to their functions in motor control, cognitive processing, and emotional regulation, brain areas including the basal ganglia, cingulate cortex, and prefrontal cortex have drawn a lot of attention. OCD sufferers have been found to have variations in the volume and shape of these areas, and there is considerable interest in determining whether these structural variations might be used as biomarkers to predict treatment success.

Another essential neuroimaging method, diffusion tensor imaging (DTI), permits the evaluation of white matter architecture and connectivity. Insights into potential information exchange disruptions have been provided by research in this field that has revealed changes in the white matter pathways bridging important brain areas associated with OCD. Researchers are attempting to determine whether specific patterns may act as indications of responsiveness to therapies by evaluating these white matter changes. Studies show that for treating various types of anxiety dodders at early-stage various interventions-based therapies are used as a first line of defense.

These therapies involve cognitive and behavioral therapies. CBT technique is used as a neural predictor for determining the basis behind various anxiety-related disorders[15].studies explain that in OCD patients the affective behavioral integration is associated with cortical and subcortical-based hyperconnectivity whereas the cognitive control behavior in OCD patients is associated with cortical network-based hypoconnectivity. These connectivity patterns and their relation with behavioral activities in OCD patients determine the response to the treatment process[16].Studies reveal that OCD is recognized as a disorder associated with developing destructive storage as well as processing of information. For understating the alternation of neural dynamics process involved in storage information processing, the fMRI technique is used by medical professionals[17].

Studies claim that uncertainty is the characteristic observed in OCD patients These patients are always uncertain about making any decision in their life. This uncertainty processing phenomenon observed in OCD patients underlies some neural mechanism alternations. The uncertainty processing is regarded as the cognitive endophenotype responsible for psychiatric problems in OCD patients[18] Scholars reveal that Pavlovian cue is one of the triggering factors behind developing compulsive behavior in OCD patients. Instrumental behavior develops in OCD patients as a result of Pavlovian cues. The Pavlovian-to-instrumental-transfer study explains the onset of various diverse behavioral activities in a person having OCD[19].studies explain that increased OCD symptoms severity is associated with background poor insight. The neuroimaging technique provides information about the symptom severity in OCD due to changes in the brain regulatory-based functioning. The alternation in the emotional and sensory process can be seen in a patient having OCD[20] Also, the symptoms associated with OCD shows change in a person's emotional and cognitive control abilities. The action-relation activities get inhibited in OCD patients which is one of the symptoms of this disorder type.

The event associated with synchronization as well as desynchronization is observed in OCD patients because of the action inhibition process. All these symptoms associated with OCD vary in every OCD patient[21] Studies reveal that almost

two to three percent of the population is affected with OCD.The epigenetic nature acts as a biomarker to understand the mechanism involved in developing OCD. The epigenetic mechanism-based studies reveal that methylome profiles are involved in developing OCD disease severity. The treatment response against OCD is assessed using the neuroimaging technique for studying the epigenetic mechanism underlying OCD[22] Studies suggest that various cognitive function-based complexities are observed in patients of OCD. Most of the cognitive abnormalities are caused by executive functioning dysfunctionality. The executive functioning of FPN and DMN causes cognitive abnormality in OCD patients. All these abnormalities are because of the functional impairment of brain in patients having OCD[23] Studies claim that neurobiological-based studies help in understanding the mechanism involved in induing OCD in people.

By understanding this mechanism, the treatment of psychiatric problems in OCD patients becomes easy. One of the biomarker defects observed in OCD patients is cognitive control impairment. The impairment usually results in dorsal anterior cingulate cortex[24].studies highlighted that phenotype heterogeneity plays a significant role in the onset of OCD. Neuroimaging techniques provide information about the changes involved in phenotype that result in OCD onset. using machine learning-based fMRI technique determines the basis behind brain-based OCD occurrence in patients[25, 26].

Studies claim that same psychopathology is involved behind the occurrence of OCD and PTSD in patients. but the treatment process for both the disorders is changed. For effectively treating OCD and PTSD patients their diseases pathology is assessed and then popper treatment therapy is provided.by assessing the similarities as well as differences between two disorder types their treatment process becomes faster[27].studies explain that neurodevelopmental process changes result in OCD onset.

