Neuropsychological and Clinical Profiles of Children and Adolescents Diagnosed with Childhood Obsessive Compulsive Disorder

Saliha BAYKAL¹, Koray KARABEKİROĞLU², Ahmet ŞENSES³, Melih Nuri KARAKURT⁴, Tülay ÇALIK², Murat YÜCE²

¹Clinic of Pediatrics Psychiatry, Dumlupınar University Evliya Çelebi Training and Research Hospital, Kütahya, Turkey

²Clinic of Pediatrics Psychiatry, Ondokuz Mayıs University Faculty of Medicine, Samsun, Turkey

³Clinic of Pediatrics Psychiatry, Isparta Maternity and Children Hospital, Isparta, Turkey

⁴Clinic of Pediatrics Psychiatry, Diyarbakır Maternity and Children Hospital, Diyarbakır, Turkey

ABSTRACT

Introduction: The differential features of childhood-onset obsessive compulsive disorder (OCD) compared to adult-onset OCD are being more of a focus of attention in recent years. The aim of this study was to determine the clinical and neuropsychological profiles of children and adolescents diagnosed with childhood-onset OCD and to investigate the association between the duration, severity, comorbidity, and family history of the disorder and clinical and neuropsychological functional impairments.

Methods: Thirty-five OCD patients (patient group) and 35 healthy control subjects (control group) between 8-15 years of age were included. To investigate the neuropsychological profiles, the Wisconsin Card Sorting Test (WCST), Stroop Test, and Continuous Performance Test (CPT) were applied. To assess the clinical and behavioral profiles, the Children's Depression Inventory (CDI), Conner's Parent Rating Scale (CPRS-48), and the Yale Brown Obsessive Compulsive Scale (YB-OCS) and Yale Global Tic Severity Rating Scale (YGTSRS) were given.

Results: Based on the performance in the WCST, Stroop Test, and SPT, the results of the study reveal that childhood-onset OCD patients have statistically significant worse performance compared to healthy controls in terms of executive functions, sustained attention, and motor inhibition tasks. Excluding the comorbid diagnoses, childhood-onset OCD patients did not show a difference in behavioral problems, but they had higher levels of anxiety compared to healthy controls.

Conclusion: The findings of this study reveal that independent of the duration, severity, comorbid problems, and anxiety levels, the disorder itself is associated with worse performance in executive functions, attention, and motor inhibition processes, and a positive family history of OCD is an important risk factor. Long-term follow-up studies with patients diagnosed with childhood-onset OCD would be a logical next step in order to determine the cause-effect relation between the disorder and cognitive impairments. (*Archives of Neuropsychiatry 2014; 51: 334-343*)

Key words: Obsessive-compulsive disorder (OCD), neuropsychology, early onset

Conflict of Interest: The authors reported no conflict of interest related to this article.

Introduction

Obsessive compulsive disorder is a disease that obsession and compulsions is frequently coexisted clinically but the presence of either obsession or compulsion is sufficient for making the diagnosis. It is resulting in the disability of the disorder affected individual (1).

The data obtained from epidemiological studies have demonstrated that OCD is not a rare condition in children and adolescents in contrast to previously accepted general data. Studies have shown that the lifelong prevalence of OCD is 3.0% and the

annual prevalence ranges between .5% and 2.1%. These rates are similar for children, adolescents, and adults (1,2,3).

In the literature, OCD is named as childhood-onset OCD if it started before adolescence and as adult-onset OCD if it started in adolescence or later (4). Although the differentiation between these two groups is not clear, childhood-onset OCD is different from adult-onset OCD in terms of gender distribution, accompanying psychiatric diseases, treatment response, distribution of obsessions and compulsions, and high-genetic transmission; it is still being discussed if it is a subgroup. It has been reported that genetic involvement ranges between 45% and 65% in child-

Correspondence Address

Dr. Saliha Baykal, Dumlupınar Üniversitesi Evliya Çelebi Eğitim ve Araştırma Hastanesi, Çocuk Psikiyatrisi Kliniği, Kütahya, Türkiye

Phone: +90 505 484 43 86 E-mail: salihabaykal35@hotmail.com Received: 01.10.2012 Accepted: 20.03.2013

©Copyright 2014 by Turkish Association of Neuropsychiatry

hood-onset OCD (5). Twin studies related with OCD have shown that comorbidity rates range between 70% and 80% in monozygous twins and between 20% and 50% in dizygous twins (6). The rates of OCD and subclinical OCD were examined in the first-degree relatives of individuals with a diagnosis of OCD, and subclinical OCD was found to be observed in 19.8% of the first-degree relatives of the individuals who had checking compulsions and in 8.7% of the first-degree relatives of the individuals who had washing compulsion (7). Based on these data, it is thought that genetic properties may be more important for some clinical subtypes of OCD, and genetic properties cause a predisposition to OCD rather than direct introduction to the disease.

The data obtained from imaging studies and neuropsychological studies are considerably important in understanding the pathophysiology of OCD. Structural and functional brain imaging studies comparing individuals with a diagnosis of OCD with healthy controls have demonstrated differences in the prefrontal cortex, basal ganglia, anterior cingulate cortex (ACC), and/or thalamus (8). Increased activity in the orbitofrontal cortex (OFC), ACC, and caudate nucleus in resting and symptom provocation states and decreased activity following treatment suggest that these regions are important in OCD symptoms (9). The medial region of OFC is particularly important with regard to reward and motivational evaluation and in learning the appropriate response to stimuli; it is directly related with the paralimbic, limbic, and diencephalic structures (insular cortex, amygdala, and hypothalamus) that are responsible for the regulation of emotion. The lateral region is related with behavioral inhibition, response prevention, and selection of one of the responses and is linked with the caudate nucleus (10). In addition, OFC is related with anterior cingulate cortex (ACC) that has a significant role in functions, including determining the appropriate behavioral pattern under unclear conditions, demonstrating the priority of strong response patterns, observing self-behavior, and detecting errors (11). The dorsolateral prefrontal cortex (DLPFC) among the prefrontal cortex regions that are responsible for executive functions is related particularly with attention, planning, and working memory (12,13).

