HAYDARPAŞA NUMUNE MEDICAL JOURNAL

DOI: 10.14744/hnhj.2021.82957
Haydarpasa Numune Med J 2022;62(2):183–189

hnhtipdergisi.com

ORIGINAL ARTICLE

Executive Functioning in Children with Attention Deficit and Hyperactivity Disorder and Social Anxiety Disorder

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Abstract

Introduction: The aim of the present study was to evaluate the association of executive functioning with social phobia and anxiety in children with ADHD.

Methods: Fifty children (aged 6–17 years) with ADHD diagnosis based on the DSM-5 diagnostic criteria were included in the study. Clinicians administered the Child Anxiety Sensitivity Index (CASI) and the Social Anxiety Scale for Children-Revised (SASC-R). Teachers and parents of the children completed the Conners' Rating Scale and the Behavioral Rating Inventory of Executive Function (BRIEF).

Results: The CASI and SASC-R scores were not correlated with the parents' and teachers' scores of the Conners' scale. However, the SASC-R scores had significantly moderate positive correlations with shift (r=0.387 and p=0.005), initiate (r=0.341 and p=0.015), plan/organize (r=0.340 and p=0.016) scores, and with metacognition index (p=0.359 and r=0.010) of the parent forms of the BRIEF scale. For the teacher form of the BRIEF scale, the SASC-R scores were moderately and negatively correlated with plan/organize score (r=–0.425 and p=0.002) and behavioral regulation index (p=–0.295 and r=0.038); however, the CASI scores were moderately and positively correlated with shift (r=0.317 and p=0.025) and initiate (r=0.314 and p=0.026) scores.

Discussion and Conclusion: Social anxiety might significantly affect executive functions; however, these effects can vary according to the environmental factors.

Keywords: Attention deficit and hyperactivity disorder; comorbidity; executive function; metacognitive awareness; social anxiety; therapy.

Attention deficit and hyperactivity disorder (ADHD) is one of the most prevalent neurobehavioral disorders among children, with an estimated worldwide prevalence of 3% to 5%[1]. The consequences of ADHD can be unfavorable for children, such as negative effect on normal development, failure in school success, and deterioration of social functioning. Moreover, ADHD may persist in adulthood, if it is left untreated and may result in academic failure, employment problems, self-harm behaviors, substance use, and other negative consequences that significantly deteriorate the entire lifespan of an individual[2]. In addition, ADHD may frequently coexist with other psychiatric conditions, especially with disruptive behavioral disorders[3]. Other most prevalent comorbid condition with ADHD is

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Submitted Date (Başvuru Tarihi): 20.10.2021 **Accepted Date (Kabul Tarihi):** 25.11.2021

anxiety disorder and the present literature has suggested that approximately 25–50% of ADHD cases may also have a comorbid anxiety disorder[4-6]. One of the sub-categories of anxiety disorders is social anxiety disorder, which can be defined as an anxiety and fear of being negatively scrutinized by others in a social situation. Among the diagnostic criteria of social anxiety disorder indicated in the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5), "fear or anxiety being provoked by social situation" and "avoiding social situations with intense fear or anxiety" are the most significant criteria that prevent patients from participating in social life[7]. As a consequence of social anxiety disorder in children with ADHD, social dysfunction gradually deteriorates and generally persists into adolescence, which is associated with worse outcomes including, but not limited to, substance use disorders and depressive disorders[8].

In its most basic definition, metacognition refers to cognition about cognition[9]. This can be expanded as one's ability to be aware of his/her own cognitive functions, strategies, and tasks, which all can be defined as metacognitive awareness[10,11]. A recent study has suggested that metacognitive awareness and metacognitive interventions on attention have promising results in children with ADHD[12]. These favorable outcomes include increased academic success both in mathematical reasoning and reading skills[13,14]. Another issue associated with enhancement of skills is executive functioning[15,16]. Executive functions can be defined as a set of cognitive skills, which enable problem solving and goal-directed behavior[17]. Based on this background, in the present study, we aimed to evaluate the association of executive functioning with social phobia and anxiety in children with ADHD.

