



Factors associated with the adjustment of typically developing siblings from single-incidence, multiple-incidence and non-autism spectrum disorders families

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Abstract

This study investigated the broader autism phenotype (BAP) in mothers and siblings and the mothers' stress and perceived support levels as factors affecting typically developing siblings' adjustment by introducing the number of children with autism spectrum disorders (n-ASD) as a factor. The sample consisted of 25 families with multiple-incidence autism spectrum disorder (ASD) children (multiplex families), 38 families with single-incidence ASD children (simplex families), and 46 families with non-ASD children. The data were collected via mothers by the Autism-Spectrum Quotient, Family Support Scale, Questionnaire on Resources and Stress, Social Communication Questionnaire, and Strengths and Difficulties Questionnaire. ANOVA, Kruskal-Wallis H-test, and multiple linear regression analysis were used to analyze the data. According to the findings, siblings and mothers' BAP, maternal stress, and perceived support levels significantly differed depending on the n-ASD, and the n-ASD was a significant predictor of both siblings' problem behaviors and prosocial behaviors. These findings were discussed, and limitations and suggestions were included.

Keywords Autism spectrum disorders · Siblings · Broader autism phenotype · Maternal factors · Multiple incidence families · Adjustment

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that also affects siblings as a family subsystem (Tsai et al., 2017). Studies reveal different results regarding the effects of ASD on typically developing siblings (ASD-sibs) (Dempsey et al., 2012; Hastings, 2003; Rao & Baidel, 2009; Verté et al., 2003). When looking at ASD-sibs' adjustment characteristics, including both problem behaviors and prosocial behaviors (Tsai et al., 2017; Walton & Ingersoll,

2015), ASD-sibs do have adjustment problems, more emotional problems, and less prosocial behavior (Verté et al., 2003).

Numerous interactive factors may impact the adjustment of ASD-sibs (Kovshoff et al., 2017), and these dynamic factors have been overlooked in the literature (Kovshoff et al., 2017; Walton & Ingersoll, 2015). Moyson and Roeyers (2011) state that differences in the effects of ASD on ASD-sibs may be due to a number of characteristics or the dynamics of family members. One of the factors related to family members that needs to be better understood is the broader autism phenotype (BAP). The BAP is the manifestation of one or more ASD characteristics at the subclinical level in linguistic, cognitive, social, and personality traits (Losh et al., 2008). Studies show that families and relatives of children with ASD have more BAP characteristics (Pisula & Ziegart-Sadowska, 2015; Piven et al., 1997). According to the results of a review by Rubenstein and Chawla (2018), the estimated range of the BAP in parents of children with ASD was 2.6–80.0%. Many studies revealed that ASD-sibs have more BAP characteristics than siblings of typically

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developing children (TDC-sibs) and display these characteristics in different developmental areas such as a restricted ability for empathy and theory of mind (Eyuboglu et al., 2018) and vulnerability in language acquisition (Yirmiya et al., 2007). The higher risk for developing the BAP for ASD-sibs (Ben-Yizhak et al., 2011; Petalas et al., 2012) is also defined a risk factor or has a determinant role in behavioral and emotional difficulties (Mohammadi & Zarafshan, 2014), more specifically, externalizing and internalizing behavior problems (Ben-Yizhak et al., 2011). Those siblings with a greater BAP have more adjustment difficulties (Meyer et al., 2011), more behavior problems, and reduced prosocial behavior (Mohammadi & Zarafshan, 2014; Petalas et al., 2012).

From the multi-factor perspective, along with the BAP characteristics of parents and siblings, parental mental health is another factor affecting ASD-sibs (Kovshoff et al., 2017). Stress is one of the conditions most frequently experienced by parents (Miranda et al., 2019). Raising typically developing children (TDC) along with a child with ASD may also increase the burdens parents, in particular mothers (Seidman et al., 2012), experience and may raise the level of stress (Dabrowska & Pisula, 2010) because not having enough time to spend with TDC and struggling to meet their needs are two of the sources of stress (Nicholas et al., 2020). This inadequacy of maternal resources affects the adjustment of ASD-sibs (Hesse et al., 2013).

While having a child with ASD is associated with stress in mothers (Duarte et al., 2005), it is also a factor that causes mothers to seek support. Mothers of children with ASD have less perceived social support than mothers of TDC (Obeid & Daou, 2015), and they need social support to meet the challenges of caring for a child with ASD (Ghanouni & Hood, 2021). If mothers cannot access such support, it may increase their stress (Spratt et al., 2007). The total stress of mothers and ASD-sib behavior problems are significantly related. In other words, as mothers perceive more stress, siblings have more behavior problems and fewer social skills. It has also been highlighted that as mothers experience more stress over time, ASD-sibs may be more vulnerable to more behavioral and emotional difficulties (Quintero & McIntyre, 2010).

