



RESEARCH ARTICLE

Comparison of social cognition in adolescents diagnosed with attention deficit hyperactivity disorder and autism spectrum disorder

Fatih Dagdelen¹ 

¹Tekirdag State Hospital, Department of Child and Adolescent Psychiatry, Suleymanpasa, Tekirdag - Turkey

ABSTRACT

Objective: The aim of this study was to analyze social cognition deficits of children with autism spectrum disorder (ASD) and attention deficit-hyperactivity disorder (ADHD) in their performance on explicit and applied measures of theory of mind (ToM) skills.

Method: This study comprised of 120 patients with ADHD and ASD according to DSM-5, between 12-16 ages, and 60 adolescents without any psychiatric diagnosis. Turkish version of Schedule for Affective Disorders and Schizophrenia for School-Age-Children Present and lifetime version were applied in order to assess psychopathology. Intelligence level of patients were assessed with Wechsler Intelligence Scale for Children-Revised. Reading the Mind in the Eyes test, Faus pax test and The Hinting task were used in patients to evaluate ToM skills.

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

Conclusion: This study supports the idea that ADHD and ASD is related to deficits in social cognition skills. Therefore, interventions to improve social cognition skills may help improve the compliance with treatment and increase treatment effectiveness of ADHD and ASD cases.

Keywords: Autism spectrum disorder, attention deficit-hyperactivity disorder, social cognition, theory of mind

INTRODUCTION

Social cognition is the ability to understand and explain the mental states such as belief, intention, emotion and imagination of the individuals themselves and others (1). The sub-field of social cognition is Theory of Mind (ToM), which is defined as the mentalizing capacity to interpret, infer and explain mental states underlying the behavior of other people, containing the understanding of false beliefs, hints, purpose, humor, metaphor (2).

ToM skills are essential to be able to understand that people's mental state is unlike from the mental state of other people and to be able to interpret the mental states of others. ToM concept has different components. First-order false belief (FOFB), Second-order false belief (SOFB), metaphor, irony and Faux Pas concepts have been identified as components related to the cognitive system (3). The ability to read the mind in the eyes suggests understanding the mental state that goes beyond simple emotions by looking at the expressions

How to cite this article: F. Dagdelen. Comparison of social cognition in adolescents diagnosed with attention deficit hyperactivity disorder and autism spectrum disorder. Dusunen Adam The Journal of Psychiatry and Neurological Sciences 2020;33:289-295.

Correspondence: Fatih Dagdelen, Tekirdag State Hospital Department of Child and Adolescent Psychiatry, 59100 Suleymanpasa/Tekirdag - Turkey

E-mail: dagdelen19@hotmail.com

Received: April 02, 2020; **Revised:** May 07, 2020; **Accepted:** August 22, 2020

in the eye of an individual, and this ability reflects one of the processes that determine the ToM (4,5). Cognitive social cognition abilities are necessary when asked what someone's belief and affective social cognition abilities are necessary when asked how someone feels (6).

Baron-Cohen first showed that ToM skills in autism and other common developmental disorders were an important social skill in inter personal communication (7). Following ToM studies in autistic children, further studies were conducted examining the ToM skills in groups with different diagnoses.

During the last decade, various ToM studies have been conducted on groups diagnosed with the neurodevelopmental disorders especially attention deficit hyperactivity disorder (ADHD) (8). Prior studies reported that children with ADHD have a reduced capacity for social reciprocity and understanding social clues and these social weakness looks like social interaction problems in Autism Spectrum Disorder (ASD). Many social cognition studies emphasised that children diagnosed with ADHD have been inappropriate social behavior problems in the deficiency of giving appropriate social responses and the perception of the behavior of others. The inappropriate social behavior of children diagnosed with ADHD could be etiologically related to ASD (9). Although this group has been seen to have better ToM skills than ASD groups, it is thought that the low level of ToM skills could contribute to the interpersonal and behavioral problems in ADHD (10).

In the light of this knowledge, ASD and ADHD are neurodevelopmental disorders characterized by social impairments. We hypothesed that; (1) ASD and ADHD group has lower ToM skills than TD group, (2) ASD group has lower ToM skills than ADHD group. The first objective of this study was to analyze social cognition deficits of children with ADHD, ASD and typical development (TD) in their performance on explicit and applied measures of ToM skills. The second objective was to compare these skills between the groups and with adolescents showing TD.

METHOD

Participants and Procedure

This cross-sectional case-control study was conducted at Tekirdag State Hospital Department of Child and Adolescent Psychiatry Department. Before initiating the study, participants' parents provided written informed consent. Ethic approval was obtained from the local ethics committee of Namık Kemal University Faculty of Medicine.

Enrollment criteria included: (a) age 12-16 years; (b) meet criteria ADHD and ASD according to DSM-5; (c) WISC-R score above 70; (d) physical and cognitive ability to participate in study procedures; and (e) absence of significant physical conditions or developmental delay impairing motility or cognition (e.g., paresis or palsy, intellectual disability). Participants with a history of substance/drug dependence, any neurological or additional medical disease, a history of perinatal complications, and a history of physical head trauma were not included in the study. This study comprised of 120 patients with ADHD and ASD and 60 healthy individuals. 64 participants diagnosed with ADHD were interviewed but 3 patients did not agree to join and 1 patient did not fill the forms. 63 participants diagnosed with ASD were interviewed but 1 patient did not agree to join and 2 patients did not fill the forms.