A consistent model reflecting the neuropsychological characteristics of childhood-onset OCD cannot be established because of the few number of studies conducted with children with a diagnosis of OCD as well as the fact that studies have been conducted with different age groups and the difference in cognitive characteristics have been measured by tests used in different studies. The results obtained are intensified on executive tasks (response inhibition, changing installation, decision making) (14,15), non-verbal memory, spatial working memory problems (16,17), and attention (sustained attention, shift in attention) (18). Few studies conducted with adult samples indicate that the problems of response inhibition as well as change in installation (14) and planning (19) may be neuropsychological endophenotype candidates for OCD.

In this study, it was aimed to determine the clinical and neuropsychological characteristics of childhood-onset OCD to ex-

amine the effect of familial clustering and clinical variables on cognitive functions and to demonstrate the neuropsychological risk factors related with early-onset OCD.

Methods

Sample

The study sample was composed of two groups including the study group that consisted of 35 patients aged between 8 and 15 years diagnosed with OCD according to the DSM-IV-TR diagnostic criteria whose symptoms had begun at the age of 12 years and earlier and who had a score of 10 and above in CY-BOCS and the healthy control group that consisted of 35 individuals who had no familial history of psychiatric disease and showed similar socio-demographic properties with the study group. In addition, in some statistical analyses, the OCD group was divided into two groups as individuals with and without a positive familial history according to the presence of first- and second-degree family members clinically meeting the diagnostic criteria of OCD and who have received treatment according to parental interviews.

Clinical Assessment Tools

Sociodemographic Data Collection Tool: This form that was specifically prepared for this study by the investigators contained information related with identity, address, phone number, education status, familial socioeconomic status, parent-sibling status, and familial structure of the subjects. In addition, the age of disease onset, type and course of the disease, the time passed until presentation for treatment, the drugs used, and familial history of psychiatric disease were recorded for the patient group.

The Schedule of Affective Disorder and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL): All participants were assessed by K-SADS-PL, and the diagnoses and additional diagnoses were determined. This schedule is a semi-structured interview form developed by Kaufman et al. (20) in 1997 to determine the psychopathologies of children and adolescents in the past and present time according to the DSM-III-R and DSM-IV diagnostic criteria. The Turkish validity and reliability study for K-SADS-PL was performed by Gökler et al. (21).

Children's Yale-Brown Obsessive Compulsive Scale for Children (CY-BOCS): This scale, which was developed by Goodman et al. in 1986, is a semi-structured questionnaire form based on clinical interview. The assessment is made according to the clinical judgement of the interviewer based on the information given by the child and parents. As a result, the obsession severity score, compulsion severity score, and the total severity score composed of the sum of the two are obtained. The inter-assessor reliability study of the scale in the Turkish sample was published by Yücelen et al. (22).

Conners Parents Rating Scale (CPRS-48): This scale consists of a total of 48 items. The factor "attention deficit" is screened by 5 items, the factor "hyperactivity" is screened by 4 items, the factor "oppositional defiance" is screened by 5 items, and the factor "behavioral disorder" is screened by 11 items. The internal consistency of the scale was calculated by the Cronbach alpha coefficient and was found to be between .67 and .92 for four subscales. The item-total correlation range value (r) was reported to be up to .35–.81. The Turkish adaptation of the scale was performed in 1998 by Dereboy et al. (23).

Child Depression Inventory (CDI): This scale is a self-assessment scale that can be applied to children aged between 6 and 18 years. Each item includes three different options in this 27-item scale. The child is asked to select the most appropriate option for the last 2 weeks. Each item is calculated according to the symptom severity and scored as 0, 1, and 2. The higher the score obtained, the higher the severity of depression. The highest score is 54 and the cut-off value is 19. The Turkish validity and reliability study of the scale was performed by Öy et al. (24).

The Yale Global Tic Severity Scale (YGTSS): This scale is a schedule filled in by the clinician based on a semi-structured interview. Motor and vocal tics in the last 1 week are recorded based on the report of the child and parents. The adaptation of the scale to the Turkish sample and the reliability study were performed by Zaimoğlu et al. (25).

Neuropsychological Tests

Wisconsin Card Sorting Test (WCST): This test was developed in 1948 by Berg. Heaton et al. (26) modified this test in 1981 and 1993 and prepared its manual. In this study, the computer version of the test was used, and the total reaction number (WCST1), total error number (WCST2), total correct number (WCST3), completed category number (WCST4), total perseverative reaction number (WCST5), total perseverative error number (WCST6), total non-perseverative error number (WCST7), perseverative error percentage (WCST8), the number of reactions used for completing the first category (WCST9), conceptual level reaction number (WCST10), conceptual level reaction percentage (WCST12), and learning (WCST13) scores were analyzed.

The Stroop Color and Word test: This test was developed by Stroop in 1935 as an experimental task. The Stroop Test has various forms. In our study, the Stroop Test Basic Sciences Research Form (BSRF) was used. Standardization studies for the Stroop Test BSRF have been performed (27). Basically, it evaluates "intensification and sustainability of attention," "resistance against confounding stimuli," and "ability to stop and suppress inappropriate stimuli and tendency to perform inappropriate reaction" depending on time and the task given. It was found that the most valid characteristic measured by the

Stroop Test BSRF was a disturbing effect (the fifth part stated by the colors in the second card). In addition, the test has been reported to assess the reading speed (time for completing the first card) that reflects attention and identification of the color (time for completing the third and fourth cards). In our study, the Stroop-1 time score and Stroop-5 time score that evaluated attention were considered.

The Continuous Performance Test (CPT): This test that measures the ability to sustain attention is based on the follow up of changes that occur randomly in the flow of stimulus. It is realized on the basis of letters that appear and disappear on computer screen. Here, the target stimulus should be responded and the non-target stimuli should be avoided. Missed targets are evaluated as an indication for attention deficit, and pressing inappropriately is evaluated as an indication for impulsivity (28). The CPT is evaluated using a computer.

Wechsler Intelligence Scale for Children - Revised form (WISC-R): This is an intelligence test developed by Wechsler for children aged between 6 and 16 years (29). Its validity and reliability study for Turkish children were estimated (30). In the study, WISC was applied to the participants for psychometric assessment by the same specialist psychologist; verbal intelligence coefficient (IC), performance IC, and total IC were evaluated.