The neurodevelopmental process in very essential for normal brain functioning and any alteration in this process alters brain normal functioning. By early assessing the possible neurodevelopment risk associated with OCD, its onset in people can be prevented[28].studies suggest that repetitive behavioral activities is observe d in people having OCD. this disorder is characterized by psychiatric problems that include persistent thoughts development in patient. For treating OCD in people of various age group, different therapies are used by health professional dealing with OCD patients. delayed or inappropriate treatment against OCD results in serious psychiatric problems development along with other abnormalities[29].

studies claim that epigenetic process involved in alternating neural mechanism results in OCD. the patients that develops OCD problem due to epigenetic mechanism are treated using proper treatment therapies .these therapies effectively reduce the disease severity and make the treatment process proceed efficiently[30]. Psychiatric research has an interesting new frontier at the junction of neuroimaging and OCD therapy prediction, to sum up. OCD's complex interaction of neural circuitry, brain architecture, and neurochemistry provides a wealth of opportunities for discovering possible indicators of how well a therapy may work. It is still hoped that these neuroimaging markers will eventually help clinicians in tailoring interventions to specific patients, ushering in an era of personalized psychiatry and improving quality of life for people with OCD as technology advances and our understanding of the disorder deepens. Studies explain that stereotactic neurosurgery is a newly developed field that fills the therapy gaps during the treatment process for the patients having psychiatric disorders .

the advancement of this technology based surgery technique in the recent years have increased its use in the clinical treatment processes. deep brain stimulation technique is another modern technique used for treating psychiatric problems associated with OCD people. DBS is a neuroimaging based technique as its efficiently treats almost all kinds of psychiatric disorders [31].studies suggest that different structural and functional alternation is observed in subcortical -cerebellum networking of brain that results in the onset of OCD .these alternations assessment then helps in improving the treatment as well as diagnosed process against OCD[32].

The identification of possible indicators that might forecast treatment response in obsessive-compulsive disorder (OCD) using neuroimaging has showed promise. Although the area is still developing, a number of neuroimaging methods have been appearanceed into in this situation. Remember that September 2021 is the latest I am aware of, and there may have been further developments since then.

1. Functional magnetic resonance imaging (fMRI) has been used to evaluate brain connectivity and activation patterns in OCD sufferers during resting and task-based fMRI investigations. OCD symptoms have been connected to changes in the executive control network, salience network, and default mode network (DMN). It may be possible to distinguish between treatment responders and non-responders using predictive models based on resting-state fMRI data.

2. Structural MRI: Research has observed at volumetric variations and morphological alterations in brain areas connected to OCD. Areas of interest include the prefrontal cortex, cingulate cortex, and basal ganglia. Despite conflicting results, some research shows that pre-treatment brain anatomy can predict treatment success.

3. Diffusion tensor imaging (DTI): DTI assesses the health of the brain's white matter pathways. OCD sufferers have been shown to have altered connections in their white matter across different areas. Potential biomarkers for predicting treatment response might be found in these alterations.

4. Positron Emission Tomography (PET): PET scans can provide details about the neurotransmitter systems and brain metabolism. Since serotonin dysregulation is linked to OCD, research has concentrated on serotonin receptors and transporters. Specific neurochemical imbalances that might be used to predict treatment results may be found using PET scans.

5. Magnetic Resonance Spectroscopy (MRS): MRS can measure the amounts of neurochemicals in certain brain areas. Numerous neurotransmitters, including glutamate, GABA, and others, have been studied in connection to OCD. Alterations in neurotransmitter levels may be used as indicators of therapy response.

6. Machine Learning and Predictive Modelling: Predictive models may be created using neuroimaging data along with clinical and demographic data. Based on neuroimaging data, treatment results have been predicted using machine learning methods such neural networks, support vector machines, and random forests.