Materials and Methods

This study was conducted in the Child and Adolescent Psychiatry Department of Haydarpasa Numune Training and Research Hospital in Istanbul province in Turkey. Study population included 50 children with ADHD. The diagnosis of ADHD was based on the structured clinical interviews and DSM-5 criteria. Eligibility criteria were being 6–17 years of age, being diagnosed with ADHD during the previous 6 months, and not receiving treatment for ADHD before or at the time of initial admission. Patients meeting these criteria and their parents were informed about the study procedures and the patients were recruited only if they provided assent and their parents provided signed informed consent. Children with any chronic medical disorder, any sensorimotor disability, neurological disorder, autism spectrum disorder, or other developmental disorders were excluded from the study. The study protocol was reviewed and approved by the Local Ethics Committee of Haydarpasa Numune Training and Research Hospital.

Procedures

The diagnostic procedures were conducted by the structured clinical interviews that included questions about each criterion of ADHD in the DSM-5. The symptom onset, duration, and associated impairments in academic, family, and social contexts were also assessed during the diagnostic interviews.

Following diagnosis, clinicians administered the Child Anxiety Sensitivity Index (CASI) to evaluate anxiety levels of children and the Social Anxiety Scale for Children-Revised (SASC-R) to assess social phobia in children. In addition, teachers and parents of the patients completed the Conners Rating Scale and the Behavioral Rating Inventory of Executive Function (BRIEF) to evaluate the severity of the disease.

CASI

This scale was modified from the Anxiety Sensitivity Index[18] by Silverman et al.[19] It is an 18-item scale which measures the degree of anxiety caused by negative consequences in school age children (6–17 years of age). The index has a three-point rating for each item as none (1), some (2), or a lot (3) and the total score ranges from 18 to 54. The Turkish validity and reliability study of CASI was conducted by Yılmaz in 2006[20].

SASC-R

This scale was developed by la Greca et al.[21] and then modified by la Greca and Stone.[22] It is a self-reporting scale consisting 18-items which measures the degree of social phobia in children. Each item is scored on a 5-point Likert scale, ranging from 1 (not at all) to 5 (all the time) and the total score ranges from 18 to 90. The Turkish validity and reliability study of SASC-R was conducted by Demir et al.[23]

Conners' Parent Rating Scale-Revised/Long

This scale was developed by Conners[24] and revised by Conners et al.[25] It consists of seven sub-scales including oppositional, cognitive problems/inattention, hyperactivity, anxious-shy, perfectionism, social problems, and psychosomatic. Turkish validity and reliability study of the Conners' Parent Rating Scale-Revised/Long was conducted by Kaner et al.[26]

Conners' Teacher Rating Scale-Revised/Long

This scale was developed by Conners[24] and revised by Conners et al.[25] It consists of six subscales including oppositional, cognitive problems/inattention, hyperactivity, anxious-shy, perfectionism, and social problems. Turkish validity and reliability study of the Conners' Teacher Rating Scale-Revised/Long was conducted by Kaner et al.[27]

BRIEF

This scale was developed by Gioia et al.[28] and included two forms to be completed by parents and teachers to assess executive functioning of children in home and school. Both forms include 86 items, each indicating a certain behavior. The items are grouped under eight subscales as inhibit, shift, emotional control, initiate, working memory, plan/organize, organization of materials, and monitor. The three subscales including inhibit, shift, and emotional control form the broader index of behavioral regulation and the remaining five subscales form the broader index of metacognition. These two broader indexes form an overall score – the global executive composite. The Turkish reliability and validity study of BRIEF was conducted by Batan et al.[29]

Statistical Analysis

Data analysis was performed using IBM Statistical Package for the Social Sciences Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive data were expressed as mean, standard deviation, minimum, and maximum values for numerical variables. Assessment of correlations between the subdomain scores of the scales was analyzed by the Pearson's correlation analysis. $p<0.05$ was considered statistically significant.

Results

The present study included 50 children with ADHD. The CASI and SASC-R scores of the children as well as the BRIEF and Conners' scores of the parents and teachers are presented in Table 1.

