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INVESTIGATION OF THE RELATIONSHIP BETWEEN AUTISM SYMPTOMS IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER AND BROAD AUTISM PHENOTYPE AND ALEXITHYMIC CHARACTERISTICS IN THEIR PARENTS

Research article

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Abstract

The study aims to examine autism-like symptoms in children with Attention Deficit Hyperactivity Disorder (ADHD), as well as to evaluate the broad autism phenotype (BAP) characteristics and alexithymia levels of their parents and to compare them with the control group and their parents. Children's autistic traits were evaluated by the Social Responsiveness Scale (SRS). BAP characteristics and alexithymia levels of parents were measured by the Autism-Spectrum Quotient (AQ) and Toronto Alexithymia Scale-20 (TAS-20), respectively. SRS scores of children and AQ and TAS-20 scores of mothers were significantly higher in the ADHD group than in the control group. In addition, significant correlations were determined between subscales and total scores of SRS, AQ, and TAS-20. The research findings underline that autistic traits are increased in children with ADHD, highlighting a notable overlap between ADHD and ASD. Moreover, the study elucidates BAP characteristics in mothers of children with ADHD, implying a potential shared genetic susceptibility or familial vulnerability. The emergence of higher alexithymic levels in parents of ADHD-affected children raises interesting questions regarding emotional processing and regulation in familial contexts. Appropriate family interventions targeting the improvement of social, communication skills, and emotional awareness could prove beneficial for treating ADHD.

Keywords: Autism, Attention deficit hyperactivity disorder, Broad autism phenotype, Alexithymia, Children.

1. Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by inattention, hyperactivity, and impulsivity (Association, 2013). ADHD is one of the most commonly diagnosed disorders in the pediatric population, with current estimates indicating a prevalence ranging from 11% to 16% among school-age children (Ercan et al., 2019; Willcutt, 2012). ADHD symptoms persist into adulthood and are related to cognitive, academic, familial, and occupational problems (Barkley, 2002). Social functioning is another crucial aspect of ADHD that is directly affected (Hoza et al., 2005). Social skill deficits have been reported in 52-82% of children diagnosed with ADHD (Pelham & Milich, 1984), which are regarded as a significant determinant of functional prognosis (Ercan, 2015).

Autism spectrum disorder (ASD) is a lifelong developmental disorder characterized by impaired social interaction and communication as well as repetitive behaviors and restricted interests (Association AP, 2013). Both ASD and ADHD, categorized as "neurodevelopmental disorders" can co-exist (Del Barrio, 2016). It has also been suggested that the prevalence of co-occurence of these disorders is high (Grzadzinski et al., 2011), which can result from the similarity of symptoms and the clinical appearance in psychiatric evaluations (Hattori et al., 2006), or there may be a transition in terms of diagnosis during the developmental period (Fein, Dixon, Paul, & Levin, 2005). It has also been reported that the symptoms of these disorders can be viewed as continuously distibuted traits (Grzadzinski et al., 2011). Research have demonstrated evident similarities in the neuropsychological and clinical profiles of both children with autism and those with ADHD (Gargaro et al., 2011). Prior findings have indicated that similar to ASD, children with ADHD encounter problems with theory of mind and emotion recognition (Bolat et al., 2017), and pragmatic language skills are impaired in most children with ADHD (Staikova et al., 2013). In accordance with this perspective, multiple investigations have elucidated a substantial overrepresentation of autism symptoms among children with ADHD when compared with their peers without ADHD (Ayaz, Ayaz, & Yazgan, 2013; Kochhar et al., 2011; Kotte et al., 2013; Martin, Hamshere, O'Donovan, Rutter, & Thapar, 2014; Okyar & Görker, 2020). The manifestation of impaired social functioning may be attributable to a reduced capability for social reciprocity, coupled with challenges in comprehending social cues and exhibiting appropriate responsiveness within social contexts (Ayaz et al., 2013; Nijmeijer et al., 2008). These phenomena may be linked to the presence of autistic traits within the ADHD population (Kotte et al., 2013).