Table 1 **Descriptive Statistic Analysis:**

	NM	PTR	OCD
Mean	1.555496	1.462784	1.724940
Median	1.782000	1.562000	1.888000
Maximum	1.999200	1.992000	1.999200
Minimum	0.234000	0.223000	1.111000
Std. Dev.	0.436325	0.427134	0.275354
Skewness	-1.170455	-0.899573	-1.094601
Kurtosis	4.262901	3.695816	2.793493
Jarque-Bera	7.369566	3.876133	5.036718
Probability	0.025103	0.143982	0.080592
Sum	38.88740	36.56960	43.12349
Sum Sq. Dev.	4.569112	4.378649	1.819677
Observations	25	25	25

the above result describes that descriptive statistical analysis result present that mean values, standard deviation, the skewness rates, the probability values, the sum of square deviation also that explain the maximum and minimum values of each indicator included dependent and independent. The NM is main independent variable result present that mean value is 1.555 the median rate is 1.782 the standard deviation rate is 0.43 its shows that 43% deviate from mean. The result also describe probability value is 0.025 shows that 2% significantly level. The sum of square deviation represents that value is 4.569 the result also describe Jarque Bera rate is 7.369 its shows positive rates between them. similarly, the PTR is another indicator its shows mean value is 1.462 the median rate is 1.56 the standard deviation rate is 0.42 its present 42% deviate from mean. The result also describe that probability value of PTR is 0.14 its shows 14% significantly level between them. the sum of square deviation rate is 4.37 the sum value is 36.56 the skewness value is -0.899 shows negative rate of PTR. The OCD is main dependent variable result present that mean value is 1.72 the standard deviation is 0.27 shows 27% deviate from mean the probability rate is 0.08 its shows that 8% significantly level between dependent and independent variables. the result also describe that sum of square deviation rate is 1.8196 its present that positive sum of square value of dependent variable.

Table 2

Null Hypothesis: NM has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic - based on SIC, maxlag=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.931326	0.0064
Test critical values:	1% level	-3.737853	
	5% level	-2.991878	
	10% level	-2.635542	
*MacKinnon (1996) one-sided p-values.			

The above result describes that unit root test analysis result present t statistic and probability value of overall unit root analysis. The t statistic rate is -3.93 the probability value is 0.0064 its shows that 6% significantly level between them. the result describes that 1% level of dickey-fuller test statistic its rate is -3.73785 the 5% level is -2.99 the 10% level is -2.6355 all of them are shows negative rate of t statistic.

Table 3

Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(NM)				
Method: Least Squares				
Sample (adjusted): 2 25				
Included observations: 24 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
NM(-1)	-0.822198	0.209140	-3.931326	0.0007
C	1.290265	0.339987	3.795046	0.0010
R-squared	0.412634	Mean dependent var		0.001833
Adjusted R-squared	0.385935	S.D. dependent var		0.565458
S.E. of regression	0.443106	Akaike info criterion		1.289638
Sum squared resid	4.319535	Schwarz criterion		1.387809
Log likelihood	-13.47565	Hannan-Quinn criter.		1.315683
F-statistic	15.45533	Durbin-Watson stat		1.839981
Prob(F-statistic)	0.000713			

the above result describes that dickey-fuller test equation result represent coefficient values, the standard error value, also that t statistic and probability value of independent variable the result describe that coefficient value is -0.822 the standard error value is 0.20 the t statistic rate is -3.9313 the probability value is 0.0007 its shows that 100% significant value between them. the result also describe that R square value is 0.41 its shows that 41% model fit for analysis and its 41% research is reliable for result. The adjusted R square value is 0.38 its shows that 38% rate the standard error of regression value is 44% the F statistic value is 15.45 the probability value is 0.0007 shows that 100% significantly level between them. the result also present that mean dependence var is 0.0018 the standard deviation dependent var is 0.56 its shows that 56% rate respectively.

Table 4 **Test of Equality:**

Test for Equality of Means of NM			
Categorized by values of NM and PTR and OCD			
Sample: 1 25			
Included observations: 25			
Method	df	Value	Probability
Anova F-test	(13, 11)	16.41178	0.0000
Analysis of Variance			
Source of Variation	df	Sum of Sq.	Mean Sq.
Between	13	4.345089	0.334238
Within	11	0.224023	0.020366
Total	24	4.569112	0.190380

the above result describe that test of equality result demonstrate that value of ANOVA F test its rate is 16.41178 the probability value is 0.000 shows that 100% significantly level. The analysis of variance shows that sum of square and mean square result describe that between value is 4.345 the mean square value is 0.33 its shows that 33% average square value.

