Executive functions, Metacognitive Beliefs, and Thought Control Strategies in Adolescents with Obsessive Compulsive Disorder

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Abstract: This is a correlational research work, non-interventional and cross-sectional in nature on adolescents with obsessive compulsive disorder. The study group(n=20) was matched with healthy control group(n=20) on age, gender, and education. WCST, MCQ-C, and TCQ-CA were administered to assess their executive functions, metacognitive beliefs and thought control strategies. Relationship between the executive function and metacognitive beliefs were studied. Additionally, relationship between executive function and thought control strategies were studied. The study group performed poorly on WCST compared to healthy control group at $p<0.001$. Heightened cognitive monitoring, punishment thought strategy, and over-all increased metacognitive beliefs were found to have independent and significant relationship with poor performance on WCST at $p<0.05$ level of significance.

Keywords: Metacognition, Executive Functions, Thought control strategies, Obsessive Compulsive Disorder, Indian Adolescents.

1. Introduction

Obsessive compulsive disorder is an anxiety disorder that debilitates an individual with intrusive thoughts, urges, images or impulses called obsessions, neutralizing ritualistic acts called compulsions or both obsessions and compulsions occurring simultaneously. There has been but one epidemiological study in India in 1993 that states that the lifetime prevalence of obsessive compulsive disorder is 0.6%(Kahanna S, Gururaj G, & Sriram T.G, 1993). The incidence and prevalence in paediatric population is not a novice, point prevalence study by Jaisooriya, T. S., Janardhan Reddy YC, Thernnarasu, K.V, et al(2015) have reported that adolescents suffer of OCD in Indian population with appoint prevalence of 0.8%, while the life time prevalence in the national mental health survey in 2015-16 has been reported as 0.3% . As much as these epidemiological studies have done their best to report prevalence both lifetime and point, but there have not been much studies to exclusively dedicated to the child and adolescent population.

Several studies in the past suggest that obsessive compulsive disorder typically cause anomaly in the executive function like cognitive flexibility and response inhibition. Executive function has been categorically associated with the frontal lobe and prefrontal lobe as the empirical literatures have suggested in the past(Schmidtke, Schorb, Winkelmann & Hohagen, 1998). Executive functions are the higher cognitive functions that are involved in planning, cognitive flexibility, response inhibition towards non-desired stimulus, strategy formation and its application, and recognition of the instance to change strategy. Executive functions in several studies have been successfully studied using WCST, Stroop test, CANTAB neuropsychological battery , BRIEF questionnaire and so on. Studies related to obsessive compulsive disorder suggest that the frontal lobe, prefrontal cortex, orbitofrontal cortex, caudate nucleus, and lenticular nucleus, cause executive dysfunction, inappropriate information processing leading to false alarms, anxiety, and obsessions(Coulacoglou, & Saklofske, 2017; Cavedini, Ferri, Scarone, & Bellodi, 1998; Rezai, Andreason, Alliger, Cohen, Swayze II, &O'Leary, 1993;). Another way to understand this executive dysfunction in obsessive compulsive disorder is to appreciate the metacognitive model by Adrian Wells. This model focuses on the phenomenology of thinking and maintenance of OCD , this model emphasizes on the maladaptive and exaggerated importance on the power of belief and the importance of thinking which causes an individual to exaggerate the significance of thoughts(Wells, Myers, Simons& Fisher, 2017; Wells. 1997). The obsessions according to this model activates metacognitive beliefs that convince the subject of false alarms related to significance and importance of such pathological thoughts that are in fact non-significant, in response to such false alarm individual applies strategies like suppression to cope with it. However, it is rendered useless due to its paradoxical nature. The subject finds it hard to

decentre themselves from such thoughts, which is typical of OCD. This inability to decentre is also due to the pathological information processing involving various neuroanatomical cause in OCD (Gruner, & Pittenger, 2017).
Some of the recent and cognitive studies in the past suggest some association between executive functions and metacognition (Kraft, Jonassen, Stiles, & Landrø, 2017; Janeck, Calamari, Reimann, & Heffelfinger, 2003). Even though some literature may suggest that metacognition and executive functions are analogous in nature and share some common framework (Roebers, 2016; Fernandez-Duque, Baird, & Posner, 2000). However, there is dearth of literature regarding their association especially among Indian adolescents suffering of Obsessive Compulsive Disorder. .