Table 1. Scores of the children and their parents and teachers

	n	Mean±SD	Min–Max
CASI score	50	43.56±6.97	21–52
SASC-R score	50	42.4±14.45	18–81
Conners' scale			
Parents' score	50	49.58±20.9	17–104
Teachers' score	50	31.2±18.31	6–76
BRIEF scale			
Parent			
Inhibit	50	79.56±9.11	57–98
Shift	50	80.8±11.03	56–95
Emotional control	50	64.54±9.82	43–83
Initiate	50	62.84±9.86	43–84
Working memory	50	71.22±8.5	51–90
Plan/organize	50	76.06±8.9	51–89
Organization of materials	50	63±7.97	45–72
Monitor	50	62.64±8.62	43–88
Behavioral regulation	50	78.12±9.24	55–99
Metacognition	50	71.38±8.76	50–89
Global executive composite	50	74.9±8.44	51–88
Teacher			
Inhibit	50	79.06±17.26	49–124
Shift	50	78.58±20.34	46–127
Emotional control	50	65.22±15.46	43–96
Initiate	50	66.4±14.71	41–97
Working memory	50	73.48±18.46	40–113
Plan/organize	50	81.62±13.43	55–107
Organization of materials	50	62.8±15.04	42–111
Monitor	50	73.68±16.02	43–112
Behavioral regulation	50	77.06±16.62	47–121
Metacognition	50	76.24±15.59	44–113
Global executive composite	50	77.6±16.08	47–121

CASI: Child Anxiety Sensitivity Index, SASC-R: Social Anxiety Scale for Children-Revised, BRIEF: Behavioral Rating Inventory of Executive Function, Min–Max: Minimum–maximum, SD: Standard deviation.

Results of the correlation analyzes of CASI and SASC-R scores with the parents' and teachers' scores of the Conners' and BRIEF scales are presented in Table 2. Accordingly, the CASI and SASC-R scores were not correlated with the parents' and teachers' scores of the Conners' scale. The analyzes revealed that the SASC-R scores had moderate and statistically significant positive correlations with shift ($r=0.387$ and $p=0.005$), initiate ($r=0.341$ and $p=0.015$), and plan/organize ($r=0.340$ and $p=0.016$) scores as well as metacognition index ($p=0.359$ and $r=0.010$) of the parent forms of the BRIEF scale. On the other hand, the SASC-R scores were moderately and negatively correlated with plan/organize score ($r=-0.425$ and $p=0.002$) and behavioral regulation index ($p=-0.295$ and $r=0.038$) of the teacher form of the BRIEF scale. However, the CASI scores were moderately and positively correlated with shift ($r=0.317$ and $p=0.025$) and initiate ($r=0.314$ and $p=0.026$) scores of the teacher form of the BRIEF scale.

Discussion

The present study evaluated the association of executive functioning with social phobia and anxiety in the sample

Table 2. Correlations of social phobia and anxiety scores with parent and teacher forms of the Conners' and BRIEF scales

	CASI		SASC-R	
	r	p	R	p
Conners' scale				
Parents' score	0.087	0.546	0.209	0.144
Teachers' score	0.157	0.276	–0.150	0.297
BRIEF scale				
Parent				
Inhibit	0.056	0.701	0.089	0.540
Shift	–0.149	0.303	0.387	0.005
Emotional control	–0.050	0.728	0.157	0.275
Initiate	–0.076	0.601	0.341	0.015
Working memory	0.043	0.767	0.244	0.088
Plan/organize	–0.029	0.844	0.340	0.016
Organization of materials	–0.126	0.385	0.017	0.909
Monitor	0.131	0.363	0.098	0.498
Behavioral regulation	–0.033	0.821	0.239	0.095
Metacognition	0.034	0.814	0.359	0.010
Global executive composite	0.097	0.504	0.130	0.367
Teacher				
Inhibit	0.125	0.389	–0.217	0.130
Shift	0.317	0.025	–0.274	0.054
Emotional control	0.226	0.114	–0.274	0.054
Initiate	0.314	0.026	–0.261	0.067
Working memory	0.233	0.103	–0.279	0.052
Plan/organize	0.321	0.023	–0.425	0.002
Organization of materials	0.182	0.207	–0.241	0.092
Monitor	0.187	0.194	–0.257	0.071
Behavioral regulation	0.226	0.115	–0.295	0.038
Metacognition	0.211	0.141	–0.246	0.086
Global executive composite	0.250	0.080	–0.287	0.043

CASI: Child Anxiety Sensitivity Index, SASC-R: Social Anxiety Scale for Children-Revised, BRIEF: Behavioral Rating Inventory of Executive Function.

of 50 ADHD children. Executive functions were assessed by the BRIEF scale and anxiety and social phobia were assessed by the CASI and SASC-R scales, respectively. In addition, the Conners' scale was applied to the parents and teachers to evaluate disease severity. Correlation analyzes between the subscale scores of these assessment tools revealed that correlation of executive functions with social phobia was moderate and positive in the parent evaluations and moderate and negative in the teacher evaluations; moreover, there was a moderate and positive correlation between executive functions and anxiety in the teacher evaluations. Overall, social anxiety may significantly affect executive functions; however, the effects might vary according to the environmental factors, which could be deduced from the differences in the parent and teacher assessments.