The total number of children with ASD in the family (n-ASD) may be a possible factor that may affect the adjustment characteristics of ASD-sibs in association with BAP among family members and maternal factors. The BAP is more common in families with multiple-incidence autism spectrum disorder children (multiplex families) (Bernier et al., 2012; Gerdts et al., 2013; Losh et al., 2008). Gerdts et al. (2013) compared the BAP in siblings and parents from multiplex families and families with single-incidence ASD children (simplex families) and revealed that siblings,

fathers, and mothers from multiplex families displayed poorer conversational skills and less social interest than participants from simplex families. Additionally, siblings from multiplex families had more restricted behavior patterns and fewer nonverbal communication skills than siblings from simplex families. Similarly, in another study, the behavioral and social characteristics of parents from multiplex families and Down syndrome families were compared, and it was found that parents from multiplex families showed a higher incidence of stereotypical behaviors and communication defects (Piven et al., 1997). Regarding siblings, Constantino et al. (2006) compared social impairment in the siblings of children from multiplex families, siblings of children with any pervasive developmental disorder, and siblings of children with psychopathology unrelated to ASD. The most significant social impairment was seen among siblings from multiplex families. Additionally, as challenging issues (e.g., stress) in parents increase, family resources (e.g., support) are reduced dramatically in the presence of multiple children with ASD in families (Bekhet et al., 2012). The BAP in mothers was also associated with causing siblings to internalize problems (e.g., depression and anxiety) under stressful life conditions (Orsmond & Seltzer, 2009) such as having multiple children with ASD in the family.

The above-mentioned factors contribute to how ASD-sibs are affected by the presence of a child with ASD. Although there are many studies on the effects of these factors on ASD-sibs, no study was found in the literature in which the n-ASD in the family was also examined as a factor in the adjustment of ASD-sibs. This study aimed to investigate the adjustment characteristics of ASD-sibs from perspectives including the BAP characteristics of both siblings and mothers and stress and perceived support in mothers as primary caregivers from multiplex families, simplex families, and families with TDC in order to reveal the effect of the n-ASD on adjustment in typically developing siblings. The research questions of the study are given below:

1. Do the BAP characteristics of mothers and siblings, stress and perceived support levels for mothers, and the siblings' adjustment characteristics have statistically significant differences according to the n-ASD?
2. Do the n-ASD, the BAP characteristics of mothers and siblings, and the stress and perceived support levels of mothers statistically significantly predict siblings' problem behaviors?
3. Do the n-ASD, the BAP characteristics of mothers and siblings, and the stress and perceived support levels of mothers statistically significantly predict siblings' prosocial behaviors?

Methods

Participants and procedures

The participants were 109 biological mothers with TDC and children with ASD. Among these participants, 25 (22.94%) mothers had multiple children (two children) with ASD (target children) and at least one TDC (target sibling), 38 (34.86%) mothers had one child with ASD (target child) and at least one TDC (target sibling), and 46 (42.20%) mothers had at least two TDC (one child as target sibling, one child as target child) and did not have a child with identified disabilities. A set of inclusion criteria was included for the target siblings and target child(ren) for the recruitment process. The inclusion criteria for target siblings were: (a) not having identified disabilities based on mothers' verification, (b) being closest in age to the target child(ren). Being officially diagnosed with ASD was the inclusion criterion for target child(ren). The official diagnostic procedure for ASD was conducted in clinical settings by child mental health professionals, including child psychiatrists and child neurologists. The age range was 6–16 for target siblings and 4–22 for target child(ren). The participants from ASD families were recruited by ASD associations which were established by ASD families to provide social and educational support to children with ASD and their parents from four different regions of Türkiye through the Federation of Autism Associations (FAA), a comprehensive organization affiliated with ASD associations. After the mothers agreed to participate in the study, the author(s) called the mothers and asked them to complete several measurement tools regarding their TDC and themselves. Mothers were sent a pack of questionnaires, each expressing clear instructions, and an informed consent form including an address for the mothers to send back the completed questionnaires. Mothers from families without ASD were recruited from three general schools in two different cities. Rates of returned completed questionnaires were 62.50% for mothers with multiple children with ASD, 69.01% for mothers with a single child with ASD, and 69.69% for mothers without children with ASD, respectively. Ethical approval for this study was obtained from the author(s)' institution (Approval No: 2021/21). Descriptive statistics of participants are presented in Table 1.

Measurement tools

Autism-Spectrum Quotient (AQ)

The BAP characteristics of mothers were measured by the AQ, a self-report including 50 items to assess the individual's ASD characteristics in adults. Higher scores on the AQ

indicate increased ASD characteristics. The validity and reliability studies for the Turkish version of the AQ developed by Baron-Cohen et al. (2001) were carried out by Köse et al. (2010). In the study of the Turkish form of the AQ, factor analysis was used to test the construct validity of the scale and Cronbach's alpha value (0.64 for the total score of the scale) and test-retest reliability (0.72) were calculated for the reliability. In this research, Cronbach's alpha reliability of the total score of the AQ was calculated as 0.89.

