Alpha Psychiatry

ORIGINAL ARTICLE
Alpha Psychiatry 2021;22(2):100-105
DOI: 10.5455/apd.135050

Decreased Theory of Mind Abilities and Increased Emotional Dysregulation in Adolescents With ASD and ADHD

ABSTRACT

Objective: The aim of this study is to evaluate the possible relationship theory of mind (ToM) and emotion regulation (ER) skills in adolescents diagnosed with autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD).

Methods: This study comprised 60 individuals with ADHD and 60 individuals with ASD according to DSM-5 and between the ages of 12-16, and 60 adolescents without any psychiatric diagnosis. The Turkish version of the schedule for affective disorders and schizophrenia for school-age children, both present and lifetime versions, was applied to assess psychopathology and comorbidity. The intelligence level of the patients was assessed with the Wechsler Intelligence Scale for Children-Revised. Reading the mind in the eyes test, the Faux Pas Test, and the hinting task were given to patients to evaluate the ToM skills. The difficulties in ER Scale were also used to evaluate the skills of regulating emotions.

Results: Adolescent patients with ADHD and ASD have difficulties in ToM and ER skills. Adolescents diagnosed with ASD had more difficulty in ToM and ER than adolescents with ADHD.

Discussion: This study supports the idea that ADHD and ASD are related to deficits in ToM and ER skills. Therefore, further studies are required to confirm the findings of this study.

Keywords: Theory of mind, emotional regulation, autism spectrum disorder, attention deficit-hyperactivity disorder, adolescent

Introduction

Social cognition is the ability of individuals to understand and explain their mental states such as belief, intention, emotion, and imagination and of others.[1] A subfield of social cognition is the theory of mind (ToM), which could be defined as the mentalizing capacity to interpret, infer and explain the mental states underlying the behavior of other people, containing the understanding of false beliefs, hints, purpose, humor, and metaphor.[2] ToM abilities were first used by Baron-Cohen to explain the symptoms in children with autism.[3] ToM theory has different components. The first-order false belief and second-order false belief have been identified as components related to the cognitive system.[4]

The ability to read the mind in the eyes suggests perceiving the mental situation that goes beyond emotions by affective system in the eye of a person, and this skill reflects one of the processes that determines ToM.[1,5] Cognitive social cognition abilities are required by a person to explain what their beliefs are and affective social cognitive abilities are required to explain how they feel.[6]

During the last decade, various studies have been conducted exploring ToM on groups diagnosed with neurodevelopmental disorders, especially attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD). Prior studies have reported that children with ADHD have a reduced capacity for social reciprocity and understanding of social clues, and these social weak-

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Received: September 16, 2020
Accepted: October 25, 2020
Published Online: March 18, 2021

Cite this article as: Dağdelen F. Decreased theory of mind abilities and increased emotional dysregulation in adolescents with ASD and ADHD. *Alpha Psychiatry*. 2021;22(2):100-105.

nesses are similar to social interaction problems in ASD. Many social cognition studies emphasize that children diagnosed with ADHD present inappropriate social behavior with deficiency in giving appropriate social responses and perception of the others' behaviors. The inappropriate social behavior of children diagnosed with ADHD could be etiologically related to ASD.[7] Children with ADHD have better ToM skills than children diagnosed with ASD; it is thought that the low level of ToM skills could contribute to interpersonal and behavioral problems in ADHD.[8] Several studies have researched the difficulties in social cognitive skills, such as emotion regulation (ER) and ToM, in addition to difficulties in ER.[9,10]

ER has an important role in children and adolescent's social and emotional development. Lack of advanced ER may cause various difficulties in adulthood (e.g., anxiety and depression).[11] For instance, it has been stated that emotional dysregulation (ED) may cause inadequate awareness of emotions and difficulty in managing these emotions.[12] Furthermore, children whose ER skills are well developed tend to present stronger socially competent behaviors and demonstrate fewer behavioral difficulties.[13] A study of preschool children presenting lower ER skills in the classroom revealed they had been rated as having less social interaction, had been less accepted by peers and had experienced greater conflict with peers.[14] Advanced ER skills are related to developed and advanced social interactions.[15] Underdeveloped ER may result in both externalizing (e.g., anger and aggression) and internalizing (e.g., anxiety and depression) the difficulties.[16,17] ER skills are usually impaired in children with ASD. One research reported that more than 60% of children diagnosed with ASD presented ER difficulties.[18] Shaw et al[19] reported in a review that ER was evident in 34% to 70% of adults with ADHD deficits.

