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Article

Personal and Family Childhood Predictors of Functional Outcomes of Adolescents With Autism Spectrum Disorder

Belén Roselló[1], Álvaro Mira[1], Carmen Berenguer[1], Inmaculada Baixauli[2] and Ana Miranda[1]

1 University of Valencia.
2 Catholic University of Valencia.

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ABSTRACT

Background: The transition to adolescence can be challenging for children with autism spectrum disorder (ASD). The present study explored child and family variables that predict functional outcomes of adolescents with ASD in emotional/behavioral difficulties, socialization, daily living skills, and the transition to secondary education. **Method:** Forty-five individuals with ASD, without intellectual disability, were assessed during childhood (aged 7-11) and almost five years later. Child measures (executive functions, theory of mind, autism symptom severity) and parent measures (parenting stress, social support, coping strategies) were collected. **Results:** In adolescence, the predictive power of childhood executive functions was important for academic and behavioral/emotional indicators whereas theory of mind mainly predicted adaptive and behavior/emotional outcomes. ASD symptoms had predictive value in all outcome domains. Parental educational level, social support and parenting distress predicted socialization, while the engagement coping strategy had a significant role in daily living skills. **Conclusions:** The findings raise several clinical considerations related to assessment and intervention in autism. Executive functions and theory of mind programs could help to improve behavior/emotional, adaptive outcomes, and adjustment to school. In addition, the study indicates the need for family-centered interventions based on positive parenting practices and principles of behavioral analysis along with parental support, stress management and coping strategies.

Predictores Personales y Familiares de Resultados Funcionales de Adolescentes con Trastorno del Espectro del Autismo

Palabras clave:
Severidad del autismo
Teoría de la mente
Funciones ejecutivas
Conducta adaptativa
Variables familiares

RESUMEN

Antecedentes: el presente estudio exploró variables del niño y familiares que predicen el funcionamiento conductual/emocional, adaptativo y transición a la Secundaria de adolescentes con trastorno del espectro autista (TEA). **Método:** se evaluó a 45 individuos con TEA sin discapacidad intelectual en la infancia y casi 5 años después, recogiendo información del niño (funciones ejecutivas, teoría de la mente, y síntomas de autismo), y de padres (estrés, apoyo social, estrategias de afrontamiento). **Resultados:** las funciones ejecutivas predijeron adaptación académica y dificultades en la adolescencia, mientras que la teoría de la mente predijo resultados en socialización y habilidades de la vida diaria. Los síntomas de autismo tuvieron valor predictivo en los cuatro dominios de resultados. El nivel educativo, el estrés de los padres y el apoyo social predijeron la socialización, mientras que la implicación predijo las habilidades de la vida diaria. **Conclusiones:** los hallazgos tienen connotaciones para la evaluación e intervención en autismo. Los programas en funciones ejecutivas y en teoría de la mente mejorarían resultados conductuales/emocionales, adaptativos y ajuste escolar. Además, el estudio señala la necesidad de incluir en las intervenciones con familias principios de paternidad positiva y de análisis conductual, junto con apoyo parental, manejo del estrés y estrategias de afrontamiento.

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Corresponding author: Ana Miranda, ana.miranda@uv.es

Autism spectrum disorder (ASD) is a complex neurodevelopmental condition characterized by persistent impairments in social communication skills and repetitive and stereotyped patterns of behavior (RRB) relative to the child's age and mental age (American Psychiatric Association [APA], 2013). Recent epidemiological data collected in 37 countries reported a mean prevalence of 0.97% in primary school children (Fombonne et al., 2021). The prevalence rate in Spain among children aged 7-9 years olds is 0.59% (Fuentes et al., 2021). The most significant increase in cases in recent years has occurred in the subgroup without intellectual disability (ID), which corresponds to approximately two-thirds of the population with ASD (Baio et al., 2018). However, despite having a full intellectual quotient (IQ) on average, there is remarkable disparity in the developmental trajectories of individuals with ASD-without ID that could be explained, at least in part, by a variety of child and family factors. The association between IQ and adolescent or adult functioning has been extensively studied, concluding that IQ may be protective against the poorest outcome profile, but it does not guarantee a good outcome (Pickles et al., 2020). By contrast, few longitudinal studies have explored the role of other variables related to child and family characteristics.