Family Support Scale (FSS)

The FSS is a 34-item scale with five subscales and was developed by Kaner (2003) to assess the perceived social support of parents of children with special needs. Higher scores on the FSS indicate increased levels of perceived social support. In Kaner's (2003) study, factor analysis was used to test the construct validity of the scale and Cronbach's alpha value (0.95 for the total score of the scale) and test-retest reliability (0.99) were calculated for the reliability. In this research, Cronbach's alpha reliability of the total score of the FSS was calculated as 0.98.

Questionnaire on Resources and Stress (QRS)

The short form of the Questionnaire on Resources and Stress (QRS) is a 52-item tool with four factors developed by Friedrich et al. (1983) and is used to assess the perceived familial stress of those with children with disabilities. The validity and reliability studies for the Turkish version of the QRS were carried out by Kaner (2001). Greater parental stress is indicated by higher scores. In Kaner's (2001) study, factor analysis was used to test the construct validity of the scale, and KR-20 (0.92), Cronbach's alpha (0.91), and Spearman-Brown (0.89) coefficients were calculated for the reliability. In this research, Cronbach's alpha reliability of the total score of the QRS-F was calculated as 0.97.

Social Communication Questionnaire (SCQ)

The SCQ is a 40-item scale that assesses ASD symptoms in children and adolescents aged 4–18 years. The BAP characteristics of TDC were quantified through mothers by the Turkish form of the SCQ. Higher scores on the SCQ indicate increased ASD characteristics. The validity and reliability studies for the Turkish version of the SCQ developed by Rutter et al. (2003) were carried out by Avcil et al. (2015). Factor analysis was used to test the construct validity of the scale, and Cronbach's alpha value (0.80) was calculated for the reliability (Avcil et al., 2015). In this research, Cronbach's alpha reliability of the total score of the SCQ was calculated as 0.90.

Table 1 Sample demographics by group

Variables	ASD siblings		Non-ASD siblings
	Multiple ASD	Single ASD	
Mother’s Age	Mean (SD)	Mean (SD)	Mean (SD)
	39.92 (5.13)	39.03 (3.65)	39.37 (4.53)
Mother’s Education Level	f (%)	f (%)	f (%)
Non-Literate	-	1 (2.60)	-
Primary	3 (12.00)	11 (28.90)	8 (17.40)
Secondary	4 (16.00)	6 (15.80)	9 (19.60)
High School	8 (32.00)	9 (23.70)	8 (17.40)
Bachelor’s degree	10 (40.00)	11 (28.90)	17 (37.00)
Master’s degree	-	-	4 (8.70)
Number of Children	f (%)	f (%)	f (%)
2	-	24 (63.20)	36 (78.30)
3	19 (76.00)	9 (23.70)	9 (19.60)
4	6 (24.00)	3 (7.90)	1 (2.20)
5	-	2 (5.30)	-
Total	25 (100.00)	38 (100.00)	46 (100.00)
Marital Status	f (%)	f (%)	f (%)
Married	21 (84.00)	33 (86.80)	39 (84.80)
Divorced	3 (12.00)	2 (5.30)	2 (4.30)
Separated	-	1 (2.60)	1 (2.20)
Widowed	-	1 (2.60)	-
Not known	1 (4.00)	1 (2.60)	4 (8.70)
Target Sibling Age	Mean (SD)	Mean (SD)	Mean (SD)
	9.92 (4.29)	10.18 (3.71)	10 (2.91)
Target Sibling Gender	f (%)	f (%)	f (%)
Male	11 (44.00)	23 (60.50)	23 (50.00)
Female	14 (56.00)	15 (39.50)	23 (50.00)
Type of School Attended	f (%)	f (%)	f (%)
Preschool	3 (12.00)	10 (26.30)	5 (10.90)
Primary	12 (48.00)	9 (23.70)	20 (43.50)
Secondary	3 (12.00)	9 (23.70)	16 (34.80)
High school	6 (24.00)	35 (92.10)	5 (10.90)
Not known	1 (4.00)	3 (7.90)	-
Target Child Age	1st Mean (SD)	2nd Mean (SD)	Mean (SD)
	11.34 (4.31)	9.66 (4.17)	10.33 (3.47)
Target Child Gender	1st f (%)	2nd f (%)	f (%)
Male	20 (80.00)	19 (24.00)	26 (68.40)
Female	5 (20.00)	6 (76.00)	12 (31.60)
Type of School Attended	1st f (%)	2nd f (%)	f (%)
Special education class	6 (24.00)	23 (92.00)	11 (28.90)
Inclusive education	4 (16.00)	1 (4.00)	1 (2.60)
Special education school	4 (16.00)	-	7 (18.40)
Other (not attending school)	2 (8.00)	-	2 (5.30)
Missing	9 (36.00)	1 (4.00)	17 (44.70)
Preschool	-	-	-
Primary	-	-	-
Secondary	-	-	-
High school	-	-	-
Not known	-	-	-