Procedure

In all participants, the diagnoses and co-diagnoses were evaluated by K-SADS-PL. For psychometric assessment, WISC was applied to the participants by a specialist psychologist. The sociodemographic data of the participants was transferred to the sociodemographic data form by the interviewer together with the parents. The CDI was applied to the participants, and CPRS-48 was applied to the families. CY-BOCS and YGTSS were filled in by the interviewer in the light of the clinical assessment data. Following the clinical assessment, the WCST, Stroop Test BSRF, and CPT were applied to the participants by the interviewer with an alternating order among consecutive subjects.

Evaluation of the data

In our study, the numerical variables were expressed as mean $\pm$ standard error or median (minimum–maximum), and the categorical variables were expressed as figures and percentages (%). Kolmogorov–Smirnov test was used for testing the normality distribution of the continuous variables; non-parametric tests were used in the analysis because our data did not show a normal distribution. Comparisons of the groups were performed using Student's t -test, Mann–Whitney U -test, and chi-square test depending on the appropriateness of the statistical assumptions. Spearman's correlation coefficient was used for correlation analyses of the variables that did not show normal distribution. The models predicted by the multiple regression model selection method were compared using the probability

ratio statistics and a p value of <0.05 was considered to be statistically significant. In the analysis of the data, the Statistical Package for Social Sciences 13.0 (SPSS Inc., Chicago, IL, USA) program was used.

The Ethical Principles of the Study

The necessary permission was obtained from the Medical faculty Ethics Committee, and the families and children who gave informed consent were included in the study.

Results

Lateralization Properties

In the lateralization evaluation of the participants, the rate of being right handed during writing was found to be 94.3%, and the rate of being left handed was found to be 5.7% in both OCD and control groups; there was no difference between the groups ($p=1$).

Intelligence measurement

The mean total WISC-R score as well as the mean verbal and performance scores were determined separately for the groups, and the median values were compared. No difference was found between the OCD and control groups in terms of total WISC-R scores and subscores ($z=.56$ and $p=.81$ for verbal IQ; $z=1.23$ and $p=.23$ for performance IQ, and $z=.89$ and $p=.5$ for total IQ). The total WISC-R scores were re-evaluated for the OCD groups with and without a positive familial history. In the group with a positive familial history, the median total WISC-R score was found to be 94.5 (min-max: 82–115), and the median value of the other group was found to be 96 (min-max: 86–109); there was no statistically significant difference between the groups ($p=.463$).

Clinical properties of the OCD group

In the OCD group, the mean age of disease onset was found to be 9.51 ± 1.77 , and 40% of the patients stated that they were confronted with a psychosocial stress at 1 month before the symptoms started. A total of 48.6% of the patients presented for treatment at the request of their families, 45.7% presented at their own wish and at the request of their families, and 5.7% presented with referral of their teachers.

Obsession and compulsion were present together in 85.7% of the patients, whereas compulsion without an accompaniment of obsession was present in 14.3% of the patients. When the symptom distribution of the OCD group was examined, the most common obsessions included contamination obsession (45.7%), aggression obsession (25.7%), sexual obsession (11.4%), religious obsession (11.4%), magical thoughts/superstitious belief obsession (5.7%), whereas the most common compulsions included washing/cleaning compulsion (45.7%), checking compulsion (34.3%), sorting/arrangement compulsion (28.6%), other compulsions (17.1%), repetitive ritual behavior (8.6%), and excessive magical thoughts/superstitious behaviors (8.6%).

When the OCD group was evaluated in terms of comorbid psychiatric diseases, it was observed that 71.4% of the patients had an additional diagnosis of psychiatric disease, and the most common comorbidities included tic disorder, attention deficit hyperactivity disorder (ADHD), pervasive anxiety disorder (PAD), specific phobia (SP), oppositional defiant disorder (ODD), social anxiety disorder (SAD), depressive disorder (DD), and enuresis.

WCST Scores

A statistically significant difference was found between the groups in the scores, excluding the total correct, the number of reaction for completing the first category, failure to sustain the installation, and learning subdimension scores when the WCST subdimension scores were assessed by the Mann–Whitney U-test. The intra-group comparison of the WCST subdimension scores is presented in Table 1.

Stroop Test Scores

When the comparison groups were analyzed in terms of Stroop-1 and Stroop-5 completion time scores, it was found that the OCD group completed Stroop-5 in a significantly longer time than the control group (Table 1).

Continuous Performance Test scores

CPT missing and erroneous pressing numbers showed significant difference between the groups. The OCD group scored significantly higher in both score types than the control group (Table 1).

Presence of Familial History and Neuropsychological Properties in OCD

After the patient group was grouped in terms of the presence of a positive familial history of OCD in first- and second-degree relatives, the neuropsychological test results were re-evaluated. The group with a positive familial history showed poorer performance in terms of the WCST total perseverative reaction number ($p=.049^*$), total perseverative error number ($p=.017^*$), CPT lack of pressing at the appropriate time ($p=.02^*$), and CPT pressing at the inappropriate time ($p<.001^*$) scores, whereas no difference was found between the groups in terms of Stroop-1 and Stroop-5 completion times ($p=.405$, $p=.134$).

Because the mean age of the OCD group with a positive familial history of OCD was significantly younger than the OCD group with a negative familial history of OCD, the effect of age on the neuropsychological properties that were found to be different between the two groups was checked using the Spearman's correlation coefficient. Although the CPT pressing at the inappropriate time [$p=0.00$, $\rho=(-.519)$] and the CPT lack of pressing at the appropriate time [$p=.037$, $\rho=(-.355)$] scores showed negative correlation with age, the total WCST perseverative reaction number [$p=.135$, $\rho=(-.257)$] and total perseverative error number [$p=.063$, $\rho=(-.317)$] were not found to be correlated with age.