Measures

Collection Form for Sociodemographical and Clinical Data

This form was developed by researchers to determine sociodemographic characteristics of patients included in the study. The form for children included data about age, gender, neuromotordevelopment stages, literacy learning time, academic achievement, medical history, and the form for their first/second-degree relatives included data about education level, residency of parents, and psychiatric/medical genealogical 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.(11) to detect present and life-time psychopathology in children and adolescents. Validity and reliability studies were conducted for Turkish sample of the scale (12). Data from the child and at least one parent was combined with 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., and this test aims to determine participants' ability to sympathize other participants and to evaluate the extent to which he/she can understand their mental states solely by recognizing the emotions in their eyes (13).

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 eyes are apparent. For each test item, a photograph is framed with four words that describe the probable mental state or feeling of the person shown in the photo. Three of these words are misleading and only one word correctly describes the mental state of the person in the photo. The test was rated with the sum of the number of items correctly answered by the participant. Girli validated Turkish translation of the pediatric version of the test and stated that Turkish version can be used in the diagnostic and education processes as a valid and reliable test (14).

The Faux Pas Test

The Faux Pas Test was used to evaluate high mental crossreferencing (15). Noticing a faux pas is accepted as the most complex skill developmentally 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. In order to be able to understand when a faux pas has performed, it is necessary to represent two mental states. This skill requires both concept skill elements and emotional empathy elements (16,17). After listening the story, four questions were asked to assess 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 stories, child has to detect that no faux pas took place. Failure of any of these questions leads to a score of zero for that story. Children's version of the Faux Pas Recognition Test, which was developed by Baron-Cohen, was performed in Turkish with 5 original faux pas stories and 5 control stories (maximum score was 10 points) (15).

The Hinting Task

The Hinting Task is one of the advanced level ToM functions (18). It tests the skill of being able to predict real intention behind the words directly spoken. After listening the story, participants were asked what the person in the story really had wanted to say. If the participant did not respond correctly to the first hint question, the practitioner moved on to a question including a clearer hint. If correct answer was given for the first hint, a score of 2 was given; and if the answer with a clearer hint was true, a score of 1 was given. If both hint questions were not answered correctly, a

score of 0 was given. In the current study, 4 stories were used in the Hinting Task (19).

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. This scale was reviewed in 1974 and standardized as the WISC-R (Revised Version) (20). It was converted to Turkish culture by Savasir and Sahin (21).

Statistical Methods

Data were analyzed using SPSS 25.0 software. The findings were given as number, percentage, mean, standard deviation (SD), median and interquartile range (IQR). The suitability of numerical variables to normal distribution was examined by Shapiro - Wilk test. The homogeneity of variances was examined by Levene test. While age, total IQ scores of the ADHD, ASD and control groups were compared with one-way ANOVA test; Gender, mother and father education and monthly income were compared using chi-square test. Comparison of test scores between groups was performed using Kruskal-Wallis H test followed by post hoc Dunn test (with Bonferroni correction). Pearson correlation analysis was used for correlation analysis between numerical data. All hypotheses were bidirectional and statistical significance level was considered as $p < 0.05$.

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 education, father education and monthly income ($p > 0.05$). Sociodemographical characteristics of participants are given in Table 1.

RMET, Faus pax test and Hinting test scores of at least one group were statistically different from others ($p < 0.001$) (Table 2).

Post-hoc Dunn test was used for binary group comparisons. Comparisons between all possible binary groups were statistically different ($p < 0.05$, adjusted using Bonferroni correction) (Table 3).

DISCUSSION

The results obtained in the study are summarized as follows: 1) ToM skills of adolescents diagnosed with ASD and ADHD are weaker than TD group; 2) ToM

Table 1: Sociodemographical characteristics of participants

	Groups						df	F/X ²	p
	ADHD		ASD		Control				
	n/mean	%/SD	n/mean	%/SD	n/mean	%/SD			
Age (years)	14.00	1.43	14.02	1.44	13.55	1.41	2	2.07	0.129
Gender									
Male	30	50.0	30	50.0	30	50.0	2	<0.001	1.000
Female	30	50.0	30	50.0	30	50.0			
Total IQ	95.47	10.31	95.47	10.31	94.45	10.82	2	0.19	0.829
Maternal Elementary Education	20	33.3	20	33.3	20	33.3	4	0.07	0.009
Education									
High School	20	33.3	20	33.3	19	31.7			
Univercity	20	33.3	20	33.3	21	35.0			
Paternal Elementary	20	33.3	19	31.7	20	33.3	4	0.07	0.009
Education									
High School	21	35.0	21	35.0	21	35.0			
Univercity	19	31.7	20	33.3	19	31.7			
Monthly <1000 TL Income	9	15.0	8	13.3	11	18.3	6	3	0.8
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			