Strengths and Difficulties Questionnaire (SDQ)

The SDQ is a 25-item scale with five subscales that assess adjustment in TDC aged 4–16 years. The scale was developed by Goodman (1997). The first four domains assess problems while the last domain, the prosocial domain, concerns positive behavior. A total difficulty score is calculated by summing the total ratings of the four problem domains. The validity and reliability studies for the Turkish version of the SDQ were carried out by Güvenir et al. (2008), concurrent validity was used for construct validation of the scale, and Cronbach's alpha value (0.84) was calculated for the reliability. Two dimensions of the scale were considered, the problem (P-SDQ) and the prosocial (Ps-SDQ) dimensions (Güvenir et al., 2008). Higher scores on the P-SDQ indicate increased problem behaviors, and higher scores on the Ps-SDQ indicate increased prosocial behaviors. Cronbach's alpha reliability of the scores for the two dimensions of the SDQ was calculated as 0.78 in this research.

Data analysis

The data were analyzed with the Jamovi 2.3.18 program. ANOVA, Kruskal-Wallis H-test, and multiple regression analysis were used to analyze the data. Assumptions were checked before analysis. There were no missing data in the data set. The dependent variables in the study are the scores obtained from the measurement tools for the first research question. Since the AQ (BAP characteristics of mothers) and Ps-SDQ (prosocial behaviors of siblings) scores did not deviate substantially from the normal distribution according to the *n*-ASD, the difference between the *n*-ASD groups was investigated with ANOVA. Since the FSS (mothers' perceived support), P-SDQ (problem behaviors of siblings), SCQ (siblings' BAP), and QRS (mothers' stress) scores were not distributed normally according to the *n*-ASD, the difference between them was investigated with the Kruskal-Wallis -H-test. Tukey's test for ANOVA and the Dwass-Steel-Critchlow-Fligner (DSCF) test for Kruskal-Wallis-H were used for pairwise comparisons. The effect sizes (η^2 , ϵ^2) of statistically existing differences between the groups were also reported. Just because a statistical analysis result is "statistically significant" does not mean that it will be significant in practice. Effect size is important in evaluating the

size and importance of the result obtained in applications (Tomczak & Tomczak, 2014).

Since the second and third research questions of the study aimed to determine the significant predictors of siblings' problem behaviors and siblings' prosocial behaviors, multiple regression analysis was conducted. For this, correlation values between variables were calculated, and the obtained values are given in Table 4. While the correlation between continuous variables was determined by the Pearson correlation coefficient, the correlation between the ordinal variable *n*-ASD and the other continuous variables was determined by Kendall's tau. The *n*-ASD variable is a discontinuous variable but on a ratio scale. It is stated that if the categories of such variables are equally spaced, they can be included in multiple linear regression analysis (Pasta, 2009). This situation is almost the same as scoring Likert-type scales. In this study, the variable of number of children was added to the regression analysis as a predictive variable because it was on a ratio scale, and its classes (0, 1, and 2) were equally spaced.

Results

For the first research question of the study, the descriptive statistics of the scores according to the *n*-ASD are given in the first table in the supplementary materials. When the descriptive statistics are examined with the Shapiro-Wilk hypothesis test for normality in this table, it can be seen that the closeness of the mean and median values and the skewness and kurtosis values between -2.00 and 2.00 indicate that the distribution of the scores does not deviate excessively from the normal distribution (George & Mallery, 2019). However, according to the *n*-ASD, while AQ and Ps-SDQ scores are normally distributed, FSS, P-SDQ, SCQ, and QRS scores are not normally distributed. The ANOVA test results for the normally distributed AQ and Ps-SDQ scores are given in Table 2, and the Kruskal-Wallis test results for the non-normally distributed FSS, SCQ, P-SDQ, and QRS scores are given in Table 3.