Executive functions in children have been extensively evaluated during the past two decades to understand the details of interactions of regulatory functions and thinking, behavior, and emotional responses[30]. The changes in these functions in children with ADHD have also been studied in detail. A recent study has suggested that ADHD is a disorder characterized with reduced inhibition control[31]. Contrarily, a previous study has reported that anxiety disorder is associated with increased inhibition disorder[32]. The copresence of anxiety and ADHD can be associated with partially inhibited impulsivity and response inhibition deficits and cause working memory deficits to be worse.[31] However, the interactions of these two disorders and their effects, either combined or per se, on executive functioning are not sharply distinguishable. There are many studies that evaluated the

effects of comorbidities on executive functions and reported contradictory results to each other. While some studies have reported that children with ADHD with comorbid anxiety disorder have increased behavioral inhibition,[33-35] no significant differences have also been reported in inhibition deficits or performance monitoring between ADHD cases with and without anxiety disorder ADHD[36]. There are also contradictory findings in other domains of executive functions. While Manassis[37] reported no significant difference in working memory tasks between the children with ADHD with and without anxiety disorder, a recent study[38] has reported impaired working memory tasks in children with ADHD with anxiety disorder. Moreover, another study has also reported that attentional problems, anxiety, and depressive symptoms are higher in children with ADHD with anxiety disorder[39]. Nevertheless, these conflicting results in the literature cannot be generalized to all patients with anxiety disorders and subtypes of anxiety should be taken into consideration in interpreting outcomes.

The results of the present study showed that several domains of the BRIEF scale were correlated with social phobia; however, the domains were different in parent and teacher forms. Moreover, while the association between executive functions and social phobia was positive in the parent forms, it was negative in the teacher forms. First, this positive correlation in the parent forms showed that the shift, initiate, plan/organize, and metacognition domains of executive functions worsened as social phobia increased. Nevertheless, the negative correlation in the teacher forms indicated that plan/organize and behavioral regulation worsened as the social phobia decreased. This contradiction might be attributed to the different effects of environmental factors on the stimulation of symptoms. Children may experience different social interactions in school and social phobia may trigger enhanced executive functions domains of plan/organize and behavioral regulation in school. However, outside the school, social phobia seems to deteriorate metacognitive awareness, which eventually worsens executive functions.

The present study also showed that anxiety had some antagonistic effects on executive functions when compared to social phobia. Although not statistically significant, anxiety was negatively correlated with many domains of executive functions in the parent forms, but positively correlated with all domains in the teacher forms of the BRIEF scale. The only significant correlations of anxiety with the teacher form of the BRIEF scale were obtained in the shift and initiate domains. The executive functions in these domains were found to be worsened as the anxiety increased. Regardless of statistical significance, our results suggested that anxiety might have triggered deteriorations in executive functions in school environment, which was vice versa for social phobia. These results add new contradictory findings to the already conflicted field in the literature.

Conclusion

The previous studies have suggested that anxiety disorder may develop due to behavioral inhibitions[40,41]. On the other, effects of behavioral inhibition on anxiety development have been indicated to be not continuous and highly inhibited children have been showed to display less social withdrawal behaviors at their schools or to have lower incidence of anxiety in future life. However, these suggestions have not been confirmed by the recent studies yet and increased incidence of anxiety disorders among behaviorally inhibited children has been reported in the literature[42]. Social anxiety has not been separately evaluated by the previous studies extensively. The results of the present study may contribute to the existing literature by providing novel data about the association between social anxiety and executive functions in children with ADHD.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author, (GML), on reasonable request.

Ethics Committee Approval: Study protocol was reviewed and approved by the Local Ethics Committee of Haydarpasa Numune Training and Research Hospital. (Date: September 25, 2018, number:.25/09/2018 version 1).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study received no financial support.

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