2. Materials and Methods

2.1 Study design

This is a correlational research study. It is cross-sectional, case control study and non-interventional in nature. Adolescents, aged 10-16 years of age, who are currently diagnosed with Obsessive Compulsive Disorder as per DSM-5 criteria with the symptom severity rating of 8 and more on C-YBOCS using standardized tools

2.2 Study sample

The sample size consists of 20 subjects each, in the study and control group, respectively. Adolescents diagnosed of Obsessive Compulsive Disorder in the study group were matched healthy control subjects and recruited in the study. Purposive sampling was well suited for this research. Treatment naïve subjects were recruited in the study group in order to control any of its effect on performance on the psychological test scores.
The study sample was drawn from the Child and Adolescent Psychiatry outpatient services from the Department of Psychiatry at King George's Medical University, Lucknow, on specified weekdays between November 2017 to March 2018. All the subjects, diagnosed with Obsessive Compulsive Disorder (as per DSM-5) were screened as per the selection criteria of the study group.
The inclusion Criteria for study group entailed of having symptomatic adolescents from age range 10 years through 16 years, who fulfilled criteria of OCD as per DSM-5. The subjects were ruled out of any other AXIS I disorders, i.e, psychiatric comorbidity of Psychosis, Depression, Bipolar Disorder, ASD, SLD, ADHD, ODD, Conduct disorder, Tic disorder, Substance use disorder, and Mental retardation, and those OCD patients having sub-clinical score of <7 on C-YBOCS were excluded. It was made sure that patients who had not undergone any psychotherapeutic intervention were included. The healthy control group subjects were drawn from community. The control group consisted of subjects matched on the basis of age, gender, and education using group matching method.

2.3 Tools

a. Mini-international Neuropsychiatric Interview 7.0.2 for children (MINI-KID-7.0.2) by Sheehan DV et al 2010. is a short and structured diagnostic interview developed for ruling out psychiatric disorders, updated according to DSM-5 diagnostic criteria by Sheehan DV et al 2010. The test–retest reliability estimates based on kappa (κ) has been found from 0.33 to 0.79 across disorders, the samples and the informants. The parent–youth agreement on disorders was found to be low (average $\kappa = 0.20$) and the confirmatory factor analysis divulges evidence supporting that the convergent and the discriminant validity.

b. Children's Yale Brown Obsessive Compulsive Scale(C-YBOCS , Goodman, 1986) is a clinician administered, meant to assesses the severity of obsessive compulsive symptoms suitable for subjects from age 6 through 17 years by interviewing both parent and child about symptoms that occurred in the past and those apparent presently. They are further scored on the basis of the magnitude of disturbance, duration involved in the obsession and compulsions, and ability to control or yield to them. The reliability and convergent and divergent validity of the CY-BOCS-CR/PR were found to be satisfactory with internal consistency of 0.87 .

c. Metacognitions questionnaire for children (MCQ-C, Bacow et al 2009) is an adaptation of Metacognitive Questionnaire for Adolescents (Cartwright-Hatton et al., 2004). This questionnaire is used for assessing metacognition in children and adolescents from ages 7 through 17 years. It consists of 24-items that measures levels of cognitive monitoring, positive meta-worry, negative meta-worry and SPR(superstition-punishment-responsibility) belief. The internal consistency to be 0.73 and satisfactory. The concurrent validity of each subscale was established using CDI AND PSWQ-C in the clinical sample.

d. Thought Control Questionnaire for children and adolescents (TCQ-CA, Meiser-Stedman, 2014) was adapted from the original TCQ by Wells and Davis 1994 which was meant for adults. This tool has acceptable reliability and validity calculated with Cronbach's a coefficients for the TCQ-CA subscales were found to acceptable based on the initial pilot study on high school pupil and later on psychiatric patients aged 10-16 years. This is a metacognitive tool consisting of 30 items and five subscales of thought control strategy, namely, distraction, punishment, reappraisal, social control, and worry.

e. Wisconsin Card sorting Test (Heaton et al., 1993) is one of the most frequently used test for assessing executive functions of the frontal lobe based on individual's capacity to identify the sorting principle, and respond to feedback concerning response accuracy. This test was computer administered and the scoring included percentage errors, perseverative responses, perseverative errors, non-perseverative errors, conceptual level responses, categories complete, trial required to complete first category, failure to maintain set, and learning to learn.