Among the child factors, the largest body of literature has focused on the possible effect of executive function, theory of mind and severity of ASD symptoms on functional outcomes.

Executive dysfunction, one of the explanatory theories of ASD, focuses on a collection of mental self-regulatory processes that guide and manage goal-directed behaviors (Ozonoff, 1995). Inhibition, shifting, working memory (WM), planning and monitoring are the most common executive function (EF) impairments found in ASD (Demetriou et al., 2019). These deficits can be detected early in ASD and they are associated with lower daily-life competence: social and adaptive behaviors, academic skills, time management and co-occurring mental health symptoms (Pugliese et al., 2020). The scarce longitudinal research has also provided information on the prognostic significance of EF in adolescents with ASD-without ID. Kenny et al. (2019) assessed young people with autism on components of EF and theory of mind (false-belief understanding). Twelve years later, the scores on early neuropsychological tasks of inhibition, planning and cognitive flexibility predicted outcomes in autistic features and adaptive behavior. Other prospective studies supported the predictive power of EF in later variations in social communication, RRB and daily living skills, highlighting self-monitoring behaviors as the most robust predictor of later adaptive functioning (Pugliese et al., 2016) and social skills in adolescents (Vogan et al., 2018). Parent reports confirmed EF as a strong predictor of functional and social communication skills in children with autism (Hutchison et al., 2020). Performance on EF visual task also influenced school performance of children with ASD-without ID, particularly those with better mathematics achievement (St John et al., 2018).

Other findings support the mediating effect of middle-childhood EF in the association between early-childhood autism symptoms and adolescent outcomes (Ameis et al., 2022). Furthermore, stronger middle-childhood EF may protect againts the development of externalizing symptoms due to the influence of inhibitory and emotional control on behavioral regulation. By contrast, poor behavior regulation EF may be a risk factor, associated with the high prevalence of anxiety disorder in children and adolescents with ASD (Hollocks et al., 2014).

Atypicalities in theory of mind (ToM) include difficulties inferring mental states of other people on structured tests and in life situations that require more ecological skills (Baron-Cohen, 2000), and they have been proposed to explain part of the variation in outcomes of individuals with ASD. Along these lines, cross-sectional studies in children and adolescents with ASD-without ID reported a positive relationship between ToM and communication and social symptoms of ASD (Berenguer et al., 2018; Jones et al., 2018).

Although to a lesser extent, some prospective studies evidence the contribution of ToM to language competence and adaptive skills. Bennett et al. (2013) identified a mediating role of ToM in the association between language ability at 6–8 years old and adaptive functioning in communication assessed 6 years later. More recently, using a facial recognition task that measures mind-reading competence, a better performance on this test at 6-12 years old, predicted less severity of ASD in adolescence (age 12-19), even adjusting for ASD symptoms in childhood (Eussen et al., 2015). By contrast, in 3-year (Pellicano, 2013) and a 12-year follow-up (Kenny et al., 2019) studies, early individual differences in ToM did not predict children's later behavior beyond what was already accounted for by early verbal development.