Table 1. Comparison of WCST, Stroop, and CPT subdimension scores of the comparison groups

	OCD group Median (min–max)	Control Median (min–max)	z	p
	OCD group Median (min–max)	Control Median (min–max)	z	p
Total reaction number	128 (80–128)	95 (72–128)	4.0	<.001*
Total correct number	76 (51–90)	73 (60–100)	.1	.92
Total error number	47 (13–77)	25 (10–56)	4.73	<.001*
Total perseverative reaction number	28 (6–55)	14 (6–37)	4.64	<.001*
Total non-perseverative reaction number	20 (7–38)	12 (4–45)	4.26	<.001*
Total perseverative error number	24 (3–45)	12 (6–33)	4.25	<.001*
Completed category number	4 (1–6)	6 (3–6)	4.31	<.001*
Perseverative error percentage	18.7 (6.8–35.1)	11.7 (7–25.7)	4.44	<.001*
First category completion reaction number	12 (10–55)	12 (10–41)	1.178	.239
Conceptual level reaction percentage	53.1 (17.1–81.2)	72.4 (17.7–84.7)	4.42	<.001*
Failure to sustain installation	2 (4–4)	1 (0–11)	.71	.474
Learning score	–1.5 (–179–10.3)	–0.6 (–14.9–5.7)	1.15	.248
Stroop-1 completion time	10.24 (7.3–15.2)	9.71 (6.8–14.3)	1.903	.057
Stroop-5 completion time	30.72 (17.9–55.9)	27.16 (19–37.9)	2.719	.007*
CPT lack of pressing at the appropriate time	3 (0–16)	1 (0–7)	3.259	.001*
CPT pressing at the inappropriate time	9 (1–33)	3 (0–13)	3.954	<.001*

WCST: Wisconsin card sorting test; CPT: continuous performance test

Multiple Regression Analysis

In our study, a negative correlation was found between age and “pressing at the inappropriate time” as well as “lack of pressing at the appropriate time” scores in CPT, which is one of the psychometric tests used. Because the mean age in the OCD group with a positive familial history was younger than the mean age in the OCD group with a negative familial history and a statistically

Table 2. Multiple regression analysis results performed among the factors that could be effective on the CPT pressing at the inappropriate time scores

Variable	Parameter (B)	Standard error	Beta	t	p
Coefficient	43.543	7.327		5.943	.000
Familial history of OCD	–10.651	3.188	–.525	–3.341	.002*
Age	–1.342	2.896	–.065	–.463	.647
ADHD	–3.852	3.204	–.166	–1.202	.239
Tic disorder	–6.053	3.233	–.270	–1.872	.072

F(6,28)=6.942 $r^2=.598$
CPT: Continuous performance test; OCD: Obsessive compulsive disorder; ADHD: Attention deficit hyperactivity disorder

significant difference was found between the two groups in terms of the subscores that showed a negative correlation with age, multiple regression analysis was performed to check the effect of the variables on the test results. Two models were formed using the factors that may be effective for CPT pressing at the inappropriate time and CPT lack of pressing at the appropriate time (familial history, age, ADHD, and tic disorder comorbidity). Statistically significant results were obtained for both multiple regression models. It was observed that the presence of a positive familial history of OCD was the only factor that significantly affected the CPT pressing at the inappropriate time and CPT lack of pressing at the appropriate time scores (Tables 2,3).

ADHD Comorbidity and Neuropsychology Test Results

In the OCD group, ADHD comorbidity was present in nine individuals (25.7%). With the objective of excluding the effect of ADHD on the neuropsychological tests, the data that were found to be statistically significant were re-evaluated after these patients were excluded from the analysis. Exclusion of the subjects with ADHD did not affect the results. The results are summarized in Table 4.

Tic Disorder Comorbidity and Neuropsychological Test Results

In the OCD group, 10 individuals (28.6%) had a tic disorder comorbidity. With the objective of excluding the potential effect of tic disorder on neuropsychological tests, the data that were found to be statistically significant were re-evaluated after these patients were excluded from the analysis. The significance continued after these subjects were excluded from the analysis, except for Stroop-5 completion time. The results are presented in Table 5.

Disease Severity, Total Disease Time, and Neuropsychological Test Results

Spearman's correlation coefficient was used to evaluate if there was a correlation between the total score of CY-BOCS

Table 3. Multiple regression analysis results performed among the factors that could be effective on the CPT lack of pressing at the appropriate time scores

Variable	Parameter (B)	Standard error	Beta	t	p
Coefficient	6.464	5.545		1.166	.253
Familial history of OCD	-4.692	1.993	-.482	-2.355	.026*
Age	-0.587	.416	-.260	-1.410	.169
ADHD	3.761	1.840	-.338	2.044	.50
Tic disorder	2.961	1.983	-.275	1.493	.146

F(5,29)=2.454 $r^2=.297$
CPT: Continuous performance test; OCD: Obsessive compulsive disorder; ADHD: Attention deficit hyperactivity disorder

Table 4. Comparison of the neuropsychological test results of the control group and OCD group without ADHD comorbidity

	OCD without n=26 Median (min-max)	Control n=35 Median (min-max)	z	p
Total reaction number	128 (80-128)	95 (72-128)	3.68	<.001*
Total error number	47 (13-82)	25 (10-56)	4.44	<.001*
Total perseverative reaction number	30.5 (6-60)	14 (6-37)	4.48	<.001*
Total non-perseverative reaction number	22 (7-38)	12 (4-45)	4.25	<.001*
Total perseverative error number	25 (3-53)	12 (6-33)	3.96	<.001*
Completed category number	4 (1-6)	6 (3-6)	4.28	<.001*
Perseverative error percentage	20.7 (7.5-41.4)	11.7 (7-25.7)	4.28	<.001*
Conceptual level reaction percentage	51.1 (17.1-81.2)	72.4 (17.7-84.7)	4.22	<.001*
Stroop-5 completion time	30.9 (19.2-52.5)	27.1 (19-37.9)	2.22	.027*
CPT lack of pressing at the appropriate time	3.5 (0-22)	1 (0-7)	3.17	.001*
CPT pressing at the inappropriate time	7.5 (1-33)	3 (0-13)	3.19	.001*

CPT: Continuous performance test; OCD: Obsessive compulsive disorder; ADHD: Attention deficit hyperactivity disorder

that is used to determine the disease severity and the neuropsychological test results that were found to be statistically significant. A statistically significant negative correlation was found between the disease severity and the WCST completed

category number [$p=.34$, $\rho=(-.358)$]. No significant correlation was found between the disease time and neuropsychological test results.