ASD and ADHD are neurodevelopmental disorders characterized by social impairments. The first objective of this study was to analyze the social cognition deficits of children with ADHD, ASD, and typical development (TD) in their performance on explicit and applied measures of ToM. The second objective was to investigate the relationships between ToM and ER in ASD and ADHD. We hypothesized that (1) the ASD and ADHD groups may have lower ToM and ER abilities than the healthy control group, (2) the ASD group may have lower ToM and ER abilities than the ADHD group, and (3) decreased ToM abilities may be related to ED.

Methods

Participants and Procedure

This cross-sectional case-control study was conducted at Department of Child and Adolescent Psychiatry of Tekirdağ State Hospital. Written informed consent was obtained from the participants' parents before initiating the study. Ethics approval for the study was obtained from the local ethics committee of the Namık Kemal University School of Medicine on March 25, 2020 with the decision number 2020.53.03.03.

MAIN POINTS

- *Adolescents with ASD and ADHD displayed impaired ToM and ER abilities.*
- *ToM and ER abilities of adolescents with ASD are weaker than ADHD group.*
- *Deterioration of ToM capabilities negatively affected ER in all groups.*

The study group included participants aged between 12 and 16 years, who applied to the Tekirdağ State Hospital Department of Child and Adolescent Psychiatry with a diagnosis of ADHD and ASD and met the inclusion criteria. Individuals with no psychiatric disorders other than ADHD and ASD were included in this study. Other inclusion criteria were a Wechsler Intelligence Scale for Children-Revised (WISC-R) score above 70 and the absence of psychotropic medication history. Patients with any neurological or medical disease, substance/drug dependence, severe head trauma, and perinatal complications were not included in the study. Considering the age and gender distributions of patient group, we included healthy volunteers in the control group. Participants with an IQ score of < 70 according to WISC-R, active psychopathology or history of active psychiatric illness, psychotropic drug use, any neurological or additional medical disease, substance/drug dependence, perinatal complications, and severe head trauma were not included in the study. This study comprised 120 patients with ADHD and ASD and 60 healthy individuals.

Measures

Form for Sociodemographic and Clinical Data: This form was developed by the researchers to determine the sociodemographic characteristics of patients included in the study. The form included data about age, sex, neuromotor development stages, literacy learning time, academic achievement, medical history; the form for their first/second-degree relatives included data about education level, residency of parents, and psychiatric/medical information.

Schedule for Affective Disorders and Schizophrenia for School-Age Children-Present and Lifetime Version (K-SADS-PL): K-SADS-PL is a semi-structured interview form developed by Kaufman et al[20] to detect present and lifetime psychopathology in children and adolescents. Validity and reliability studies were conducted for the Turkish sample of the scale.[21] Data from the child and at least one parent were combined with the clinician's opinions, and evaluation was completed.

Reading the Mind in the Eyes Test (RMET): The "eyes test" was designed by Baron-Cohen et al[1] and is used to determine participants' ability to sympathize with others and to evaluate the extent to which he/she can understand their mental states solely by recognizing the emotions in their eyes. The eyes test has been frequently used in studies investigating the relationship between psychopathology and social cognition. The pediatric version of this test includes a total of 28 photos in which only the eyes are apparent. For each test item, a photograph with four words that describe the probable mental state or feeling of the person shown in the photo is framed. Three of these words are misleading, and only one word correctly describes the mental state of the person in the photo. The test is rated using the number of items correctly answered by the participant. Girli validated the Turkish translation for the pediatric version of the test and stated that the Turkish version can be used in the diagnostic and education processes as a valid and reliable test.[22]

The Faux Pas Test: The Faux Pas Test was used to evaluate high mental cross referencing in this research.[23] Noticing a faux pas is accepted as the most complex skill develop-mentally, and it is accepted as a sensitive measurement tool for ToM. A faux pas occurs when a person says something that they should not have, without knowing or realizing. To be able to understand when a faux pas has occurred, it is necessary to represent two mental states. This skill requires both concept

skill elements and emotional empathy elements.[24,25] After narrating a story, four questions are asked to assess the child's understanding. To detect a faux pas, the child has to answer all questions correctly, answer a comprehension question, and recognize that faux pas was a consequence of a false belief. In control group, the child has to detect that no faux pas has taken place. Failure to answer any of these questions correctly leads to a score of zero for that story. The children's version of the faux pas recognition test, which was developed by Baron-Cohen et al,[23] was performed in Turkish with five original faux pas stories and five control stories (maximum score was 10 points).