The literature also emphasizes the close relationship from childhood between higher autism scores and overall greater impairment in interpersonal-social skills, adaptive functioning, cognition, and communication (Goldin et al., 2014). From a longitudinal perspective, autistic symptoms at baseline were the most significant predictor of emotional and behavioral problems in children and adolescents with high-functioning autism (HFA) after two years, more than inattention problems and verbal IQ (Andersen et al., 2017). Higher levels of stereotyped behaviors and reduced social interests in childhood, significantly predicted psychiatric comorbidities in ASD individuals from childhood to early adulthood (Verheij et al., 2015). In addition, an analysis of the trajectory of symptom severity from early to middle childhood showed that, an increase in severity is linked to a decrease in adaptive functioning throughout childhood (Waizbard-Bartov et al., 2022). Likewise, in three subgroups of children with ASD, classified according to the severity of social communication and RRB, a different development was observed (Rosello et al., 2021). In particular, the subgroup with more severe ASD symptoms at baseline presented worse scores on socialization, daily living skills, and prosocial behavior in adolescence.

In terms of family characteristics, socioeconomic status, parental stress, social support and coping strategies have been the most interesting factors for researchers. We understand that the trajectory of ASD may be impacted by environmental factors, in particular family characteristics. In mothers of children with ASD, psychological stress is associated with their child´s emotional and behavioral problems (Yorke et al., 2018), whereas higher levels of problem-focused coping (engagement) are linked to greater well-being (Miranda et al., 2019). Moreover, mothers of children with 'serious difficulties' in social, pragmatic and adaptive behaviors experienced more parental distress and mental health problems, whereas coping strategies were often used to a greater extent by mothers of children with 'slight difficulties' (Mira et al., 2022).

The small body of prospective research on this topic suggests that family functioning is an important contributing factor to ASD outcomes of different nature. Using a latent profile analysis based on socioeconomic risk, coping strategies, family functioning and social support, four different family profiles were identified (Zaidman-Zait et al., 2018). At the two-year follow-up evaluation, children in the group of parents characterized by high disengaged coping and poor social resources had significantly lower adaptive behaviors and more behavioral problems than those in the other three groups. In another longitudinal cohort study (Szatmari et al., 2021), participants' socialization, communication, independent living skills, and internalizing and externalizing behaviors were assessed from childhood into middle childhood. Doing well was associated with preschool scores on each specific outcome domain, early language skills and three family contextual variables: household income, parent disengaged coping (parents' attempts to distance themselves, avoid, or minimize negative emotions associated to a stressor), and family functioning (communication, discipline, and support among family members).

The emerging literature strongly suggests that ASD, even in the presence of normalized intellectual functioning, presents a risk for suboptimal functioning over time, although relatively little is known about factors in middle childhood that predict significant outcomes in adolescence. In general, studies have focused on examining specific predictors of later outcomes, for example, social communication (Kenny et al., 2019; Pellicano 2013), stereotyped behavior (Verheij et al., 2015), EF (St John et al., 2018), behavioral regulation (Vogan et al., 2018), or the level of ASD total symptoms (Andersen et al., 2017). In Spain, to our knowledge, there are no longitudinal studies ranging from childhood to adolescence, that have explored the influence of different childhood predictive factors (child and family) on various outcomes of individuals with ASD without ID, between childhood and adolescence.

The present study attempted to expand the prior literature by analyzing the relative importance of the predictive power of EF, ToM, ASD symptoms and family factors that were assessed in childhood, on four significant functional outcomes five years later, in adolescence: 1) socialization; 2) daily living skills; 3) emotional and behavioral problems; and 4) transition to secondary education. Based on the scarce literature,

We hypothesized that the executive functions most commonly impaired in

ASD, theory of mind knowledge, and the level of ASD symptoms in childhood would predict adaptive behaviors (socialization and daily living skills), emotional/behavioral problems, and successful transition to secondary school in adolescence. Likewise, the family context in childhood, in terms of coping strategies, social support, parental stress, and parent education, would make an important contribution to the outcomes achieved by adolescents with ASD

Additionally, the consideration of multiple factors in the analysis would allow us to explore the possible explanatory value of each of these predictive factors in several fundamental outcomes that were evaluated in adolescence. Identifying several early predictors of risk will contribute to planning more targeted and effective interventions that can be implemented in educational and mental health systems.