3. Procedure

The study was conducted after getting ethical clearance from the ethical committee and research cell of King George's Medical University Lucknow. The old as well as new cases patients diagnosed with OCD attending the Child and Adolescent Psychiatry O.P.D on specified days, Department of Psychiatry, King George Medical university, Lucknow, were initially assessed according to DSM-5 and then the diagnosis was confirmed by the consultant psychiatrists of the respective OPD. Subjects were informed about the non-invasive nature of the test and both the assent and consent was taken from the subjects and their respective guardians. Patients were then assessed on the basis of inclusion and exclusion criteria. The aforementioned tools mentioned were administered on all subjects of both the groups except C-YOBCS which is applicable on clinical subjects.
The sample size comprised of 20 subjects in the study group and 20 comparable healthy controls based on group matching of age, gender, and education. It was ensured that both psychotherapeutically naïve subjects were included and no other psychiatric comorbidities were present in the subject. The subjects were advised not to take any benzodiazepines a night before the assessments, hence, effect of drugs were partially controlled.

3.1 Statistical Analysis

The results are presented in frequencies, percentages and mean ±SD. Chi-square test was used to compare the categorical variables between the groups. Unpaired t-test was used to compare the continuous variables between the groups. Pearson correlation coefficient was calculated amongst clinical parameters. The p-value<0.05 was considered significant and <0.001 was considered as highly significant. All the analysis was carried out on SPSS 20.0 version (Chicago, Inc., USA).

4. Results & Discussion

4.1 Results

39 patients were screened in all, and 5 potential subjects were excluded due to the other psychiatric illnesses, 5 potential subjects and their guardians withdrew content, 5 potential subjects were ruled out because of they did not satisfy the criteria age range and 4 potential subjects who were previously under treatment were found to asymptomatic at the time of screening. Finally, there were 20 participants in the study group with matched subjects in the control group.

TABLE 4.1 :Socio-demographic characteristics of the sample

SOCIO- DEMOGRAPHIC VARIABLES		STUDY GROUP n=20	CONTROL GROUP n=20	SIGNIFICANCE
Age Range	10-16 YRS	20(100%)	20(100%)	t=0.12; p= 0.45
	Mean	14.05±1.28	13.95±1.32	
Gender	Male	16(80%)	4(20%)	Chi-square= 0.00 p=1.00
	Female	16(80%)	4(20%)	
Education	≤ 8th Grade	9 (45%)	7 (35%)	Chi-square= 0.42; p=0.52
	9th-10th Grade	11 (55%)	13 (65%)	

Table 4.1 depicts that there were no statistically significant among the socio-demographic differences between the study and the control group.

TABLE 4.2: Distribution of participants on the basis of severity and duration of OCD

SEVERITY	FREQUENCTY	PERCENTAGE
MILD	7	35
MODERATE	4	20
SEVERE	7	35
EXTREME	2	10

Table 4.2 shows that when assessed on C-YBOCS 7(35%) subjects had Mild, 4(20%) had Moderate, 7(35%) had Severe, and 2(20%) had Extreme level of severity of symptoms of OCD.

TABLE 4.3: Frequencies and percentage of subjects from the study group falling under respective duration of illness

DURATION	CASES
DURATION<6 months	3 (15%)
6 months-12 months	14 (70%)
>12 months	3 (15%)
MEAN / SD± (in months)	13.25 ± 9.07 months

Table 4.3 shows that when assessed on C-YBOCS 7(35%) subjects had Mild, 4(20%) had Moderate, 7(35%) had Severe, and 2(20%) had Extreme level of severity of symptoms of OCD.

In terms of duration of OCD, 3(15%) had less than 6 months of duration, 14(70%) were within duration of 6-12months while 3(15%) had the duration more than 1 year. The mean duration of the 20(100%) subjects was found to be 13.25 (SD 9.07 months).