Difficulties in Emotion Regulation Scale (DERS): The DERS is a 36-item scale developed by Gratz and Roemer[12] to measure difficulties in emotion regulation. The 5-point Likert-type scale (1: almost never and 5: almost al-ways) assesses mood regulation in six dimensions. The six subscales are as follows:

1. Goals (5 items): evaluates initiating purposive behavior in a negative mood.
2. Strategies (8 items): evaluates using effective strategies for mood regulation.
3. Impulsivity (6 items): evaluates controlling impulsive behaviors.
4. Awareness (6 items): evaluates awareness of emotional responses.
5. Clarity (5 items): evaluates clarity in emotional responses.
6. Non-acceptance (6 items): Evaluates acceptability of negative emotions.

An overall scale score is obtained from the sum of the scores obtained from all subscales. A high score indicates difficulties in ER. Neuman et al[26] verified the validity and reliability of DERS for adolescents. A Turkish psychometric assessment of the scale for adolescents was validated and it was concluded that DERS is a valid age-appropriate measure for investigating emotion regulation difficulties in adolescents by Sarıtas Atalar et al.[27]

The Hinting Task: The Hinting Task is one of the advanced levels for ToM functions.[28] It tests the skill of being able to predict the real intention behind the words directly spoken. After being narrated a story, participants are asked what the person in the story really wanted to say. If the participant does not respond correctly to the first hint question, the practitioner moves on to a question with a clearer hint. If the correct answer is given for the first hint, a score of 2 is given; and if the correct answer is given for the clearer hint, a score of 1 is given. If both hint questions are answered incorrectly, a score of 0 is given. In this study, four stories were used in the Hinting Task.[29]

Wechsler Intelligence Scale for Children-Revised Short Form (WISC-R): This scale measures the intelligence levels of children between the ages of 6 and 16 years. It was converted to Turkish by Savasir and Sahin.[30]

Statistical Analysis

Data were analyzed using the SPSS 25.0 software (IBM Corp.; Armonk, NY, USA). The findings are given as number, percentage, mean, standard deviation (SD), median and interquartile range (IQR). Numerical variables were examined by Shapiro-Wilk test to check for normality The homogeneity of variances was examined by the Levene test. While age and total IQ scores of the ADHD, ASD and control groups were compared with one-way ANOVA test, gender, mother's and father's education, and monthly income were compared using the chi-square test. Comparison of test scores between groups was performed using the Kruskal-Wallis H test followed by the post hoc Dunn Test (with Bonferroni correction). The Pearson correlation analysis was used for correlation analysis of numerical data. Multivariate linear regression analysis was performed to determine the factors affecting the total DERS score. All hypotheses were bidirectional and statistical significance level was considered as $P < .05$.

Results

In the study, the data of 180 individuals (60 ADHD, 60 ASD patients, and 60 controls) were analyzed. The groups were similar in terms of age, gender, total IQ, mother's education, father's education, and monthly income ($P > .05$). Sociodemographic characteristics of participants are given in Table 1.

Post hoc Dunn Test was used for binary group comparisons. Comparisons between all possible binary groups were statistically different