Method

Participants

The sample at baseline included 52 children with autism aged 7-11 years old (M_{age}= 8.56, SD_{age} = 1.38), mostly males (92.3%). Their intellectual functioning was within the normal range (> 80), measured with the Kaufman Brief Intelligence Test (K-BIT; Kauffman & Kauffman, 2000), as well as the lexical level that was assessed by the vocabulary subtest from the Wechsler Intelligence Scale for Children (WISC-IV) (Wechsler, 2003).

The participants´degree of ASD severity corresponded to level 1 or mild autism. Difficulties in social interactions and repetitive and restricted behaviors were not extreme, but help was needed. In fact, standard scores on socialization and daily living skills on Vineland Adaptive Behavior Scales (VABS-II: Sparrow et al., 2005) were more than one standard deviation below the mean.

On average, about five years after baseline, the follow-up included 45 adolescents with ASD between 12-15 years old (M_{age}= 12.9, SD_{age} = 0.9) with a retention rate of 86.5%. There were no differences in IQ, ASD symptom severity or sex between children who continued in the study and those who did not because the families had relocated or declined the invitation to attend the evaluations.

Table 1 presents socio-demographic characteristics of the sample both at baseline and follow-up: age, gender, IQ, vocabulary, autism symptoms, adaptive functioning, parental education, repeated courses, educational support and psychiatric medication (risperidone and/or methylphenidate for behavioral problems and irritability symptoms)

Table 1.
Socio-demographic characteristics of the study sample.

Participants ASD	Baseline (n=52)		Follow up (n=45)	
	M / %	SD	M / %	SD
Age	8.56	1.38	12.90	0.98
Full IQ	101.42	12.65	101.51	12.90
Vocabulary	11.78	2.78	11.42	2.95
SCQ-Total (cutoff= 15)	22.98	6.50	14.20	5.24
SDQ-Total	19.63	6.23	18.40	5.47
VABS-Socialization	75	5.05	77	5.52
VABS-Daily Living Skills	76	4.31	83	5.25
ADI-R A (cutoff= 10)	13.49	2.79		
ADI-R B (cutoff= 8)	8.91	2.42		
ADI-R C (cutoff= 3)	4.70	1.92		
Parental Education (% university level)	69.2%		65.5%	
Repeated courses (% yes)	5.7%		22.2%	
Educational Support (% yes)	96.1%		77.7%	
Gender (% Males)	92.3%		91.1%	
Medication (% yes)	32.7%		40.0%	

Note: M: Mean. SD: Standard deviation. ADI-R A: Qualitative alterations in the reciprocal social interaction. ADI-R B: Qualitative alterations in communication. ADI-R C: Restrictive and stereotyped behaviors. ASD: Autism Spectrum Disorder. SCQ: Social communication questionnaire. SDQ: Strengths and Difficulties Questionnaire (total score >16 indicates difficulties).VABS: Vineland Adaptative Behaviour Scale (percentile ranks 1-99). Parental education measured as highest level of mother or father.

Instruments

Predictor variables in childhood. Child measures

Executive Functions. The executive functions most commonly implicated in ASD (Pugliese et al., 2020) - inhibition, shift, initiative, working memory, and monitoring subscales-, were selected from the Behavior Rating Inventory of Executive Function (BRIEF, teachers' version; Gioia et al., 2000). In our sample, the Cronbach's α coefficients for these four subscales were .83 (inhibition), .79 (shift), .82 (working memory), .78 (initiative) and .80 (monitoring).

Theory of Mind. Two subtests from the NEPSY– II, A Developmental Neuropsychological Assessment Battery (Korkman et al., 2007) were administered to the children. The verbal task assesses the ability to understand beliefs, intentions, thoughts, and feelings that are different from their own. The contextual task assesses the ability to put him/herself in the place of one of the characters and think about what that character is feeling. In addition, the advance scale of the Theory of Mind Inventory (ToMI) (Hutchins et al., 2014; Spanish adaptation by Pujals et al., 2016) was completed by parents to evaluate: the understanding of basic emotions and mental terms, the distinction between physical and mental representations, second-order beliefs and competence to comprehend inferences and complex social judgments. ToMI has adequate validity, good internal consistency (.98) and test-retest reliability, excellent sensitivity (.90) and specificity (.90) (Hutchins et al., 2014; Pujals et al., 2016). High scores indicate good development of ToM skills.