The broad autism phenotype (BAP) is a set of personality and language traits that mirror the phenotypic manifestation of genetic predisposition to autism, observable in non-autistic family members of individuals with autism, exhibiting milder yet qualitatively similar characteristics to the core attributes of ASD (Folstein & Rutter, 1977). Kanner (1943) was a pioneering researcher who remarked that a subset of parents with ASD offspring exhibited attributes of being "serious-minded, perfectionistic individuals, with an intense interest in abstract ideas" who had a lack of interest in developing social relationships with others (Kanner, 1943). It is posited that a group exhibiting difficulties in social domains such as social communication, self-perception, awareness of others, and adaptation to the surrounding environment, as well as being perceived as "odd" by others, but not meeting the diagnostic criteria for ASD, may possess autistic-like features or exhibit subthreshold autism symptoms and may be defined within the context of the BAP (John N Constantino & Todd, 2003; Posserud, Lundervold, & Gillberg, 2006). It has been well documented that these subthreshold autistic traits are observed at a notably higher frequency in clinical settings, particularly among individuals with ADHD, in addition to the families of individuals with ASD (Kochhar et al., 2011; Kotte et al., 2013).

Alexithymia is characterized by deficits in identifying and describing one's own feelings, distinguishing between feelings and bodily sensations (Sifneos, 1996). Although defined as a personality trait observable in the general population (Franz et al., 2008), alexithymia has been found to be more prevalent in individuals diagnosed with ASD (Hill, Berthoz, & Frith, 2004; Tani et al., 2004) as well as in parents of children with ASD (Szatmari et al., 2008). In other words, alexithymic features are associated with autism symptoms (Hill et al., 2004). Additionally, alexithymia is frequently associated with many other psychiatric disorders, such as ADHD (Donfrancesco et al., 2013; Edel et al., 2010).

In line with the aforementioned literature, it is considered that autism-like symptoms are more frequently observed in children with ADHD and their parents; furthermore, it is posited that BAP characteristics are associated with alexithymic traits in parents. The present study

aimed to investigate autism-like symptoms in children with ADHD, as well as assess the levels of BAP traits and alexithymia among their parents, and compare these outcomes with those of control groups and their parents. Several hypotheses are proposed; (1) children with ADHD would exhibit higher levels of autism characteristics when compared to typically developing children, (2) parents of children with ADHD would be more likely to have BAP traits in comparison to parents of controls, (3) they would have higher alexithymia levels, (4) positive correlations would be observed between autistic traits of children and BAP features of parents as well as alexithymia levels. To the best of our knowledge, this clinical study contributes to an enhanced comprehension of autism-like symptoms manifested in children diagnosed with ADHD. Furthermore, it extends to the assessment of BAP characteristics and alexithymic traits among parents of children with ADHD. This study addresses an essential gap in the literature, underscoring the significance of evaluating not only the social functioning of children with ADHD but also the parental attributes in the context of psychosocial interventions aimed at fostering desired changes and providing education.

2. Method

2.1. Participants

The sample consisted of 85 children (6-11-year-old); those who were newly diagnosed with ADHD (n=40), and typically developing children (n=45) without any psychiatric diagnosis. Parents were invited and informed about the study. Mothers and/or fathers accompanying the children were also included in the study. The ADHD group comprised clinical cases who applied to the child and adolescent psychiatry outpatient clinic between April 2023 and June 2023. In the ADHD group, there were only newly diagnosed pure ADHD cases (with no accompanying other psychiatric disorder). The inclusion criteria for the ADHD group were as follows: (1) aged between 6 and 11; (2) having a diagnosis of ADHD according to the Diagnostic and Statistical Manual of Mental Disorders-fifth edition (DSM-5); (3) full-scale IQ score above 90 according to the Wechsler Intelligence Scale for Children-Revised Version (WISC-R). The control group was selected from among the patients who applied to the pediatric outpatient clinics for minor acute illnesses such as common cold and coughs. The inclusion criteria for the control group were as follows: (1) children and parents who were willing and capable of providing informed consent and (2) aged between 6 and 11. Children were excluded from the control group if they had any psychiatric disorder, were undergoing routine clinical follow-up, or were using medication for chronic illness. The exclusion criteria for both groups had no previous psychiatric, neurological, or other medical chronic diseases and/or uncorrected visual and hearing impairments.