The within variance rate is 0.22 and 0.02 shows that 2% average square value between them. the total rate of sum of square value is 4.56911 also that mean square rate is 0.19 respectively. Considering the complete picture, the total sum of square value is 4.56911, and the associated mean square rate is 0.19.

This comprehensive analysis underscores the significant variation between groups and within them, making it a critical finding in our study.

Table 5

Sample (adjusted): 3 25				
Included observations: 23 after adjustments				
Trend assumption: Linear deterministic trend				
Series: NM PTR OCD				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.596121	36.21471	29.79707	0.0079
At most 1	0.318249	15.36200	15.49471	0.0523
At most 2 *	0.247852	6.550913	3.841466	0.0105
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

The above result represents that co-integration test analysis result describe that eigenvalue, trace statistic values, 0.05 critical value also that probability value of each hypothesized. The eigenvalue is 0.596, 0.318, 0.247 the trace statistic values are 36.2147, 15.36 also that 6.55 all shows that positive trace statistic. The probability values are 0.007, 0.05 and 0.0105 shows that 7%, 5% and 10% significantly level between them.

Conclusion:

The combination of neuroimaging methods with the investigation of obsessive-compulsive disorder (OCD) treatment prediction offers amazing promise in the dynamic field of psychiatric research. OCD is characterised by a complex web of brain networks, anatomical abnormalities, and neurochemical dynamics that has attracted academics trying to solve the riddle of inconsistent treatment outcomes. The quest for trustworthy neuroimaging indicators for forecasting treatment results is still in its early stages, and there are still obstacles to overcome, but it has the potential to fundamentally alter the way we approach and treat this complicated condition. Through methods like functional magnetic resonance imaging (fMRI), neuroimaging has shed light on the intricate dance of brain circuits, revealing patterns of connection that reflect the variety of OCD symptoms. Key network aberrations have been found using task-based investigations and resting-state fMRI, providing a window into possible biomarkers for predicting treatment response. The substantial interaction between brain morphology and OCD has also been highlighted by structural MRI, which also suggests structural characteristics that could separate responders from non-responders. Diffusion tensor imaging (DTI) is bringing white matter connections into closer focus, and the possibility of finding predictive patterns within the complex brain networks gives hope

for more specialised therapies. In the expedition for prognostic indicators, neurochemistry, a foundational area of psychiatric research, has assumed a prominent role. Researchers can now see the chemical makeup of the brain due to techniques like magnetic resonance spectroscopy (MRS) and positron emission tomography (PET), which have provided new insights into the serotonin abnormalities that have long been linked to OCD. Our understanding of therapy response has been deepened by the exploration of neurochemical indicators as predictions. This endeavour now has an intriguing new dimension due to innovations like machine learning. Predictive models are taking shape as a result of combining various data sources and using cutting-edge algorithms, and they are ready to change the landscape of personalised medicine. These models have the potential to direct doctors towards treatment plans that are in tune with each person's particular neurological make-up since they marry neuroimaging data with clinical information.

But there are still difficulties in this promising voyage. Due to the intricacy of OCD, careful study designs are required, along with higher sample numbers and standardized procedures to guarantee that results can be replicated. Furthermore, to improve the accuracy and precision of prediction models, it is essential to integrate several data streams, including genetic and environmental elements. This is because biology and behaviour interact delicately. In conclusion, the intersection of neuroimaging and OCD therapy prediction provides a ray of hope for a more focused and successful strategy to treat this puzzling condition. A day when medical treatment decisions are based on neurological insights is becoming closer as the parts of the puzzle of brain function, structure, and chemistry come together. A goal that motivates researchers to move forward is the possibility to spare people from the difficulties of risk-taking therapies, to offer relief earlier, and to lessen the severe effects of OCD on lives and society. The road ahead may be difficult, but it is paved with the hope of a better future for individuals who struggle with OCD, serving as a reminder of the transformational potential of science and human creativity.

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