Discussion

This study is a cross-sectional study that compared children and adolescents who were diagnosed with childhood-onset OCD with children and adolescents who had no clinical psychopathology in terms of sociodemographic, clinical, and neuropsychological properties; this study examined the potential effect of the presence of a positive familial history of OCD on the clinical and neuropsychological properties and investigated the relation between disruption in neuropsychological functions and clinical findings of the patients.

In our study, three neuropsychological tests were used to evaluate attention and executive functions. These include WCST, Stroop Test, and CPT. There are different points of views in terms of the properties measured by WCST. These properties include "abstract reasoning," "concept formation," "conceptual reasoning," "determining property," "working memory," "executive functions," and "attention." According to factor analysis studies, WCST subscores are collected under the following three factors: the first factor is qualified as perseveration tendency, the second factor is qualified as conceptualization/reasoning, and the third factor has been reported to explain a small portion of variance; no significant correlations are present between the scores in question (31). An increased perseverative reaction number in WCST has been associated with the inability to suppress incorrect response, and this leads to the persistence of maintaining the old installation (32). In the study of Andres et al. in which 29 patients with a diagnosis of OCD between the ages of 7 and 18 years with no comorbidity were matched with 22 healthy controls, it was shown that the patients showed significant disruption before treatment in some parameters of WCST (completed category number, error score, perseverations) (15). In the study by Shin et al. that was conducted with 17 OCD, 25 ADHD, and 21 tic disorder patients as well as 23 healthy controls aged between 6 and 16 years, the OCD and ADHD groups showed poorer performance in the "completed category number" and "total error number" scores than the control group, whereas the mean perseverative error scores of the OCD group were found to be higher than those of the depression group and the healthy control group (33). In addition, there are studies that used WCST in children and adolescents with a diagnosis of OCD and found no difference between the patient and control groups (18,34). However, almost none of the sample groups of these studies stated the period of onset of OCD (childhood or adulthood onset). Our results were found to be compatible with the studies that presented data in the direction that patients showed poorer performance in the subscores, which showed perseveration tendency. Considering

Table 5. Comparison of the neuropsychological test results of the control group and OCD group without tic disorder comorbidity

	OCD without Tic disorder n=25 Median (min-max)	Control n=35 Median (min-max)	z	p
Total reaction number	128 (80–128)	95 (72–128)	3.22	.001*
Total error number	47 (13–82)	25 (10–56)	3.84	<.001*
Total perseverative reaction number	28 (6–60)	14 (6–37)	3.73	<.001*
Total non-perseverative reaction number	21 (7–38)	12 (4–45)	3.81	<.001*
Total perseverative error number	24 (3–53)	12 (6–33)	3.22	<.001*
Completed category number	4 (1–6)	6 (3–6)	3.41	.001*
Perseverative error percentage	18.7 (6.8–41.4)	11.7 (7–25.7)	3.57	<.001*
Conceptual level reaction percentage	53.1 (17.1–81.2)	72.4 (17.7–84.7)	3.55	<.001*
Stroop-5 completion time	30.2 (17–55)	27.1 (19–37.9)	1.77	.076
CPT lack of pressing at the appropriate time	2 (0–22)	1 (0–7)	2.40	.016*
CPT pressing at the inappropriate time	5 (1–29)	3 (0–13)	2.78	.005*

CPT: Continuous performance test; OCD: Obsessive compulsive disorder

that our participants were only individuals who had a diagnosis of childhood-onset OCD, it can be stated that these results that were obtained in a more specific group are important in terms of showing the negative effects of the disease on the central nervous system that has not completed its development and on the executive functions in the early period. Some studies conducted with adult patients have reported that a marked disruption occurs in the total error (35), perseverative error (36), and completed category (37) numbers, whereas the results of some other studies do not support these results (38,39). Based on the literature information that childhood-onset OCD continued at a rate of 40% in the adulthood (40), evaluation of childhood-onset OCD subjects separately using neuropsychological tests for groups in whom the disease continues and does not continue clinically by further studies may provide important information to explain if the disorder leads to permanent deficits in the developmental process. On the other hand, the fact that a difference between the two groups was found only in terms of con-

ceptual reaction percentage among the subscores that showed conceptualization/reasoning, and that no difference was found in terms of the other areas collected under this factor suggested that this result may not be significant. When the literature was examined, data suggesting that individuals with a diagnosis of OCD showed failure in the sustainability of installation were found (33), but no such finding was obtained in our study.

The Stroop Test evaluates “intensification and sustainability of attention,” “resistance to confounding stimuli,” “ability to stop and suppress inappropriate stimuli and tendency to perform inappropriate reactions” depending on the time and the task given. It has been stated that the most valid property measured by the Stroop Test BSRF is the disrupting effect (the fifth part where the colors in the second card are stated). It has been reported that disruption in the sustainability of installation under disrupting effect is particularly related with damage to the OFC. It has also been reported that the test evaluates the reading speed (the time to complete the first card) and identification of the colors (the time to complete the third and fourth cards) that reflect attention (41). In our study, the Stroop-1 and Stroop-5 completion times were evaluated, and the patient group showed a significant difference compared with the control group in terms of Stroop-5 completion time. When the literature was examined, publications that considered disruption in the control mechanisms of impulse and thought as the basic disruption of cognitive behavioral model in terms of OCD pathophysiology and the Stroop Test were proposed to be used in the evaluation of cognitive inhibition processes in this context (42). In one study that investigated the neurocognitive properties before and after treatment in children and adolescents with a diagnosis of OCD, automatic response inhibition in the Stroop Test was found to be poorer in the individuals with a diagnosis of OCD; no difference was reported to be found between the groups after treatment (15). In a study performed by Beers et al. in which 21 OCD subjects (mean age: 12.3) and 21 healthy controls (mean age: 12.2) were compared, it was reported that the OCD group showed poorer performance in terms of reading words and stating colors in the Stroop Test (34). Chamberlain et al. compared the disease-free first-degree relatives of the individuals with a diagnosis of OCD with healthy controls and reported that response inhibition may be an endophenotype for OCD (14). In addition to this data, there are also publications that have reported that there is no disruption in the cognitive inhibition processes in children and adolescents with a diagnosis of OCD (43,44).