The research protocol was approved by the Ethics Committee of Ankara University Faculty of Medicine (Ethics approval number: 2023/253). The children and their parents were verbally informed about the design of the study, and written informed consent forms in accordance with the Declaration of Helsinki were obtained from them.

2.2. Instruments

This study employed a demographic information form, a survey, and a semi-structured interview protocol to collect data from the participants. The demographic information form contained items about social and demographic factors, including age, disease history and their parents' educational level, family income, and family structure. This form was completed by the researchers by asking parents these questions during the initial interview. The

Hollingshead–Redlich Scale (HRS) was used to determine socioeconomic status (SES), which was simply divided into three categories: low (HRS ≤22), medium (HRS 23-44), and high (HRS ≥ 45) levels of SES (Hollingshead & Redlich, 2007). After that, the parents of the children were also asked to complete the psychiatric scales described below.

The Social Responsiveness Scale (SRS) is a 65-item parent-report questionnaire developed by Constantino et al. (2003) used to assess autistic traits among children and has been shown to have high reliability and validity (J N Constantino & Gruber, 2005). There are 65 items related to social behavior that can be observed on the scale, 39 items on language use, and 6 items on autism behaviors. Each item rates the frequency of a particular behavior on a 4-point Likert scale (0-3 points), with responses ranging from 0 = '*not true'*, to 3 = '*almost always true'*, with higher scores indicating a higher degree of autistic symptoms. The SRS items were also separated into 3 mutually exclusive categories based on the 3 DSM-IV autism symptom domains of social impairment (47 items), communication impairment (6 items), and stereotyped behaviors (12 items). Additionally, an 'ADHD-like' subscale including 8 items that seemed most probably directly affected by ADHD symptoms and a 'key autism' subscale including only 9 items that seemed very specific for ASD were also described according to the study conducted by Reiersen , Constantino, & Todd, 2008 (Reiersen, Constantino, & Todd, 2008). In a large sample study of school-age children by Ünal et al. (2009), the SRS-Turkish version was found to be valid and reliable (Ünal, Güler, Dedeoğlu, Taşkın, & Yazgan, 2009). In the current study, SRS was used to assess social and communication skills (whole scale score) as well as autism characteristics (key autism subscale score) among children. Of 60 scores and above of SRS, clinical problematic issues in this field are indicated (Ayaz et al., 2013).

The AutismSpectrum Quotient (AQ) is a 50-item self-report questionnaire that measures the degree to which someone has traits similar to those of individuals with ASD (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Each item can elicit one of four potential responses: "strongly agree," "slightly agree," "slightly disagree," or "strongly disagree." The questionnaire comprises five subscales: social skills, attention to detail, attention switching, communication, and imagination. Higher scores correlate with increased autistic traits. The assessment 's reliability and validity within the Turkish population were established through research conducted (Köse, Bora, Erermis, & Aydin, 2010). Within the scope of this study, the employed instrument served as a means to determine the manifestations of BAP among parents of child participants.

Toronto Alexithymia Scale-20 (TAS-20) is an established self-report measure of alexithymia that comprises 20 items rated using a 5-point Likert scale (1= strongly disagree, 5= strongly agree), with higher scores indicating higher degrees of alexithymia. The TAS-20 has a total and three subscales (factors 1–3): (1) difficulty in describing feelings, (2) difficulty in identifying difficulties, (3) externally oriented thinking (Bagby, Parker, & Taylor, 1994). Preliminarily, a TAS-20 total score of ≥ 61 was suggested to indicate higher levels of alexithymia (Bagby & Taylor, 1997). The three-factor model Turkish TAS-20 was found to be consistent with the original scale and had adequate internal consistency for all factors (Güleç et al., 2009). This measurement was used to describe the alexithymic features of the parents.