SD: Standard deviation, ADHD: Attention deficit-hyperactivity disorder, ASD: Autism spectrum disorder, RMET: Reading the mind in the eyes test

Table 2: Comparison of the RMET, Faus pax test and Hinting test scores of the groups

	Groups						df	Kruskal-Wallis H	p
	ADHD		ASD		Controls				
	Med.	IQR	Med.	IQR	Med.	IQR			
REMT	18.0	3.0	16.0	3.0	20.0	4.0	2	77.87	<0.001
Faus pax test	4.0	3.0	2.0	1.0	7.0	2.0	2	139.42	<0.001
Hinting test	15.0	2.0	14.0	2.0	18.0	1.0	2	122.24	<0.001

IQR: Interquartile range, ADHD: Attention deficit-hyperactivity disorder, ASD: High functioning autism spectrum disorder, RMET: Reading the mind in the eyes test

skills of adolescents diagnosed with ASD are weaker than ADHD group. In the previous study, it was determined that ToM performances of children diagnosed with ASD were similar to ADHD group; while same study showed that children diagnosed with ASD and ADHD performed rather poorly than healthy controls (22). There are also studies consistent with the study showing that children with

ADHD and ASD perform poorly in ToM tests, especially in the second-level false belief field, compared to healthy control (23). In a study conducted with ADHD, ASD, ADHD + ASD and healthy control, ToM performance was lower in the groups with ADHD symptoms (24). Another study contradicts our study that children diagnosed with ASD and ADHD do not differ in terms of ToM performance

Table 3: Comparison of the RMET, Faus pax test and Hinting test scores between groups

	RMET		Faus pax test		Hinting test	
	Test statistics	p	Test statistics	p	Test statistics	p
ADHD-ASD	29.55	0.005	56.79	<0.001	22.42	0.052
ASD-controls	81.95	<0.001	111.23	<0.001	99.26	<0.001
ADHD-controls	52.40	<0.001	54.44	<0.001	76.84	<0.001

Post-hoc Dunn test, ADHD: attention deficit-hyperactivity disorder, ASD: high functioning autism spectrum disorder, RMET: Reading the mind in the eyes test

(25). In our study, ToM performances of ADHD and ASD groups were quite low compared to TD group. A meta-analysis by Bora and Pantelis along with other study consistent with today's results have found that the ToM abilities of individuals with ADHD lies somewhere between that of individuals with ASD and that of TD individuals (26,27)

Today's findings supports the recent study showing that patients diagnosed with ADHD and ASD had weak facial affect recognition abilities due to ADHD symptoms (28). In prior study, attention has been reported to have a significant effect on the performance of reading the mind in eyes and facial recognition (29). In this study, it was found that adolescents diagnosed with ADHD and ASD had poorer mind reading performance compared to adolescents with TD group.

Miranda et al. previously evaluated ToM and executive functions on ADHD, ASD and TD groups. ADHD, ASD groups showed low ToM performance, while ASD group performed much lower than TD group (30). Present findings are similar to the results of previous studies, where patient groups performed poorly than TD group and ASD group had poorer ToM performance compared to ADHD group. Similar findings were found in the study (31) with weak ToM and limited flexibility, which is one of the core symptoms of ASD, and the low performance of ToM in ASD group in our study. Different studies determined that attention deficit/hyperactivity disorder, oppositional defiant disorder and depression and anxiety rates were higher in children diagnosed with ASD and ADHD than in children with TD (32,33)

It has been reported in the literature that the executive function problems in the ADHD group with a comorbid oppositional defiant disorder (ODD), caused ToM deficits and there was a reciprocal relationship between the two skills (34). In the current study, in the comparison between the ADHD group without ODD comorbidity and TD groups, significant difference was found in respect of all the ToM tasks. When the TD

group and the ADHD groups were compared, it was found that the RMET performances between the control group and the ADHD group without ODD were not significant. Thus, the results of the current study were not similar to the findings of previous studies that have shown that ADHD with ODD had no significant effect on ToM (35).

Our results consistent with the prior study found poorer performance on the Faux Pas Recognition task in children with ADHD. The other interesting finding of this study ToM scores increased to the level of healthy controls upon methylphenidate administration (36). Conversely with the findings of previous studies (37,38) the performance of the ADHD and ASD group on the Faux Pas Test was poorer from that of the TD group.

It is necessary to state 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 (39) and 30% of children with ADHD evidence heightened ASD traits (40). Therefore, groups diagnosed with pure ADHD and ASD are required in future studies. In addition, using a relatively small sample in this study is another limiting factor for generalizing the data. Due to the cross-sectional nature, longitudinal studies are needed as adolescents with ADHD and ASD cannot provide information about the progression of ADHD and ASD, treatment response and/or clinical changes for ADHD and ASD.

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

Ethics Committee Approval: Ethic approval was obtained from the local ethics committee of Namik Kemal University Faculty of Medicine.

Informed Consent: Before initiating the study, participants' parents provided written informed consent.

Peer-review: Externally peer-reviewed.

Conflict of Interest: No potential conflict of interest was reported by the author.

Financial Disclosure: No potential financial support was reported by the author.

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