CPT basically measures the ability to “sustain attention” and is based on the ability to trace the changes that randomly occur in the flow of stimulus. Missed targets are evaluated as attention deficit, and erroneous alarms (pressing at inappropriate times) are evaluated as indications of impulsivity (28). In our study, statistically significant differences were found in terms of the missing and erroneous pressing subscores in the patient group compared with the healthy controls. In the study by Shin et al., which was conducted with 106 children and adolescents

aged between 6 and 16 years, the CPT results of the OCD group were not found to be different compared with those of the healthy controls (33). In contrast to these results, Wooley et al. compared 10 adolescents with a diagnosis of OCD who were in partial remission and nine healthy controls during three different tasks that required inhibitory control using functional magnetic resonance imaging (fMRI); the activity was found to be decreased in the right OFC, thalamus, and basal ganglia during the task of "stop" and in the mesial frontal region in the state of "insufficient inhibition" in the OCD group. Changing the task and suppression of disruptive effect were found to be related with sustaining the activity in the frontal, temporoparietal, and cerebellar regions. It has been reported that disruption occurs in the frontostriatthalamic brain regions required for motor inhibition in OCD, and disruption in the temporoparietal and frontocerebellar attention pathways included mostly the cognitive processes of inhibition (45). Our results were compatible with the data suggesting that disruption occurs during motor inhibition processes in individuals with a diagnosis of OCD.

When the OCD group was compared in itself according to the presence of familial history in terms of neuropsychological test results, no difference was found in the Stroop Test results; however, the group with a positive familial history was found to show poorer performance in terms of WCST total perseverative reaction number, total perseverative error number, CPT lack of pressing at the appropriate time, and CTP pressing at the inappropriate time scores. Menzies et al. compared 31 individuals diagnosed with OCD and 31 disease-free first-degree relatives with healthy controls and reported that OCD patients and their relatives showed delayed reaction during the "stop" task in terms of response inhibition compared with healthy controls. Disruption in behavioral inhibition found in patients and relatives was found to be significantly related with decreased gray matter volume in the orbitofrontal and right inferior frontal regions, and it was found to be related with increased gray matter volume in the singulate, parietal, and striatal regions. These MRI findings were interpreted as possible anatomic regions of the endophenotypic property proposed to be related with inhibition tasks for OCD (46). In another study, 35 patients of OCD proband and their 35 disease-free relatives were compared with 31 healthy controls who were not in the OCD proband and their 31 relatives in terms of neuropsychological properties using the Tower of Hanoi, Iowa gambling test, and WCST. Although individuals with a diagnosis of OCD showed inadequacy in the areas of deciding, planning, and cognitive flexibility, their relatives who were in the OCD proband showed poorer performance in each of the three tests than the ones in the healthy control proband. These findings were interpreted by the investigators such that disruption in executive functions may be endophenotype for OCD, and the problems of deciding and planning were clustered in the families who were in the OCD proband and indicated to the hereditary component of OCD (47). The results of our study suggested that individuals with a diagnosis of OCD and a

positive familial history may have an attitude of previously persisting behavior with a higher rate, and that their abilities of sustaining attention and motor inhibition may be lower. Based on the information that has been reported in previous studies that genetic loading leads to neuropsychological disruption even in individuals who have not been affected by the disease, it can be stated that the presence of a positive familial history in individuals with a diagnosis of OCD results in cognitive disruption with a higher rate.

Conclusively, OCD is thought to be a disease that develops because of functional pathology in the corticostriatthalamocortical pathway, and this is the most commonly accepted point of view at the present time. In particular, orbitofrontal-limbic-basal ganglion dysfunction has been emphasized; however, it has been reported that failure in the task of shifting attention found in OCD patients is related with the dorsolateral and ventrolateral prefrontal cortex, and that cognitive problems observed in OCD cannot be explained solely with disruption in orbitofrontal-limbic-basal ganglion cycle (48). In addition, it has been reported that the OFC, ASC, and DLPC regions play an important role in deciding, and the abilities of reward evaluation, detection of errors, and planning behavior are hindered as a result of dysfunction in these pathways during OCD; thus, the abnormal behavior response becomes frequent with increased activity in the basal ganglion (49). It is thought that WCST that is among the neuropsychological tests in our battery is a frontal lobe test, which is particularly sensitive to the DLPC region (201). The Stroop Test has been associated with OFC that is responsible for sustaining installation under a disruptive effect, ASC, right DLPC, and right lateral prefrontal cortex (41). CPT has been emphasized to be related with the mesial frontal cortex with predominance in the left side (50). When the data of WCST, Stroop Test, and CPT that were used in our study were completely examined, it was concluded that disruption occurred in the tasks of executive functions, sustained attention, and motor inhibition in patients with a diagnosis of OCD; these patients showed compatibility with the neuroanatomical model defined for OCD.

Study Limitations

The primary limitations include the lack of establishment of subgroups according to symptom profiles because of relatively insufficient number of patients and the lack of assessment of the relation of different obsession-compulsion symptom clusters with neuropsychological test results and clinical properties. In further studies, it can be examined if this disorder that has a heterogeneous clinical nature includes specific groups affecting the neuropsychological deficits determined with a higher number of participants. Other important limitations include the fact that the clinical diagnosis was made considering DSM-IV criteria when evaluating the parents of the patients and the lack of use of structured or semi-structured interview form as well as by obtaining information regarding second-degree relatives indirectly by the way of interrogation in the history. In our study,

some of the co-diagnoses could not be excluded because of known high comorbidity rates for childhood-onset OCD. With the objective of eliminating this important limitation, some variables that may affect the neuropsychological tests were statistically controlled. It was thought that the presence of use of stimulant or non-stimulant drugs that increased attention in 29.9% of our population and the application of neuropsychological tests under treatment may have prevented the emergence of some neuropsychological properties. In addition, three neuropsychological tests were used to examine attention and executive functions. Supporting these results with larger neuropsychological test batteries in further studies and examination of the areas including memory, working memory, and social cognition may demonstrate different properties for OCD.