Table 2 shows mean, standard deviation, and *F*-values for AQ and Ps-SDQ scores according to the *n*-ASD. Results indicate significant mean differences according to the *n*-ASD for the AQ, with $F_{(2, 106)}=34.50$, $p<.05$. Findings reveal that as the *n*-ASD increases, the mothers' BAP

Table 2 ANOVA results for AQ and Ps-SDQ scores according to the *n*-ASD

<i>n</i> -ASD	0		1		2		<i>F</i>	η^2	Post-hoc
	Mean	SD	Mean	SD	Mean	SD			
AQ	24.13	7.09	31.13	7.97	39.20	6.90	34.50*	0.64	0–1, 0–2, 1–2
Ps-SDQ	8.87	1.07	6.21	1.96	3.60	1.55	98.10*	0.65	0–1, 0–2, 1–2

* $p<.001$; *SD* Standard deviation, *n*-ASD The number of children with autism spectrum disorders, AQ Autism-Spectrum Quotient, Ps-SDQ Prosocial dimension of the Strengths and Difficulties Questionnaire

Table 3 Kruskal-Wallis results for FSS, P-SDQ, SCQ, and QRS scores according to the n-ASD

n-ASD	0		1		2		χ^2	ϵ^2	DSCF
	Mean	SD	Mean	SD	Mean	SD			
FSS	87.11	9.18	68.05	13.40	56.40	16.20	56.05*	0.52	0–1, 0–2, 1–2
P-SDQ	16.65	3.62	22.66	4.15	26.34	4.53	54.14*	0.50	0–1, 0–2, 1–2
SCQ	4.57	3.53	8.21	7.46	14.88	7.59	27.13*	0.25	0–2, 1–2
QRS	4.41	4.96	22.21	6.17	27.76	10.15	73.81*	0.68	0–1, 0–2, 1–2

* $p < .001$; *DSCF* Dwass-Steel-Critchlow-Fligner, *n-ASD* The number of children with autism spectrum disorders, *FSS* Family Support Scale, *SCQ* Social Communication Questionnaire, *P-SDQ* Problem dimension of the Strengths and Difficulties Questionnaire, *QRS* Questionnaire on Resources and Stress

Table 4 Correlations between AQ, FSS, SCQ, P-SDQ, Ps-SDQ, and QRS scores

	n-ASD	AQ	FSS	P-SDQ	Ps-SDQ	SCQ	QRS
AQ	0.52*						
FSS	-0.59*	-0.57*					
P-SDQ	0.58*	0.34*	-0.56*				
Ps-SDQ	-0.70*	-0.64*	0.74*	-0.57*			
SCQ	0.38*	0.49*	-0.58*	0.38*	-0.55*		
QRS	0.68*	0.52*	-0.77*	0.68*	-0.68*	0.52*	

* $p < .001$; *n-ASD* The number of children with autism spectrum disorders, *AQ* Autism-Spectrum Quotient, *FSS* Family Support Scale, *SCQ* Social Communication Questionnaire, *P-SDQ* Problem dimension of the Strengths and Difficulties Questionnaire, *Ps-SDQ* Prosocial dimension of the Strengths and Difficulties Questionnaire, *QRS* Questionnaire on Resources and Stress

increases. Especially when the n-ASD is considered, the mean of the AQ scores is the highest when the n-ASD is 2.

As shown in Table 2, there are significant mean differences according to the n-ASD for the Ps-SDQ, with $F_{(2, 106)} = 98.10$, $p < .05$. The findings revealed that, as the n-ASD increases, the Ps-SDQ scores decrease. Especially when the n-ASD is considered, the mean of the Ps-SDQ scores is the highest when the n-ASD is 0. Additionally, when the effect size values are examined, it may be seen that the effect size of the differences is medium level. In another words, the statistical significance found between the means also is meaningful in practice.

As shown in Table 3, results indicate significant mean differences according to the n-ASD for the FSS [$\chi^2(2) = 56.05$; $p < .05$], P-SDQ [$\chi^2(2) = 54.14$; $p < .05$], SCQ [$\chi^2(2) = 27.13$; $p < .05$], and QRS [$\chi^2(2) = 73.81$; $p < .05$]. According to the DSCF test, FSS, P-SDQ, and QRS scores show significant mean differences according to the n-ASD. As the n-ASD increases, mothers’ perceived support level decreases while children’s problem behavior increases, and mothers’ stress level increases. When the SCQ is examined, the BAP in TDC increases as the n-ASD increases. However, this difference is not significant between those who do not have a sibling with ASD and those who have only one sibling with ASD. Additionally, when the effect size values are examined, it may be seen that the effect size of the differences is medium level except for the SCQ scale. A low effect size was determined for the SCQ. In other words, the statistical significance found between the means is also significant in practice. However, this significance was found to be small in our sample. Because the generalizability of the

statistical significance obtained is small, statistical results need to be interpreted carefully here.

For the second and third research questions of the study, firstly, the correlations between scores were calculated. The descriptive statistics of the scores before the calculations are given in the second table in the [supplementary materials](#). When the descriptive statistics are examined with the Shapiro-Wilk hypothesis test for normality, the distribution of the scores does not deviate excessively from the normal distribution. The Pearson correlation coefficients between scores are presented in Table 4. Additionally, in the relevant table, the relationship between the ordinal variable n-ASD and the scale scores is shown with Kendall’s tau correlation coefficient.