TABLE 4.4: Comparison of WCST performance between study group and control group

WCST	STUDY GROUP	CONTROL GROUP	t-value, d.f.	p-value
TOTAL CORRECT REPONSES	73.05±18.80	97.65±9.14	5.26, 38	**<0.001****
TOTAL ERRORS	53.85±19.91	27.9±11.19	5.08,38	**<0.001****
PERSEVERATIVE RESPONSE	33.70±17.87	14.7±9.4	7.56, 38	**<0.001****
PERSEVERATIVE ERROR	33.7±13.64	14.65±7.78	5.29, 38	**<0.001****
CATEGORIES COMPLETED	3.40±2.77	6.75±2.23	4.16, 38	**<0.001****
NON-PERSEVERATIVE ERROR	28.20±24.65	6.75±4.73	3.73, 38	**<0.001****
TRIAL TO COMPLETE 1ST CATEGORY	16.30±24.64	18.55±9.25	0.38, 38	0.70
CONCEPTUAL LEVEL RESPONSES	54.20±26.12	86.20±14.90	4.75, 38	**<0.001****
FAILURE TO MAINTAIN SET	1.25±1.41	1.40±1.14	0.37, 38	0.71
LEARNING TO LEARN SCORE	3.32±6.57	1.56±4.14	0.99, 38	0.16

Table 4.4 depicts fewer correct responses, increased errors, increased perseverations, fewer categories completed, and poor conceptual level of understanding in the study group compared to the control group

- **significant at level p<0.001

TABLE 4.5: Comparison of the study and control group on MCQ-C

MCQ-C	STUDY GROUP (N=20)	CONTROL GROUP (N=20)	t-value, d.f.	p-value
POSITIVE WORRY	17.35±3.96	15.60±4.89	1.24, 38	0.22
NEGATIVE WORRY	11.75±3.72	7.60±1.75	4.50, 38	**<0.001****
SPR	19.55±3.79	6.70±1.38	14.24, 38	**<0.001****
COGNITIVE MONITORING	15.50±4.69	9.90±1.91	4.93, 38	**<0.001****
FULL SCALE MCQ-C	64.15±.68	51.20±15.38	3.18, 38	**0.05***

Table 4.5 depicts that the study group was found to be using increased Negative worry (t=4.50), SPR (Superstition-Punishment-Responsibility) (t=14.24), Cognitive monitoring (t=4.93) and full-scale score on MCQ-C (t=3.18, p<0.05*) at p<0.001**.

- *significant at level p<0.05
- **significant at level p<0.001

TABLE 4.6: Comparison of the study and control group on TCQ-CA

TCQ-CA	STUDY GROUP (N=20)	CONTROL GROUP (N=20)	t-value, d.f.		p-value
DISTRACTION	16.45±4.12	20.85±2.15	4.22, 38		**<0.001****
SOCIAL CONTROL	13.30±3.78	18.10±4.37	3.71, 38		**<0.05***
WORRY	12.65±4.22	7.10±1.61	5.49, 38		**<0.001****
PUNISHMENT	14.80±5.35	6.00±0.00	7.35, 38		**<0.001****
RE-APPRAISAL	14.75±3.46	10.25±2.48	4.71,38		**<0.001****
FULL SCALE TCQ-CA	71.95±8.73	62.30±6.56	3.94, 38		**<0.001****

Table 4.6 depicts that the study group was used significantly less of distraction at p<0.001*

and social thought control strategy at p<0.05*. Study group scored significantly more than controls on use of worry, punishment, and reappraisal at p<0.001**. The full scale TCQ-CA score of the study group was significantly higher than the control group at p<0.001**.

- *significant at level p<0.05
- **significant at level p<0.001

TABLE 4.7: Correlation between performance on WCST and scores obtained on Metacognitive Questionnaire(MCQ-CA)

Table 4.7 depicts correlation between WCST performance of executive functions and metacognitive beliefs in the study group, increased cognitive monitoring negatively affects executive functions.