2.3. Procedure

Among the children and their parents who presented to the unit of the child and adolescent psychiatry department and were diagnosed with ADHD, and typically developing controls selected from the pediatric outpatient clinics of the hospital, those who accepted to participate

in this study were invited and informed about the research procedures. Written and verbal consent was obtained from all children and their parents. Self-report scales for parental assessment were completed by all mothers, whereas in the ADHD group, 10 fathers and in the control group, 13 fathers did not complete the psychiatric scales. Therefore, fathers were excluded from the study data.

The current study was conducted at Ankara University Faculty of Medicine, Department of Child and Adolescent Psychiatry. The clinical assessment procedure involved the execution of psychiatric evaluations and scale-based assessments of both the children 's and their parents' features. ADHD diagnosis was made by performing a comprehensive psychiatric assessment, which thoroughly identified symptoms and behavioral problems based on the DSM-5 criteria. In addition, the level of impairment was evaluated by excluding other psychiatric disorders that could contribute to the observed symptoms. The clinical and sociodemographic characteristics of all children were evaluated using a 'sociodemographic questionnaire by a child psychiatrist. Subsequently, SRS, AQ, and TAS were completed by the mothers. The whole session lasted a maximum of one hour.

2.4. Data Analysis

Statistical power analysis was performed for sample size estimation using Student's *t-test*. To detect a "large" effect with 95 % power (two groups, alpha = 0.05) (Cohen, 1988), the projected sample size needed with this effect size (G*Power 3.1) was approximately N = 84 for the simplest between-group comparison (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007).

Statistical analyzes were performed using SPSS 23.0. Shapiro –Wilk tests were used to explore the normality distribution of the continuous variables. For comparisons between the ADHD and control groups, the Mann–Whitney U test was used for scale scores because of the non-normal distribution. Chi-square and Fisher's exact tests were used for the categorical variables. Spearman's correlations were used to determine the relationships between scale scores. A p value of 0.05 was considered statistically significant in all statistical tests.

3. Results

3.1. Sociodemographic Characteristics of Groups

Table 1 presents the sociodemographic characteristics of the study participants. Both groups were found to be similar in terms of age, parental age and education level, family characteristics, and socioeconomic status (p>0.05). The median age of children aged between 6 and 11 years was 8. In both groups, the male gender was predominant. Most of the children had intact families, and most families had a moderate to high socioeconomic level. It was observed that the educational levels of the mothers and fathers were above high school degrees on average. The age of the mothers in the ADHD group ranged between 26 and 45, with a mean age of 36; and in the control group ranged between 30 and 50 years, with a mean age of 38.

Table 1. *Sociodemographic Characteristics of Groups*

Variables	**ADHD (n=40)** Mdn (IQR)/n (%)	**Control (n=45)** Mdn (IQR)/n (%)	χ^2/ U	p
Gender[1]				
Female	6 (15)	11 (22.4)	0.791	0.277
Male	34 (85)	38 (77.6)		
Child age[2]	8 (7-9)	8 (6.5-9.5)	858.5	0.707
Mothers' age[2]	36.5 (32.5-40.5)	39 (35.5-42.5)	289.0	0.096
Fathers' age[2]	39 (35.5-42.5)	42.5 (39.5-45.5)	276.0	0.060
Mothers' education level[1]				
Less than high school	7 (17.5)	7 (15.6)		
High school	13 (32.5)	19 (42.2)	0.859	0.651
College degree and higher	20 (50)	19 (42.2)		
Fathers' education level[1]				
Less than high school	5 (12.5)	2 (4.4)		
High school	13 (32.5)	13 (28.9)	2.230	0.328
College degree and higher	22 (55.5)	30 (66.7)		
Socioeconomic status[3]				
Low	2 (5)	2 (4.4)		
Medium	20 (50)	23 (51.1)	0.166	1
High	18 (45)	20 (44.4)		
Family type[3]				
Intact family	38 (95)	43 (95.6)	0.015	1
Single-parent family	2 (5)	2 (4.4)		

ADHD: Attention deficit hyperactivity disorder, Mdn: Median, IQR: Interquartile range
[1]Chi-square test
[2]Mann-Whitney *U* test
[3]Fisher's exact test

3.2. Comparison of Scale Scores between the Groups

In comparisons of the SRS, AQ, and TAS-20 scales, the Mann–Whitney *U* test was performed and statistically significant differences were found between the groups. Children with ADHD had significantly higher scores in all subscales and total SRS scores, and the mothers of ADHD children displayed elevated scores in both AQ (Communication, Imagination and Total scores) and TAS-20 measurements (all three domains) (See Table 2).