As shown in Table 4, all correlations between the scores obtained from the scales are statistically significant, and most of them are at medium level. The highest positive correlation was found between the Ps-SDQ and FSS ($r = .74$; $p < .05$). The lowest positive correlation was found between the P-SDQ and AQ ($r = .34$; $p < .05$). The highest negative correlation was found between the QRS and FSS ($r = -.77$; $p < .05$). The lowest negative correlation was found between the Ps-SDQ and SCQ ($r = -.55$; $p < .05$).

To determine whether the problem behavior of children is statistically significantly predicted by the n-ASD, the ASD characteristics in mothers, perceived support, social communication, and stress variables, multiple regression analysis was conducted. In other words, a linear multiple regression was calculated to predict P-SDQ based on the n-ASD, AQ, FSS, SCQ, and QRS. A significant regression equation was found ($F_{(5, 103)} = 24.67$, $p < .05$) with an R^2 of

0.55. After the established regression model was found to be statistically significant, the model coefficients are given in Table 5 in the supplementary materials.

Table 5 shows that the n-ASD ($t_{(103)}=4.16; p<.05$) and QRS ($t_{(103)}=2.65; p<.05$) variables are significant predictors of P-SDQ. According to the multiple regression analysis, it can be concluded that as the n-ASD and stress increase, the child's problem behavior increases. It means that the P-SDQ level was predicted by n-ASD and stress.

To determine whether the prosocial behavior of children is statistically significantly predicted by the n-ASD, ASD characteristics in mothers, perceived support, social communication, and perceived stress variables, multiple regression analysis was conducted. In other words, a linear multiple regression was calculated to predict Ps-SDQ, based on the n-ASD, AQ, FSS, SCQ, and QRS. A significant regression equation was found ($F_{(5, 103)}=55.88, p<.05$) with an R^2 of 0.73. After the established regression model was found to be statistically significant, the model coefficients are given in Table 6 in the supplementary materials.

As may be seen in Table 6, the n-ASD ($t_{(103)}=-5.73; p<.05$), AQ ($t_{(103)}=-2.15; p<.05$), and FSS ($t_{(103)}=3.80; p<.05$) variables are significant predictors of Ps-SDQ. According to the multiple regression, it can be concluded that, as the n-ASD and mothers' BAP decreases, the child's prosocial behavior increases. As perceived support increases, the child's prosocial behavior increases.

Discussion

We aimed to analyze the effects of BAP and maternal factors (stress and perceived support) in simplex families, multiplex families, and families with children with no developmental disabilities on siblings' adjustment outcomes, with reference to the n-ASD. According to the results, based on mothers' ratings, siblings' and mothers' BAP, maternal stress and perceived support levels significantly differed depending on n-ASD, and n-ASD was a significant predictor of siblings' adjustment.

n-ASD as a factor in the significant difference in the sibling and maternal variables

The results regarding whether maternal and sibling factors differed significantly according to the n-ASD showed that as the n-ASD increased, mothers' and siblings' BAP characteristics and mothers' stress levels increased while mothers' levels of perceived support decreased. Furthermore, as the n-ASD increased, ASD-sibs' prosocial behaviors decreased, and their problem behaviors increased. There are different studies in the literature showing that parents' BAP

characteristics increase with the n-ASD, thereby supporting the finding of the current study in this direction (Bernier et al., 2012; Piven et al., 1997; Wheelwright et al., 2010). When examining studies in the literature on the changes in BAP characteristics according to the n-ASD, we find similar results to those of the current study (Bernier et al., 2012; Losh et al., 2008). Mothers with a child with ASD have more BAP characteristics than mothers of TDC (Wheelwright et al., 2010). Losh et al. (2008) investigated a sample of multiplex families, simplex families, and control families to explore the prevalence of specific characteristics assumed to constitute the BAP (such as language, personality, and social and behavioral characteristics). The parents of multiplex families showed more BAP characteristics compared to those of simplex families. In studies on the changes in BAP characteristics of ASD-sibs according to the n-ASD, similar findings to those of the current study can again be found (Constantino et al., 2006; Gerdts et al., 2013). In one of these studies (Gerdts et al., 2013), siblings from multiplex families showed more restricted and repetitive patterns of behavior than siblings from simplex families. Similarly, Frazier et al. (2015) stated that ASD-sibs from multiplex families had a higher ASD symptom burden.