- *significant at level p<0.05

WCST	POSITIVE WORRY	NEGATIVE WORRY	SPR	COGNITIVE MONITORING	FULL SCALE MCQ-C
TOTAL CORRECT REPONSES	-0.0737, 0.76	-0.2522, 0.28	0.196, 0.41	0.196., 0.41	**-0.5009, p<0.05***
TOTAL ERRORS	0.016,0.95	0.141,.55	-0.207,0.38	**0.492, p<0.05***	0.218, 0.36
PERSEVERATIVE RESPONSE	0.2255, 0.34	-0.1728, 0.47	0.0579, 0.81	-0.3024, 0.196	-0.0981, 0.68
PERSEVERATIVE ERROR	0.28, 0.23	0.018, 0.94	0.13, 0.58	0.25, 0.29	0.29, 0.21
CATEGORIES COMPLETED	0.10, 0.67	0.139, 0.5595	0.028, 0.9064	**-0.4541**, **p<0.05***	0.32, .174547
NON-PERSEVERATIVE ERROR	-0.25, 0.2866	0.16, 0.4915	-0.168, 0.4795	0.21, 0.3659	-0.002, 0.9939
TRIAL TO COMPLETE 1ST CATEGORY	-0.093, 0.6956	-0.28, 0.2378	-0.39, 0.0885	-0.023, 0.9227	-0.31, 0.1854
CONCEPTUAL LEVEL RESPONSES	0.02, 0.93	-0.27, 0.26	0.221, 0.35	**-0.5191, p<0.05***	-0.26, 0.27
FAILURE TO MAINTAIN SET	-0.31, 0.19	-0.29, 0.22	0.1995, 0.399	**-0.5447, p<0.05***	-0.42, 0.06
LEARNING TO LEARN SCORE	-0.15, 0.52	-0.06, 0.82	-0.08, 0.73	-0.046, 0.85	-0.14,0.56

TABLE 4.8: Correlation between performance on WCST and scores obtained on thought control strategies questionnaire(TCQ-CA)

WCST	DISTRACTION	SOCIAL	WORRY	PUNISHMENT	RE-APPARISAL	TCQ-CA FULL SCALE
TOTAL CORRECT REPONSES	-0.1463, 0.5382					
TOTAL ERRORS	0.201, 0.40	-0.046, 0.85	0.292, 0.212	-0.083, 0.729	0.307, 0.19	0.29, 0.22
PERSEVERATIVE RESPONSE	0.0753, 0.7524	0.1931, 0.4147	-0.3373, 0.14585	-0.3301, 0.1552	-0.2516, 0.2846	-0.3458, 0.13533
PERSEVERATIVE ERROR	0.22, 0.35	0.1049, .6598	0.1524, 0.5212	-0.23 , 0.33	0.1735. 0.4645	0.1493, 0.5299
CATEGORIES COMPLETED	0.2296, 0.33	0.1101, 0.644	0.1478, 0.534	-0.20, 0.398	0.308, 0.186	0.2245, 0.3413
NON-PERSEVERATIVE ERROR	-0.0724, 0.7617	-0.3079, 0.1866	0.2718,0.246356	0.3109, 0.182135	0.2297. 0.3299	0.2453, 0.2972
TRIAL TO COMPLETE 1ST CATEGORY	0.2804, 0.2311	0.267, 0.255126	-0.3663, 0.1122	-0.1654, 0.4859	0.07, 0.7693	-0.0026, 0.9913
CONCEPTUAL LEVEL RESPONSES	-0.1866, .432368	0.1575, .50859.	-0.2404, .308109	0.03, .900086	-0.2584, .268267	-0.2199, .351332
FAILURE TO MAINTAIN SET	-0.4098, 0.0727	0.0641, 0.788329	-0.0111, 0.96295	**0.53, p<0.05***	-0.0944,0.692199	0.1164, 0.6251
LEARNING TO LEARN SCORE	0.2276, 0.3345	-0.2435,0.3009	0.0033, 0.98898	0.0546, 0.8191	-0.2213, 0.3484	-0.0507, 0.83189

Table 4.8 depicts correlation of executive function obtained from WCST performance and scores obtained for thought control strategies used by adolescents in the study group

- *significant at level p<0.05

4.2 Discussion

The aim of this research work was to study the relationship between the executive functions and metacognitive beliefs in adolescents with obsessive compulsive disorder(OCD). Additionally, the thought control strategies were not only studied and compared between groups, but also relationship between the thought control strategies and executive functions was explored.

The study group and the control group were found to have no clinically significant difference on the sociodemographic variables. The study group included obsessive compulsive disorder with severity level of mild(7), moderate(4), severe(7), and profound(2), and therefore, constituting 35%, 20%. 35%, and 10%, respectively. The mean duration of illness was found to be 13.25 (± 9.07) months.