Table 2. *Comparisons of Scale Scores Across Groups*

Scales	ADHD (n=40) Mdn (IQR)	Control (n=45) Mdn (IQR)	*Z/U*	*p*
Social Responsiveness Scale				
Social Impairment	46 (39-53)	21 (13.5-28.5)	-6.77/131.5	**<0.001**
Communication Impairment	4 (0-8)	1 (0.5-1.5)	-5.69/264.0	**<0.001**
Stereotyped Behaviors	9.5 (6-13)	3 (1.5-4.5)	-6.42/172.5	**<0.001**
ADHD-like Scale	10 (8-12)	5 (2.5-7.5)	-6.71/139.5	**<0.001**
Key Autism Scale	6.5 (4-9)	2 (1-3)	-6.13/209.0	**<0.001**
Total Scale Score	60 (49-71)	24 (16-32)	-7.03/101.0	**<0.001**
Autism Spectrum Quotient				
Communication	2 (0.5-3.5)	2 (1-3)	-2.79/595.5	**0.005**
Social Skills	3 (1-5)	3 (1.5-4.5)	-0.89/799.5	0.369
Imagination	4 (3-5)	3 (2-4)	-2.51/620.5	**0.012**
Attention to Detail	5 (3.5-6.5)	5 (3.5-6.5)	-0.75/815.0	0.448
Attention Switching	4 (0.5-7.5)	3 (1-5)	-1.07/780.5	0.282
Total Score	18 (15-21)	15 (12.5-17.5)	-2.61/604.5	**0.009**
Toronto Alexithymia Scale				
DIF	10 (5.5-14.5)	8 (3-13)	-2.61/604.0	**0.009**
DDF	9 (6.5-11.5)	6 (3.5-8.5)	-2.72/592.50	**0.007**
EOT	19.5 (17-22)	17 (13-21)	-2.33/635.5	**0.020**
Total Score	38.5 (31-46)	31 (11-42)	-2.64/599.5	**0.008**

ADHD: Attention deficit hyperactivity disorder, Mdn: Median, IQR: Interquartile range; DIF: Difficulty in identifying: Difficulty inidentifying feelings, DDF: Difficulty describing feelings, EOT: Externally oriented thinking
Mann–Whitney *U* test

3.3. Outcomes of the Correlation Analyses

Comparing the AQ scale scores of mothers and the social responsiveness of children, there were significant correlations between AQ subscale scores and both SRS total scores and SRS-key autism scale scores in all groups. Statistically significant correlations were found between SRS-total scores and AQ-total (r=0.218, *p*=0.045), AQ-Social Skills (r=0.236, *p*=0.030), and AQ-Imagination (r=0.258, *p*=0.017) subscales. In addition, moderate correlations were identified between the SRS-key autism subscale and AQ total and subscale scores, except the Imagination subscale (Shown in Table 3).

Although no significant relationship was observed between SRS-total scores and TAS-20 scale scores, significant correlations were identified between SRS-key autism subscale and TAS-20 total and subscale scores (Difficulty describing feelings and Externally-oriented thinking) (See Table 3).

Table 3. *Correlations between the SRS-Key Autism Scale and Parental Measurements*

SRS-Key Autism Scale	*p*	r
Autism Spectrum Quotient		
Communication	**0.003**	**0.321**
Social Skills	**0.002**	**0.337**
Imagination	**0.003**	**0.323**
Attention to Detail	0.700	-0.042
Attention Switching	**0.008**	**0.284**
Total Score	**<0.001**	**0.418**
Toronto Alexithymia Scale		
DIF	0.143	0.160
DDF	**0.033**	**0.232**
EOT	**0.002**	**0.327**
Total Score	**0.015**	**0.264**

DIF: Difficulty inidentifying feelings, DDF: Difficulty describing feelings, EOT: Externally-oriented thinking
Spearman Correlation Test

While investigating the associations between AQ and TAS-20 scales fulfilled by mothers, moderate to strong significant correlations were found in the whole sample (See Table 4).