ASD symptoms severity. The Social Communication Questionnaire (SCQ) (Rutter et al., 2019), filled out by the parents, provided information about autistic symptoms in the three domains of reciprocal social interaction, social communication, and RRB. In the present study, the Cronbach's alpha was .78, similar to what was reported by Rutter et al. (2019).

Predictor variables childhood. Family measures

Parenting Stress Index (PSI-SF; Abidin, 1995, adapted to Spanish by Diaz-Herrero et al., 2010). The parental distress subscale was completed by the main caregiver and evaluates the distress experienced by parents due to personal factors, such as depression, conflict with a partner or life restrictions due to the demands of childrearing. The Cronbach's alpha in our sample was .89.

Social support was estimated with the Duke-UNK Functional Social Support Questionnaire (Broadhead et al., 1988; adapted to Spanish by Bellón-Saameño et al., 1996). The confidant support subscale analyzes the possibility of having someone for expressing feelings and emotions to, whereas the affective support subscale evaluates the displays of affection and empathy. The questionnaire has good psychometric properties in the Spanish population, with reliability coefficient between .80 and .90 (Bellón- Saameño et al., 1996). In our sample, the reliability coefficient Cronbach's alpha fo the confident support and the affective support subscales were .83 and .74 respectively.

Parents' coping strategies were recorded with coping orientation to problems experienced (Brief COPE – Carver, 1997, Spanish adaptation by Moran et al., 2010). We used the engagement scale, which refers to active involvement in addressing the stressful situation posed by the child´s autism diagnosis. In our sample, Cronbach's alpha was .77.

Demographic information was collected by semi-structured interviews with parents including parents' age, education level, family structure variables as well as the child's characteristics (i.e., age, sex, neurodevelopmental history, age of diagnosis, medication, academic performance, support at school).

Outcome variables in adolescence

Adaptive Behavior. Socialization and daily living skills were evaluated with the Vineland Adaptive Behavior Scale (VABS-II: Sparrow et al., 2005), a semi-structured interview for parents. The daily living domain describes skills related to personal (e.g., eating, dressing, hygiene), domestic (e.g., household activities), and community (e.g., using money, answering the phone) tasks. The socialization domain includes interpersonal relationships, play and leisure, and coping skills. VABS-II has solid psychometric properties, with high test–retest reliability (α=.98)

Emotional and behavioral problems. The Strengths and Difficulties Questionnaire (SDQ-Cas; Goodman, 1997; Spanish adaptation by Rodríguez-Hernandez et al., 2014) was completed by parents to assess emotional symptoms, peer relationship problems, behavior problems and hyperactivity. In this study, the total difficulties score was used. The SDQ has adequate psychometric properties with good reliability in Spanish population (.76) (Rodríguez-Hernandez et al., 2014) and adequate internal consistency in the current study (Cronbach's α = .64 to .80 between subscales; α = .83 for total difficulties).

Transition to secondary education. This information was obtained from a questionnaire filled out by parents (Evangelou et al., 2008; Makin et al., 2017), with five factors related to their level of satisfaction with the whole process of their child's transition to secondary school: developing friendships, self-esteem and confidence, settling in school life, showing a growing interest in school and work, getting used to new routines and experiencing curriculum continuity. Cronbach's alpha in our sample was .91.