The study group was found to perform significantly poor on WCST compared to the healthy control group. Adolescents with OCD returned fewer number of 'total correct responses'(73.05±18.80), scored lower on categories completed(3.04±2.77), and conceptual level responses(54.20±26.12) at significant at p<0.001.The study group also scored higher on total errors(53.85± 19.91), perseverative responses(33.70±17.87), perseverative error(33.70±13.64), and non-perseverative errors(28.20±24.65) at p<0.001. The Wisconsin card sorting test is meant to study the executive function of the frontal lobe. Since it helps to measure abstract ability of an individual, to shift and maintain set, capacity to employ feedback and inhibitory potential of the individual towards interference(Spree & Strauss, 1998). WCST involves the activation of left dorsolateral prefrontal cortex(Rezai,1993). Poor performance on the set shifting capacity from one sorting principle to another due to perseverative interferences of the former sorting principle is associated with dorsolateral frontal lobe lesions(Milner, 1963). In individuals with obsessive compulsive disorder, cognitive inflexibility is a very common phenomenon. Cognitive inflexibility is marked by inability to adjust one's behaviour(overt and/or covert) to the demands of changing feedback from the environment which is commonly understood as the set shifting capacity. The literature also suggests that subjects with obsessive compulsive disorder seem to have broad range or diffuse impairment in their executive functions. The findings suggest that subjects with obsessive compulsive disorder yield less accurate responses on tests of executive functions and tend to commit errors subject to their inability to shift attention and change strategies in response to cues, therefore, commit more perseverative errors (Snyder et al., 2015; Dajani & Uddin, 2015; Baykal,

KARABEKİROĞLU, & ŞENSES, et al., 2014; Abramovitch et al., 2013; Armbruster, 2012). The study group also completed less categories and scored poorly on conceptual level responses as awareness of sorting principle indicative of poor abstract concept formation (Kashyap, Kumar, Kandavel, & Reddy, 2013; Rao, Reddy, Kumar, Kandavel, & Chandrashekar, 2008).