As the n-ASD increased, mothers' stress level increased, and their level of perceived support decreased. To the best of our knowledge, although no study in the literature was found related to mental status and level of perceived support in mothers with more than one child with ASD, in studies conducted with mothers of multiple children with disabilities, there are findings that reveal mixed results to those of the current study in terms of mothers' levels of stress and perceived support (Stanford et al., 2022; Orsmond et al., 2007). Despite the fact that Stanford et al. (2022) found no difference in overall psychological distress between mothers of a child with ASD and mothers of multiple children with special needs including a child with ASD and a child with other neurodevelopmental disorders, Orsmond et al. (2007) indicated that mothers with multiple children with disability had greater challenges in terms of personal well-being. When considering that stress and social support are important indicators of well-being (Drogomyretska et al., 2020; Prata et al., 2019), mothers' support and stress levels also vary based on the n-ASD.

Problem behaviors in siblings increase along with the n-ASD while prosocial behaviors decrease. In the literature, problem and prosocial behaviors in siblings are compared as adjustment characteristics (e.g., Tsai et al., 2017; Walton & Ingersoll, 2015). To the best of our knowledge, the current study is the first to examine the effect of the n-ASD on adjustment in siblings. With regard to prosocial behaviors, there are findings supporting our research findings in studies conducted with families with one individual with ASD (e.g.,

Petalas et al., 2012). Since siblings' BAP characteristics are a negative predictor of prosocial behaviors (Petalas et al., 2012), and siblings with two ASD siblings have more BAP characteristics in the current study, the prosocial behaviors of this group are lower than in the other groups. With regard to problem behaviors, the bulk of studies revealed that ASD-sibs have more problem behaviors than TD-sibs (Verté et al., 2003) or those with other developmental disabilities (Hastings, 2007), which supports the current research findings.

The predictors of problem behaviors and prosocial behaviors of ASD-sibs

To evaluate the predictors of siblings' problem behaviors and prosocial behaviors, firstly, we calculated the correlations and found that the BAP characteristics of mothers and siblings, mothers' levels of stress and perceived support, and siblings' prosocial and problem behaviors were significantly correlated with each other. The findings of a study conducted by Tsai et al. (2017) investigating the influence of the BAP on sibling adjustment showed that siblings' BAP and siblings' problem behaviors were significantly correlated. Similar correlations were encountered between maternal stress and siblings' difficulties. For example, Hesse et al. (2013) found that siblings' difficulties were positively correlated with maternal stress. If the presence of more children with special needs in a family means more stress for mothers (Stanford et al., 2022) and the significant correlation between siblings' behavioral adjustment and maternal well-being (Quintero & McIntyre, 2010) are considered, it is meaningful to find a significant correlation between maternal stress and sibling outcomes in the current study which aims to contribute to the existing literature by adding n-ASD as another possible factor in assessing the impacts of ASD on mothers and particularly on siblings.

One of the highest negative correlations was seen between mothers' support and stress. Similar correlations were found in previous studies. In a study conducted by Miranda et al. (2019), mothers' stress was negatively correlated with social support. A similar study conducted by Drogomyretska et al. (2020) included parents with more than one child with ASD, and they found significant positive correlation between stress and raising more than one child with ASD and negative correlation between perceived social support and stress derived from caring for a child or multiple children with ASD.

The findings revealed that the n-ASD predicted problems and prosocial behaviors in siblings. When studies related to the predictors of adjustment characteristics in siblings are examined, although no study related to the n-ASD was found, it is thought that the n-ASD has an effect on the predictors that are significant in the current study. Although

the BAP in mothers was a negative predictor of siblings' prosocial behaviors in the current study, in different studies, siblings' BAP emerged as a negative predictor of prosocial behaviors (Petalas et al., 2012) and a positive predictor of problem behaviors in siblings (Meyer et al., 2011; Petalas et al., 2012). When the n-ASD is taken into consideration, mothers have more BAP characteristics as the n-ASD increases, and these characteristics may cause their TDC to have adjustment problems because mothers may not have sufficient resources to meet the needs of their TDC. Benson and Karlof (2008) reached a similar conclusion in their study, indicating that stressful life events were a negative predictor of prosocial behavior, and it is well known that having multiple children with special needs is a stressful situation.

In the current study, mothers' levels of stress and perceived support were significant predictors of both prosocial and problem behaviors in siblings. In their study, Quintero and McIntyre (2010) concluded that siblings' behavioral adjustment was related to maternal well-being. Because having more than one child with ASD was a significant predictor of mothers' well-being (Ekas & Whitman, 2010), as the n-ASD increased, mothers' perceived level of well-being decreased and significantly predicted siblings' adjustment. Additionally, Bishop et al. (2007) indicated that in families with children with ASD, negative impacts were predicted by less perceived social support in mothers. This means that if mothers feel more support, siblings have more prosocial behaviors, and this information supports our findings.

According to the current study, one of the significant predictors of prosocial behaviors in siblings was perceived support. As mothers' level of perceived social support increased, this predicted less depression and increased well-being (Benson, 2012). Less depression may cause a mother to feel more effective in balancing the needs of different children with different developmental needs and may be a strong model for expressing adaptive coping styles that may turn into prosocial behaviors in TDC (Meyer et al., 2011).