Procedure

This study was part of a research project designed to investigate the development of children with ASD and identify outcome predictors in adolescence. To select participants in the baseline (T1), official authorization from the Board of Education and School Management (Consellería de Educación de la Generalitat Valenciana) was obtained to consult school´s records. This made it possible to locate children in Primary Education who had received a previous diagnosis of ASD (without intellectual disability) in specialized childhood mental health services of the Valencian Community. Additionally, the Revised Autism Diagnostic Interview (ADI-R; Rutter et al., 2006) was administered by the research team. All the children met the DSM-5 (APA, 2013) diagnostic criteria for ASD, based on parental report. Exclusion criteria were neurological or genetic diseases, brain lesions, and visual, auditory or motor impairment.

At 5-year follow-up, parents (only mothers 38; both parents 4; only fathers 3) completed the battery of questionnaires in one

session with the research team trained in the administration and rating of the questionnaires used. Furthermore, teachers/tutors provided additional information about their students. All the participants were informed of the study aims and written informed consent was obtained.

The ethical standards of the Ethics Committee of the University of Valencia, accordance with the principles of Helsinki Declaration (World Medical Association, 2013), were followed (protocol codes H1425284258543; and H1493972644643). Basic standard procedures were followed to ensure the security of the research data (e.g. anonymization, restriction of data use to members of the research team, effective method of data destruction, use of secure storage of material in a locked cabinet only accessible to team members; periodic change in computer passwords for storing data).

Data Analyses

All analyses were performed using the Statistical Package for the Social Sciences (SPSS version 26.0). The statistical significance level was set at $p \leq .05$.

Preliminary analyses were conducted to examine the distribution of the variables as well as their fit to the normal distribution curve, by applying the Kolmogorov–Smirnov test; variables that did not show a normal distribution were transformed using square-root transformation. Subsequently, multiple linear regression analyses were carried out to predict the proportion of variance that could be attributed to four functional outcomes in adolescence: socialization, daily living skills, emotional /behavioral problems and transition to secondary education (dependent variables), taking account of the following variables from the baseline evaluation (independent variables): 1) EF of inhibition, shift, working memory, initiative, monitoring ; 2) ToM, verbal, contextual and advanced applied skills; 3) autism symptoms (SCQ); 4) family factors including educational level, engagement, social support and parenting stress.

The presence of multicollinearity in the data was evaluated using the variance inflation factor (VIF) and tolerance tests. VIF <7 and tolerance >.20 indicated the absence of multicollinearity problems.

Results

Predictors of follow-up outcomes

Prediction of emotional/behavioral difficulties. The regression analyses indicated that all ToM predictors collectively explained 17% of the variance of total SDQ, being verbal ToM (β = .28, t =1.96, p = .05) and ToMI advanced (β = -.29, t =-2.17, p = .04) two significant individual predictors. Inhibition (β = 0.57, t = 2.4, p = .02) and monitoring (β = -.63, t =-2.4, p = .02) were significant predictors, with all the EF explaining 26% of the variance. Both ASD symptoms, social interaction (β = .50, t =2.93, p = .005) and repetitive and restrictive behavior (β = .28, t =2.03, p = .04) significantly predicted total problems (SDQ) and explained 24% of the variance. Family factors did not reach statistical significance, individually or globally (Table 2).

Prediction of socialization skills. ToM predictors globally explained 25% of the variance in socialization skills, with ToMI advanced (β = .39, t =2.83, p = .01) being the only significant individual predictor. Problems with reciprocal social interaction (β = -0.39, t = –2.40, p = .02) and repetitive and restricted behavior (β = -.29, t =-2.15, p = .04) were significant predictors, explaining all autism symptoms 28% of the variance. Both parent education (β = .31, t =2.73, p = .03) and social support (β = .40, t =2.39, p = .01) significantly predicted socialization with 24% of the variance explained by all the family variables. EF did not reach statistical significance either individually or globally (Table 3).