Table 4. *Correlations between Total and Subscale Scores of Autism Spectrum Quotient and Toronto Alexithymia Scale-20*

	Toronto Alexithymia Scale-20			
	DIF r/*p*	DDF r/*p*	EOT r/*p*	Total Score r/*p*
Autism-Spectrum Quotient				
Communication	**0.244/0.024**	**0.399/<0.001**	0.133/0.224	**0.274/0.011**
Social Skills	**0.522/<0.001**	**0.532/<0.001**	**0.606/<0.001**	**0.630/<0.001**
Imagination	**0.402/<0.001**	**0.461/<0.001**	**0.368/0.001**	**0.453/<0.001**
Attention to Detail	0.140/0.202	0.068/0.539	0.11/0.225	0.121/0.270
Attention Switching	**0.220/0.043**	0.191/0.079	0.102/0.353	0.205/0.060
Total Score	**0.588/<0.001**	**0.638/<0.001**	**0.516/<0.001**	**0.653/<0.001**

DIF: Difficulty inidentifying feelings, DDF: Difficulty describing feelings, EOT: Externally-oriented thinking
Spearman Correlation Test

4. Discussion

In the current study, autism-like features of children and BAP characteristics and alexithymia features of parents were investigated among two groups consisting of children with ADHD and their typically developing children peers. Further elaboration on each hypothesis will be provided subsequently.

Consistent with the first hypothesis, our research outcomes reveal that children diagnosed with ADHD exhibit higher levels of autistic traits determined by SRS than their typically developing counterparts. This is also in line with prior research, which has shown that a positive ASD traits profile is significantly overrepresented among ADHD children versus controls (Ayaz et al., 2013; Kochhar et al., 2011; Kotte et al., 2013; Martin et al., 2014; Reiersen et al., 2008). Conversely, this result contradicts the assertion that autism-related attributes are less prevalent in ADHD than originally anticipated (Mayes, Calhoun, Mayes, & Molitoris, 2012). Hence, these divergent outcomes could stem from the clinical heterogeneity in ADHD (Taurines et al., 2012), or social problems in ADHD may primarily reflect inconsistent performance rather than a lack of social knowledge/skills (Aduen et al., 2018). To summarize, the elevated SRS subscale scores in the ADHD children (relative to controls) indicated increased social and communication deficits as well as autistic traits within this group. Moreover, the mean SRS total score in this group was 60, which can be interpreted as some of the children with ADHD having scores above the threshold (positive autistic traits), while others fell below the threshold. This finding suggests the presence of autistic symptoms in a subgroup of children with ADHD (Kotte et al., 2013).

The current results corroborated the second hypothesis, which suggested higher BAP traits in parents of children with ADHD than in the control group. BAP is more common in parents of children with ASD than in controls (Rubenstein & Chawla, 2018). This finding may be explained by the dimensional overlap between autism-relevant and ADHD-relevant characteristics (Stanton, DeLucia, Brown, & McDonnell, 2021). A study conducted among parents of school-aged children demonstrated mild to moderate associations between ADHD symptoms and BAP traits (Stanton et al., 2021). In the present study, we did not assess ADHD indicators in parents; however, it is possible that ADHD symptoms are elevated in the families of children diagnosed with ADHD compared with the normal population. In this regard, our findings support the previous study. Another study compared autism characteristics among parents of children with ADHD accompanied by Specific Learning Disorder (SLD) with those of parents having typically developing children and revealed that mothers in the ADHD group exhibited notably higher AQ scores than mothers in the control group (Ozbaran et al., 2022). Although these findings were derived from cases with co-occurring SLD and ADHD rather than pure ADHD, they still, to some extent, substantiate our research outcomes.