Continuing stress in mothers of children with ASD makes ASD-sibs more vulnerable to accumulated risk over time and the effects of behavioral adjustment (Quintero & McIntyre, 2010). Prata et al. (2019) suggested an integrative approach to explain stress experienced by parents of children with ASD, and the number of children with disability was identified as a determinant of stress, similar to the study by Orsmond et al. (2007) indicating that the number of children with a disability in the family is as an important factor in perceived stress. In a study about the quality of life of parents of children with ASD, it emerged that parents with more than two children with special needs felt less happiness, more depression, and

a higher caregiver burden (Kuhlthau et al., 2014). In the light of these studies, it is possible to conclude that if the family has more than one child with special needs, stress and perceived support levels may predict sibling adjustment significantly.

Limitations

This study had several limitations. Firstly, the findings of the current study should be considered within the small sample size. The difficulty in reaching families with children with disabilities including ASD due to the lack of a national network or database in Türkiye limited the total number of ASD families, particularly multiplex families, in the sample. Although the FAA is a comprehensive organization with affiliated associations from all regions of Türkiye, it is not a state-funded organization and does not have a database.

The second limitation was that the data were collected through questionnaires completed by mothers as the primary caregivers. The participation of fathers as respondents or sibling self-report would shed more light on understanding TD siblings' outcomes. It is strongly suggested for future research to use different respondents (e.g., fathers, typically developing siblings) to prevent possible bias caused by using mothers as single respondents. In the context of this limitation, we considered that it may be stressful for mothers to assess the ASD characteristics of their TDC, and to reduce the stress that mothers might feel, although it was difficult to reach the participant groups, we relied on their volunteer participation and expressed what the scales' context and how they implemented in detail.

A third limitation was maternal verification of the diagnosis of target siblings and target children. We did not perform any diagnostic procedures or a formal diagnosis of children with ASD to confirm the absence of ASD or any other developmental condition in the ASD-sibs. However, it seems acceptable to select samples from children with ASD by confirmation of their parents since previous research has used similar methods to recruit participants (Tsai et al., 2017; Walton & Ingersoll, 2015). Due to the lack of a national official network for children with ASD, we collected data from large areas by postal questionnaires through parent-established associations named by the FFA, and, therefore, we could not perform any diagnosis process other than the parents' verification. Additionally, we did not exclude children with ASD with co-occurring conditions and did not obtain any information about the prevalence of co-occurring conditions among our target children.

Conclusion and implications

Despite the limitations, the collection of data from the three samples will make a meaningful contribution to understanding to what extent the n-ASD contributes to siblings' adjustment. Unlike studies in the literature, this current study introduced the n-ASD as a variable to see how the presence of none, one, or two children with ASD in a family along with maternal variables and sibling BAP influence sibling outcomes. According to the results, the n-ASD has a dominant impact on not only siblings but also mothers, and the maternal and sibling variables significantly predicted adjustment in siblings. Findings from the present study suggest that various variables including the BAP, maternal, and environmental and demographic variables (n-ASD) regulate sibling outcomes. According to the findings, if mothers have more children with ASD, they and their TDC have more BAP characteristics, and they experience more stress and less perceived support, which may disrupt adjustment in TDC.

Regarding the implication for practice, these results show that there is an interconnectedness of many factors associated with adjustment in siblings. A multi-factor family-centered approach should be taken into account when discussing the impacts of children with ASD on families and planning to support family members. In the Turkish context, as a developing country with the lack of a formal support system and limited accessible healthcare for families of children with ASD, our results showed that the vulnerability of families increases as the number of children with ASD increases. Our results highlight the need to develop formal support systems for families in our country. Regarding the implication for research, the results indicated that the n-ASD, as a new variable, has a predominant impact, and future research should examine the persistence of this impact in a larger sample. The mediating or moderating roles of variables (e.g., gender, birth order, and ASD severity) may be added to new research in order to examine their impacts on ASD-sibs from simplex families and multiplex families.

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Data transparency All data collected and analyzed during this study are not publicly available due to the conditions of our ethics approval. The data may be made available based on receipt of a reasonable request to the corresponding author.

Authors' contributions All researchers contributed to the study conception and design. The literature review, obtaining permission for

data collection, and data collection processes were performed by Hatice Şengül Erdem. The analysis of the data, the presentation of the findings, and the literature review were performed by Asiye Şengül Aşar. The researchers prepared the draft manuscript together and completed the final version of the manuscript together. All authors read and approved the final manuscript.

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Declarations

Ethics approval The study was approved by the ethics committee and conducted in accordance with the ethical standards at Istanbul Medipol University.

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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