References

1. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. American Psychiatric Press. Washington DC, 2000.
2. Rasmussen SA, Eisen JL. Clinical and epidemiological features of obsessive-compulsive disorder. In MA. Jenike L, Baer WE. Minichiello (eds.). Obsessive-compulsive disorder: Practical management. 1998; pp.12-43. St.Louis: Mosby.
3. Valeni-Basile LA, Garrison CZ, Waller JL, McKeown RE, Addy CL, Cuffe SR. Frequency of obsessive-compulsive disorder in a community sample of young adolescent. J Am Acad Child Adolesc Psychiatry 1994; 33:782-791. [CrossRef]
4. Karla SK, Swedo SE. Children with obsessive-compulsive disorder: are they just 'little adults'? J. Clin. Invest. 2009; 119:737-746. [CrossRef]
5. Van Grootheest DS, Catch DC, Beekman AT and Boomsma DI. Twin studies on obsessive-compulsive disorder: a review. Twin Res Hum Genet 2005; 8:450-458. [CrossRef]
6. Rauch SL, Cora-Locatelli G, Greenberg BD. Pathogenesis of obsessive-compulsive disorder. In: Stein DJ, Hollander E.(eds). Textbook of Anxiety Disorders. Washington DC: American Psychiatric Publishing. 2002; 191-206.
7. Bhattacharyya S, Prasanna CLN, Khanna S, Reddy YCJ, Sheshadri S. A family genetic study clinical subtypes of obsessive-compulsive disorder. Psychiatry Genet 2005; 15:175-180. [CrossRef]
8. Huey ED, Zahn R, Krueger F, Moll J, Kapogiannis D, Wassermann E, Grafman J. A psychological and neuroanatomical model of obsessive-compulsive disorder. The Journal of Neuropsychiatry and Clinical Neurosciences 2008; 20:309-408. [CrossRef]
9. Maia VT, Cooney ER, Peterson BS. The neural bases of obsessive-compulsive disorder in children and adults. Development and Psychopathology 2008; 1251-1283. [CrossRef]
10. Bradshaw JL, Sheppard DM. The neurodevelopmental frontostriatal disorders: Evolutionary adaptiveness and anomalous lateralization. Brain and Language 2000; 73: 297-320. [CrossRef]
11. Carter CS, MacDonald AM, Botvinick MM, Ross LL, Stenger VA, Noll D, Cohen JD. Parsing executive processes: Strategic vs. evaluative functions of the anterior cingulate cortex. Proc Natl Acad Sci U S A 2000; 97:1944-1948. [CrossRef]
12. Saxena S, Brody AI, Schwartz JM, Baxter LR. Neuroimaging and frontal-subcortical circuitry in obsessive-compulsive disorder. Br J Psychiatry 1998; 173:26S-37S.
13. Schultz RT, Evans DW, Wolf M. Neuropsychological models of childhood obsessive compulsive disorder. Child and Psychiatric Clinics of North America 1999; 8:513-531.
14. Chamberlain SR, Fineberg NA, Menzies LA, Blackwell A, Bullmore ET, Robbins TW, Sahakian BJ. 2007b. Impaired cognitive flexibility and motor inhibition in unaffected first degree relatives of patients with obsessive-compulsive disorder. American Journal of Psychiatry 2007; 164:335-338. [CrossRef]
15. Andres S, Lazaro L, Salamero M, Boget T, Penades R, Castro-Fornieles J. Changes in cognitive dysfunction in children and adolescent with obsessive-compulsive disorder after treatment. J Psychiatric Research 2008; 42:507-514. [CrossRef]
16. Kuelz AK, Hohagen F, Voderholzer U. Neuropsychological performance in obsessive-compulsive disorder: a critical review. Biol Psychol 2004; 65:185-236. [CrossRef]
17. Gladstone M, Carter AS, Schultz RT ve ed. Neuropsychological functioning of children affected with Tourette syndrome and obsessive-compulsive disorder. J Clin Exp Neuropsychol 1993; 15:70.
18. Cox CS, Fedio P, Rapoport JL. Neuropsychological testing of obsessive-compulsive adolescents. In: Rapoport JL, editor. Obsessive-compulsive disorder in children and adolescent. Washington(-DC): American Psychiatric Press 1989; p. 73-85.
19. Delorme R, Ghouse V, Roy I, Trandafir A, Mathieu F, Mouren Simeoni MC, Betancur C, Leboyer M. Shared executive dysfunctions in unaffected relatives of patients with autism and obsessive-compulsive disorder. European Psychiatry 2007; 2:32-38. [CrossRef]
20. Kaufman J, Birmaher B, Brent D, Rao U, Flynn C, Moreci P, Williamson D, Ryan N. Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SA-DS-PL): initial reliability and validity data. J Am Acad Child Adolesc Psychiatry 1997; 36:980. [CrossRef]
21. B Gökler, F Ünal, B Pehlivanlı, EÇ Kültür, D Akdemir, Y Taner. Okul çağı çocukları için duygulanım bozuklukları ve şizofreni görüşme çelgesi-şimdi ve yaşamboyu şekli-Türkçe uyarlamasının geçerlik ve güvenirliği. Çocuk ve Gençlik Ruh Sağlığı Dergisi 2004; 11:109-116.
22. Yücelen Erkal G, Arman Rodopman A, Topçuoğlu V, Fişek G, Yazgan MY. Çocuklar için Yale-Brown Obsesif Kompulsif Ölçeği Geçerlilik Güvenirlik Çalışması. 12. Ulusal Çocuk ve Ergen Psikiyatrisi Kongresinde poster olarak sunulmuştur. İstanbul. 2002.
23. Dereboy Ç, Şenol S, Şener Ş. Conner's anababa derecelendirme ölçeği uyarlama çalışması. X. Ulusal Psikoloji Kongresi, Ankara 1998.
24. Öy B. Çocuklar için depresyon ölçeği geçerlik güvenirlik çalışması. Türk Psikiyatri Dergisi 1991; 2:132-137.
25. Zaimoğlu S, Rodopman A, Sabuncuoğlu O. Yale Genel Tik Ağırliğini Derecelendirme Ölçeğinin güvenirlik çalışması. Sunum. 5. Ulusal Çocuk ve Ergen Psikiyatrisi Kongresi, Ankara, 1995.
26. Heaton RK, Chelune GJ, Talley JL, Kay GG, Curtis CG. Wisconsin card sorting test manual: Revised and expanded. Florida: Psychological Assessment Resources, 1993.
27. Karakaş S. Bilişsel fonksiyonların değerlendirilmesinde nöropsikolojik testler. Türk Nöroloji Dergisi. 2002; 8:61-69.
28. Corkum PV, Siegel LS. Is the Continuous test a valuable research tool for use with children with ADHD? J Child Psycho Psychiatry 1993; 34:1217-1239. [CrossRef]
29. Wechsler D. WISC-R, manual for the Wechsler Intelligence Scale for Children-Revised. New York (US): Psychological Corporation; 1974.
30. Savagır I, Şahin N. Wechsler çocuklar için zeka ölçeği (WISC-R) el kitabı. Ankara: Türk Psikologlar Derneği Yayınları; 1995.
31. Karakaş S, Eski R, Başer E. Türk kültürü için standardizasyonu yapılmış bir nöropsikolojik testler topluluğu. BİLNOT Bataryası. 32. Ulusal Nöroloji Kongresi Kitabı. 1996; İstanbul, Ufuk Matbaası.