A notable finding of this study is the elevated alexithymia levels observed among parents of children with ADHD aligned with the third hypothesis. Based on our current findings, the mothers of the ADHD group had significantly higher scores on all three alexithymia domains than the mothers of control peers. This contradicts a prior study, which found no significant differences between the parents of ADHD and those of controls (without any psychiatric diagnosis) in terms of TAS-20 alexithymia scores (Güleş et al., 2018).
Durukan et al. (2018) compared the alexithymia levels of parents with children diagnosed with autism, pervasive developmental disorder not otherwise specified (PDD-NOS, categorized as a milder form of ASD according to DSM-IV-TR), and ADHD. The study revealed that alexithymia symptoms were more pronounced in parents of children with ADHD than in those in the PDD-NOS group. This is an unexpected outcome, given that ADHD is generally perceived as a milder neurodevelopmental disorder than ASD (Durukan et al., 2018). Similarly, research conducted on children and adults diagnosed with ADHD detected higher alexithymia features in the ADHD group (Donfrancesco et al., 2013; Roshani et al., 2017). A study conducted among an adult sample demonstrated that scores of individuals with ADHD across the components of alexithymia, specifically difficulty in identifying and recognizing feelings, were significantly elevated compared with the normal population (Roshani et al., 2017). On the other hand, another study suggested that the TAS-20 total score in the ADHD group did not exhibit a substantial elevation compared with community-based samples (Edel et al., 2010). Hence, despite the observed significantly higher TAS-20 scores among mothers of children with ADHD compared with those of peer controls in our study, it is plausible to understand that these scores bear a resemblance to the population norms, considering that the mean TAS-20 score of ADHD mothers remains below 60.

Based on our fourth hypothesis, we expect to observe significant correlations between children ’s autistic traits and both parental BAP features and alexithymia levels. Not surprisingly, we identified statistically significant connections between SRS-key autism scores of children and AQ subscales, including Communication, Social Skills, Imagination, and Attention Switching, as well as total scores. This finding could be interpreted as evidence for parent-of-origin effects in ASD symptoms (Ryan & Heron, 2023). In other words, one could argue that a strong genetic component is identified in the manifestation of autism characteristics. Some studies reported that ASD was mainly transmitted through the maternal line (Lauritsen et al., 2005), while a few found no association between autism symptoms of children and mothers’ (Okyar & Görker, 2020; van Steijn et al., 2012). Okyar and Görker found

no relationship between the autism symptoms displayed by parents (both mother and father) and those exhibited by their children. It was also identified that maternal and paternal ADHD symptoms were predictive of autism symptoms in children (Okyar & Görker, 2020). Because our study 's hypotheses did not encompass associations with ADHD symptoms in parents, we did not examine this aspect. However, our correlation findings regarding autism symptoms are not align with the findings of this study.

Our findings showed moderate-to-strong associations between parental alexithymic features and autism characteristics, particularly in the social, communication, and imagination domains. This agrees with a prior research conducted on an adult community sample, which revealed that poorer social skills were associated with greater difficulty in identifying and describing feelings. Poorer communication was associated with greater difficulty in identifying feelings, describing feelings, and externally oriented thinking (Liss et al., 2008). Alexithymia, which refers to the inability to identify and express feelings, might have a significant impact on social cognition (Di Tella et al., 2020). Since, recognising recognizing emotions and feelings relies on the ability to identify correctly one's own feelings. It is also associated with emotion recognition, empathy, and emotional regulation (Di Tella et al., 2020; Hoffmann et al., 2016), which are crucial for engaging in social interaction and communication with others (Albantakis et al., 2020).