On the metacognitive questionnaire, the study group scored higher on the negative worry(11.75±3.72), SPR(superstition-punishment-responsibility, 19.55±3.79), and cognitive monitoring(cognitive awareness, 15.50±4.69) than the healthy controls at $p<0.001$. The study group also scored higher on over-all metacognitive belief(Full scale MCQ-C, 64.15±0.68) than healthy control group at $p<0.05$. Negative worry is better understood as negative belief about uncontrollability and danger about worry. Individuals with anxiety disorder often experience distress due to the ruminations. Negative beliefs about one's intrusive thoughts and ruminations has been found to be consistently associated with worry and obsessional severity. Therefore, increased negative beliefs about one's thought are in turn inimical towards individual's psychological well-being(Sica, Steketee, Ghisi, Chiri, & Franceschini, 2007). Another theme of negative belief is SPR(Superstition-Punishment-Responsibility) which implies superstitious beliefs about one's behaviour, inflicting punishment on oneself for tabooed thoughts or other intrusive images or urges, and inflated responsibility towards one's capacity to control one's thoughts(Baccow et al., 2009). Punishment as a thought control strategy alone was found to have positive correlation at failure to maintain set on WCST(0.53) at $p<0.05$. Punishment is used as one of the thought control strategies to gain dominance over one's intrusive thoughts. This inflated responsibility, and determination to control them, has been found to be related to as a prominent and independent predictors of OCD(Baccow et al., 2010, 2009; Sica, Steketee, Ghisi, Chiri, & Franceschini, 2007) while superstitious beliefs have been found to be correlated with obsessions and compulsivity(Frost, Krause, & McMahon, et al.,1993). The study group also scored higher on cognitive monitoring which is heightened awareness about one's mental phenomenon. Cognitive monitoring was also found to be correlated to performance on WCST. Increased cognitive awareness was negatively correlated with the number of categories completed(-0.4541), conceptual level of responses(-0.5191), and failure to maintain set(-0.5447) at $p<0.05$. Heightened cognitive awareness was also found to be positively correlated with increased total errors(0.492) at $p<0.05$. Heightened self-consciousness or cognitive awareness increases possibilities for negative appraisals of intrusive thoughts, in turn encourages increased importance towards beliefs about thoughts, and therefore increases the likelihood of obsessive compulsive disorder(Janeck, Calamari, Reimann, & Heffelfinger, 2003). Cognitive appraisal along with individual experience, understanding of self and one's situation furthers heightened cognitive awareness and monitoring leading to rigidity and perseverations(Fresco, Frankel, Mennin, Turk, & Heimeberg, 2002). The study scored higher on overall metacognitive beliefs which consistent with previous findings(Barua, Singh, & Agarwal, 2020). Increased overall metacognitive beliefs have been found to be negatively correlated with total correct responses(-0.5009) at $p<0.05$ suggests the increased metacognitive beliefs affect executive functions. The relationship can be better understood with the well-established Self-Regulatory Executive function Model(S-REF) and Cognitive Attentional Syndrome(CAS)for anxiety disorder whereby individual's unique personal significance to an intrusive thought leads to incapacity to decenter from it and by extension leads to perseverative process, and therefore, affecting the executive functions. Phenomenology of this disorder involves metacognitive aspects of inflated responsibilities towards intrusive thoughts, superstitious beliefs /magical beliefs towards one's behaviour, consistent urge to control these obsessions causes increased frustration and negative evaluation of self for these thoughts and inability to control them. The more individual tries to avoid or skip the ruminations, which paradoxically increases awareness towards it, which leads the subjects to spend more time into internal thought process. Cognitive rigidity further prohibits the subject from shifting one's attention, away from the painful intrusions. Maladaptively heightened in OCD leading to maladaptive metacognitive strategies that maintains the symptomatology in OCD(Wells, Meyer, & Simmons, et al., 2017; Wells, 1994; Wells & Matthews, 1994). Several studies in the past few decades have explained this poor information processing, obsession slowness, and over load on cognition, therefore, resulting in poor performance on neuropsychological test(Lacerda, Dalgalarrondo, & Caetano., et al., 2003; Rachman,1974). Classical symptoms in OCD, are related to intrusive, thoughts, images, urges, and impulses that may be sexual, aggressive, related to contamination, or moralistic in nature. Individuals typically may spend an hour or more to neutralize or undo them with ritualistic overt/covert behaviour(Rajashekharaiah & Verma, 2016).

4.2 Strength of the study

The study has homogenous sample with the study group matched on age, gender, and education, there was no significant difference on sociodemographic variables between the groups. The effect of drugs was partially controlled since the patients were asked to stop benzodiazepines a night before the testing. Psychotherapeutically naïve patients were included to make sure any metacognitive or cognitive strategies learnt in therapy would not affect their belief system and by extension their scores on metacognitive and thought control questionnaires. There has been a significant dearth in literature on a unifying paradigm and relationship between executive functions and metacognition specifically in child and adolescent population. This study has focused on studying this relationship and has also focused on adolescent population with obsessive compulsive disorder.

4.3 Limitations

Keeping in mind the inclusive criteria for homogeneity and tight time frame allowed for sample collection, only a small sample could be collected. Therefore, generalization of this study is not possible. The subjects were not assessed for subclinical level of anxiety and depression. The participants were not assessed colour blindness. WCST is not a pure test of frontal lobe functions as literature suggests that once set shifting is taken into account, inhibitory and change in strategy contributes to explanation of performance on WCST(Miyake, Emerson, & Friedman, 2000). Other correlations were expected with executive functions were with positive beliefs about worry, and with negative belief about worry, however, it is noticeable that both MCQ-C and TCQ-CA are not exclusively meant for assessing beliefs and thoughts in obsessive compulsive disorder.

4.5 Future implication of the study

With a larger sample size and generalizability of the study metacognitive strategies could help Indian adolescents with a more culturally suited metacognitive paradigm to remedy their metacognitive beliefs and maladaptive strategies. With further double dissociation techniques cognitive functions can be better assessed in future studies.

5. Conclusion

The study group scored poorly on the Wisconsin Card Sorting Test of executive functions compared to the health control group. The study group was found to have higher scores on metacognitive beliefs and used thought control strategies more than the healthy controls. It was found that increased metacognitive beliefs, heightened cognitive monitoring(awareness), and punishment strategies were found to have independent relationship with poor executive functions in adolescents with obsessive compulsive disorder.

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