Table 1. Sociodemographical Characteristics of Participants

		Groups							
		ADHD		ASD		Controls			
		n/mean	%/SD	n/mean	%/SD	n/mean	%/SD	F/χ^2	*P*
Age (years)		14.00	1.43	14.02	1.44	13.55	1.41	2.07	.129
Gender	Male	30	50	30	50	30	50	0	.000
	Female	30	50	30	50	30	50		
Total IQ		95.47	10.31	95.47	10.31	94.45	10.82	0.19	.829
Maternal education	Elementary	20	33.3	20	33.3	20	33.3	0.07	.999
	High school	20	33.3	20	33.3	19	31.7		
	University	20	33.3	20	33.3	21	35.0		
Paternal education	Elementary	20	33.3	19	31.7	20	33.3	0.07	.999
	High school	21	35.0	21	35.0	21	35.0		
	University	19	31.7	20	33.3	19	31.7		
Monthly income	< 1000 TL	9	15.0	8	13.3	11	18.3	3	.80
	1000-1999 TL	19	31.7	21	35.0	16	26.7		
	2000-2999 TL	22	36.7	22	36.7	19	31.7		
	> 3000 TL	10	16.7	9	15.0	14	23.3		

Abbreviations: SD, standard deviation; ADHD, attention deficit-hyperactivity disorder; ASD, autism spectrum disorder.

Table 2. Comparison of the RMET, Faux Pas Test and Hinting Test Scores of the Groups

	Groups							
	ADHD		ASD		Controls		Kruskal-Wallis H	*P*
	Med.	IQR	Med.	IQR	Med.	IQR		
REMT	18.0	3.0	16.0	3.0	20.0	4.0	77.87	< .001
Faux pas test	4.0	3.0	2.0	1.0	7.0	2.0	139.42	< .001
Hinting test	15.0	2.0	14.0	2.0	18.0	1.0	122.24	< .001

Abbreviations: IQR, Interquartile range; ADHD, attention deficit-hyperactivity disorder; ASD, autism spectrum disorder.

Table 3. Comparison of DERS Test Scores Between Groups

	Groups							
	ADHD		ASD		Controls		Kruskal-Wallis H	*P*
	Med	IQR	Med	IQR	Med	IQR		
DERS test goals	14.0	2.0	17.0	4.0	8.5	2.0	130.7	< .001
DERS test strategies	18.0	2.0	20.0	3.0	13.0	2.0	140.79	< .001
DERS test impulsivity	13.0	2.0	16.0	2.0	10.0	2.0	131.4	< .001
DERS test awareness	15.0	2.0	20.5	3.0	12.0	3.0	149.40	< .001
DERS test clarity	12.0	1.0	16.0	2.0	10.0	2.0	146.32	< .001
DERS test non-acceptance	13.0	2.0	16.0	2.0	9.0	2.0	155.17	< .001
DERS test total	85.0	5.0	106.0	7.0	62.0	6.0	159.28	< .001

Abbreviations: IQR, interquartile range; ADHD, attention deficit-hyperactivity disorder; ASD, autism spectrum disorder.

Table 4. Analysis of DERS Test Total Score and RMET, Faux Pas Test and Hinting Test Scores by Pearson Correlation

	DERS test total score	
	r	*P*
RMET	-0.628	< .001
Faux pas test	-0.856	< .001
Hinting test	-0.801	< .001

Table 5. Analysis of the Effect of RMET, Faux Pas Test and Hinting Test Scores on DERS Test Total Score by Multiple Linear Regression

	B	t	*P*
Invariant	161.817	29.807	< .001
RMET	-0.694	-2.118	.036
Faus pax test	-4.65	-12.446	< .001
Hinting test	-2.782	-6.96	< .001

Dependent variable: DERS test total score.

($P < .05$, adjusted using Bonferroni correction). RMET, Faux Pas Test and Hinting Test scores of at least one group were statistically different from others ($P < .001$) (Table 2).

The post hoc Dunn Test was used for binary group comparisons. Comparisons between all possible binary groups were statistically different ($P < .001$, adjusted using Bonferroni correction). The DERS scores of at least one group were statistically different from others ($P < .001$) (Table 3).

There was a strong negative, statistically significant correlation between the DERS test total score and the RMET test scores (r = -0.628, $P < .001$). There was a very strong, statistically significant correlation between the DERS total score and the Faux Pas Test (r = -0.856, $P < .001$) and the Hinting Test (r = -0.801, $P < .001$) scores (Table 4).

The analysis of the effect of RMET, Faux Pas Test and Hinting Test scores to the DERS total score with multiple linear regression is represented in Table 5. The predictors put in the model corresponded to 81.9% of the DERS total score. All variables included in the model had a significant effect on the DERS total score ($P < .05$) (Table 5). The equation obtained in linear regression analysis was: DERS total score: 161.82, RMET: -0.694, Faux Pas Test: -4.65, Hinting Test: -2.78.