The existing literature indicates that individuals with ADHD might possess shortcomings in emotional processing, which in turn could impact their social interactions. The proficient interpretation of one's own and others' emotions is pivotal for establishing adaptive interpersonal relationships (Donfrancesco et al., 2013). Furthermore, considering the high prevalence of autistic traits in this group, managing children with ADHD might prove challenging. Additionally, when considering mothers ' alexithymic and autistic traits alongside these factors, it becomes crucial to consider various aspects during the prognosis process for this vulnerable group. Nevertheless, mothers with BAP traits often encounter challenges in administering interventions or participating in training programs designed to enhance their children 's outcomes, as their own difficulties can negatively impact successful outcomes. For instance, autistic traits might limit their interaction with young children, potentially hindering the adaptability of their own social communication style, which could subsequently impact the effectiveness of parent-mediated interventions. On the other hand, the rigidity linked to BAP could lead to more consistent delivery of interventions with suggested frequency and regularity. Therefore, if children with ADHD who have parents with a BAP profile show poorer response to the interventions, clinicians and researchers should tailor individual modifications for the implementation of parent-mediated interventions (Parr et al., 2015).

4.1. Limitations of the Study and Directions for Future Suggestions

There are some limitations of this study that need to be addressed. First, the cross-sectional design of the study precludes the establishment of causal relationships, limiting our ability to infer the directionality of the observed associations. Second, the reliance on parental self-report measures might introduce biases that potentially impact the accuracy of the reported data. Additionally, the study sample size although carefully selected, may not fully encompass the heterogeneity of ADHD and parental characteristics. As we did not explore autism features in relation to different clinical presentations of ADHD (eg, inattention, hyperactivity/impulsivity, or combined) or examine the relationship between child ADHD symptoms and other child and parental characteristics, the overall strength of our study is diminished. This could limit the generalizability of the findings to broader populations. Furthermore, the study exclusively focused on school-aged children, thereby excluding potential developmental variations that

could emerge in younger or older age groups. Similarly, due to the predominant representation of males and the inclusion of only mothers in our study, we could not perform a gender comparison and assess the BAP profile of fathers, which also limited our ability to compare maternal and paternal characteristics. Despite these limitations, this study provides valuable insights into the intricate relationships among children's autistic traits, parental BAP, and alexithymia levels, paving the way for further investigations and refined methodologies.

Future research endeavors could build upon these findings to address these limitations and delve deeper into unexplored dimensions. Longitudinal studies spanning various developmental stages would provide valuable insights into the stability and progression of autistic traits in children with ADHD, as well as the potential evolution of BAP features and alexithymic levels among parents. Exploring potential mediating factors, such as executive functioning deficits or genetic predispositions, could offer a more comprehensive understanding of the mechanisms underlying these traits. Moreover, extending the investigation to include diverse cultural and socioeconomic backgrounds would enhance the applicability of the results to a broader population. Finally, interventions designed to mitigate the impact of both ADHD and autism-related characteristics, tailored to the unique needs of these individuals and their families, warrant exploration to guide more effective clinical practices.

5. Conclusions

To the best of our knowledge, this is the first study to investigate autistic traits in children with ADHD, along with broader autism symptoms and alexithymic features in their parents. In addition, it explores the associations between child and parental attributes and compares the findings with those of the control group. In conclusion, this study sheds light on several pivotal aspects of the intricate relationship between ADHD and autism-like characteristics. The findings emphasized the presence of elevated autistic traits in children diagnosed with ADHD, highlighting a noteworthy intersection between these two neurodevelopmental conditions. Moreover, the study elucidates BAP within parents of children with ADHD, implying a potential shared genetic susceptibility or familial vulnerability between the disorders. The revelation of elevated alexithymic levels in parents of ADHD-affected children raises intriguing questions regarding emotional processing and regulation in familial contexts. Collectively, these findings accentuate the nuanced interplay between ADHD and autism, underscoring the necessity for nuanced clinical interventions and a holistic understanding of these multifaceted conditions. This research not only advances our understanding of these interconnected phenomena but also sets the stage for further investigations aimed at unraveling the intricate mechanisms underlying neurodevelopmental disorders.

6. Ethical Statement

This study was conducted in accordance with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Ankara University Faculty of Medicine (Approval number: 2023/253). Informed consent before psychiatric assessment was a prerequisite for study inclusion. Confidentiality was assured, and participants were able to withdraw consent or discontinue participation at any time.

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