32. Sanz M, Molina V, Calcedo A. The Wisconsin Card Sorting Test and the assessment of frontal function in obsessive-compulsive patients: An event-related potential study. *Cognitive Neuropsychiatry* 2001; 6:109-129. [\[CrossRef\]](#)
33. Shin MS, Choi H, Kim H, Hwang JW, Kim BN, Cho SC. A study of neuropsychological deficit in children with obsessive-compulsive disorder. *Eur Psychiatry* 2008; 23:512-520. [\[CrossRef\]](#)
34. Beers SR, Rosenberg DR, Dick EL, Williams T, O'Hearn KM, Birmaher B, Ryan CM. Neuropsychological study of frontal lobe function in psychotropic-naïve children with obsessive-compulsive disorder. *American Journal of Psychiatry*. 1999; 157:1182-1183.
35. Gambini O, Abbruzzese M, Scarone S. Smooth-pursuit and saccadic eye-movements and Wisconsin Card Sorting Test performance in obsessive-compulsive disorder. *Psychiatry Research* 1993; 48:191-200. [\[CrossRef\]](#)
36. Head D, Bolton D, Hymas N. Deficit in cognitive shifting ability in patients with obsessive-compulsive disorder. *Biological Psychiatry* 1989; 25:929-937. [\[CrossRef\]](#)
37. Hymas N, Lees A, Bolton D, Epps K, Head D. The neurology of obsessional slowness. *Brain* 1991; 114:2203-2233. [\[CrossRef\]](#)
38. Cavallaro R, Cavedini P, Mistretta P. Basal-cortico-frontal circuits in schizophrenia and obsessive-compulsive disorder: A controlled, double dissociation study. *Biological Psychiatry*. 2003 ;54:437-443. [\[CrossRef\]](#)
39. Roth R M, Baribeau J, Milovan DL, O'Connor K. Speed and accuracy on tests of executive function in obsessive-compulsive disorder. *Brain and Cognition* 2004; 54:263-265. [\[CrossRef\]](#)
40. Stewart SE, Geller DA, Jenike M, Pauls D, Shaw D, Mullin B, Faraone SV. Long-term outcome of pediatric obsessive-compulsive disorder: a meta-analysis and qualitative review of the literature. *Acta Psychiatry Scand* 2004; 110:4-13. [\[CrossRef\]](#)
41. Karakaş S, Erdoğan E, Sak L, Soysal Ş, Ulusoy T, Ulusoy İY, Alkan S. Stroop Testi TBAG Formu: Türk kültürüne standardizasyon çalışmaları, güvenirlik ve geçerlik. *Klinik Psikiyatri* 1999; 2:75-88.
42. Chamberlain SR, Fineberg NA, Blackwell AD, Robbins TW, Sahakian BJ. Motor inhibition and cognitive flexibility in obsessive-compulsive disorder and trichotillomania. *American Journal of Psychiatry* 2006; 163:1282-1284. [\[CrossRef\]](#)
43. Andres S, Boget T, Lazaro L, Penades R, Morer A, Salamero M, Castro-Fornieles J. Neuropsychological performance in children and adolescent with obsessive-compulsive disorder and influence of clinical variables. *Biological Psychiatry* 2007; 61:946-951. [\[CrossRef\]](#)
44. Chang WS, McCracken J, Piacentini CJ. Neurocognitive correlates of child obsessive compulsive disorder and Tourette syndrome. *Journal of clinical and experimental neuropsychology*. 2007; 29:724-733. [\[CrossRef\]](#)
45. Wooley J, Heyman I, Brammer M, Frampton I, McGuire PK, Rubia K. Brain activation in paediatric obsessive-compulsive disorder during tasks of inhibitory control. *The British Journal of Psychiatry* 2008; 192:25-31. [\[CrossRef\]](#)
46. Menzies L, Achard S, Chamberlain SR, Fineberg N, Chen CH, Campo N, Sahakian BJ, Robbins TW, Bullmore E. Neurocognitive endophenotypes of obsessive-compulsive disorder. *Brain* 2007; 130:3223-3236. [\[CrossRef\]](#)
47. Cavedini P, Zorzi C, Piccinni M, Cavallini MC, Bellodi L. Executive dysfunctions in obsessive-compulsive patients and unaffected relatives: searching for a new intermediate phenotype. *Biol Psychiatry* 2010; 67:1178-1184. [\[CrossRef\]](#)
48. Nagahama Y, Okada T, Katsumi Y, Hayashi T, Yamauchi H, Oyanagi C, Konishi J, Fukuyama H, Shibasaki H. Dissociable mechanisms of attentional control within the human prefrontal cortex. *Cerebral Cortex* 2001; 11:85-92. [\[CrossRef\]](#)
49. Westenberg HGM, Fineberg NA, Denys D. Neurobiology of obsessive-compulsive disorder: Serotonin and beyond. *CNS Spectrums* 2007; 12:14-27.
50. Rezai K, Andersen NC, Aliger R, Cohen G, Swayze G, O'Leary S. The neuropsychology of the prefrontal cortex. *Archives of Neurology* 1993; 60:636-642. [\[CrossRef\]](#)