Discussion

This study stands out as the first study in which adolescents diagnosed with ASD and ADHD were evaluated together with ToM and ER abilities. The results obtained in this study are summarized as follows: (1) ToM and ER abilities of adolescents diagnosed with ASD and ADHD are weaker than those of the healthy control group, (2) ToM and ER abilities of adolescents diagnosed with ASD are weaker than those of the ADHD group, and (3) the deterioration of ToM capabilities negatively affected ER in all groups. In the previous study, it was determined that the ToM performances of children diagnosed with ASD were similar to those of the ADHD group, while same study showed that children diagnosed with ASD and ADHD performed much poorer than healthy controls.[31] Another study contradicts our study findings that children diagnosed with ASD and ADHD did not differ in terms of ToM performance.[32] In our study, the ToM performances of the ADHD and ASD groups were lower compared with those of the healthy control group. The fact that both groups diagnosed with ADHD and ASD had weak facial effect recognition abilities due to ADHD symptoms in the previous study supports our hypothesis.[33]

Miranda et al[34] previously evaluated ToM and executive functions on ADHD, ASD, and healthy control groups. The ADHD and ASD groups showed lower ToM performance, while the ASD group performed much poorer than the control group. The present findings are similar to the results of previous studies, where patient groups performed lower than the control group, and the ASD group had lower ToM performance compared with the ADHD group.

The findings of the study, which has been shown to have weaker ER abilities and exhibit more negative effects in patients diagnosed with

ADHD, were found to be compatible with current findings.[35,36] In our study, ER skills of the ADHD group were weaker than those of the control group. Our findings are compatible with our previous study indicating that ED is more common in children with ADHD carrying hyperactivity/impulsivity symptoms.[37]

In our study, children with ASD had higher ED than healthy controls. In accordance with our previous study, it has been determined that children with ASD experience more internalization and externalization problems than children with normal development.[38] Similar to contemporary findings, different studies have determined that diagnoses of ADHD, oppositional defiant disorder,[39] and depression and anxiety symptomatology rates are higher in children diagnosed with ASD than in children with TD.[38]

Our study showed that ER capabilities of the ASD and ASD groups were weaker compared with those of the control group. Our findings are consistent with previous studies showing that children with ASD and ADHD have impaired ER functions.[40,41] Our present findings are compatible with those of a previous study,[42] where ER losses of the ADHD and ASD groups were evaluated and the ASD group presented higher ER deficits than the ADHD group. Similar findings were found in another study[43] with weak a ToM and limited flexibility, which is one of the core symptoms of ASD, and with lower performance for ToM and ER in the ASD group, similar to our study.

It is necessary to mention the limitations that may affect the interpretation of the data. First of all, comorbid presentations of ASD and ADHD diagnoses are common. About 60% of children with ASD are diagnosed with ADHD,[44] and 30% of children with ADHD might have heightened ASD traits.[45] Therefore, to highlight the unique relationship between ToM and ER in future studies, groups diagnosed with pure ADHD and ASD are required. In addition, the relatively small sample size in this study is another limiting factor for generalizing the data. Due to the cross-sectional nature of our research, longitudinal studies are needed.

In conclusion, the results of this study show that adolescent patients with ADHD and ASD may have difficulties in ToM and ER skills, which are consistent with the results reported in prior studies on children and adolescents with ADHD and ASD. In addition, the findings of this study support our hypotheses. Considering other studies, interventions to improve ToM and ER skills may help improve compliance with treatment and increase treatment effectiveness of children and adolescents with ADHD and ASD. ER and ToM have the potential for affecting social, academic, and behavioral outcomes in children, which are often the target of early intervention.

Ethics Committee Approval: *Ethics committee approval was received for this study from the Ethics Committee of Namık Kemal University (Approval Date: March 25, 2020; Approval Number: 2020.53.03.03).*

Informed Consent: *Informed consent was obtained from the parents of the participants.*

Peer-review: *Externally peer-reviewed.*

Conflict of Interest: *The author has no conflict of interest to declare.*

Financial Disclosure: *The author declared that this study has received no financial support.*

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