Prediction of daily living skills. ToM predictors collectively explained 17% of the variance, with ToMI advanced (β = .40, t =2.73, p = .01) being the only significant individual predictor. The three domains of ASD symptoms globally explained 29% of the variance, although only social communication symptoms obtained a value close to statistical significance (p = .06). The family factors collectively explained 27% of the variance in daily living skills, with the engagement coping strategy having a significant value (β = .34, t =2.09, p =.04). EF did not reach statistical significance either individually or globally (Table 4).

Table 2.
Hierarchical regression analysis to predict emotional/behavioral difficulties (SDQ total score) at 5-year follow-up.

	Beta	t	p	R^2	F		Beta	t	p	R^2	F
ToM				.17	2.81*	SCQ				.24	4.4**
Verbal ToM	.28	1.9	.05*			Social Interaction	.50	2.9	.05*		
Contextual ToM	-.17	-1.2	.23			Communication	-.26	-1.5	.14		
ToMI Advanced	-.29	-2.1	.04*			RRB	.28	2.03	.04*		
Executive Function				.26	2.65*	Family F.				.18	2.1
Inhibition	.57	2.4	.02*			Parental Stress	.28	1.76	.09		
Shift	.22	1.3	.21			Parent Education	-.24	-.37	.11		
Initiative	.36	1.9	.06			Social Support	-.08	-1.6	.71		
Working memory	-.16	-.85	.41			Engagement	-.09	-.53	.60		
Monitoring	-.63	-2.4	.02*								

Note: Family F.= Family factors. RRB= Restrictive Repetitive Behaviours. ToM= Theory of Mind; ToMI= Theory of Mind Inventory. SCQ= Social Communication Questionnaire. *p ≤ .05, **p ≤ .01

Prediction of transition to secondary education. Inhibition (β = -.57, *t* =-2.1, *p* = .04) and monitoring (β =.58, *t* =-2.1, *p* = .05) were significant predictors individually, although EF did not collectively predict the transition to secondary education. ASD symptoms collectively explained 19% of the variance, being difficulties in reciprocal social interaction an individual significant predictor of secondary school transitioning (β =-.39, *t* =-2.22, *p* =.03). ToM variables and family factors did not have statistical significance either individually or globally (Table 5).

Table 3.
Hierarchical regression analysis to predict socialization skills (VABS) at 5-year follow-up.

	Beta	t	p	R^2	F		Beta	t	p	R^2	F
ToM				.25	4.5**	SCQ				.28	5.3**
Verbal ToM	.05	.37	.71			Social Interaction	-.39	-2.4	.02*		
Contextual ToM	.25	1.82	.08			Communication	-.03	-.15	.88		
ToMI Advanced	.39	2.83	.01**			RRB	-.29	-2.1	.04*		
Executive Function				.05	.39	Family F.				.33	4.7**
Inhibition	-.09	-.36	.72			Parental Stress	-.26	-1.8	.08		
Shift	.18	.95	.35			Parent Education	.31	2.7	.03*		
Initiative	-.22	-1.1	.29			Social Support	.40	2.3	.01**		
Working memory	.06	.29	.77			Engagement	-.11	-.11	.49		
Monitoring	-.01	-.34	.97								

Note: Family F.= Family factors. RRB= Restrictive Repetitive Behaviours. ToM= Theory of Mind; ToMI= Theory of Mind Inventory. SCQ= Social Communication Questionnaire
*p ≤ .05, **p ≤ .01

Table 4.
Hierarchical regression analysis to predict daily living skills (VABS) at 5-year follow-up.

	Beta	t	p	R^2	F		Beta	t	p	R^2	F
ToM				.17	2.81*	SCQ				.29	5.4**
Verbal ToM	-.01	-.04	.97			Social Interaction	-.27	-1.6	.11		
Contextual ToM	.07	.48	.64			Communication	-.32	-1.9	.06		
ToMI Advanced	.40	2.73	.01**			RRB	-.04	-.26	.78		
Executive Function				.07	.67	Family F.				.27	3.6**
Inhibition	.47	1.8	.08			Parental Stress	-.12	-.81	.42		
Shift	-.07	-.37	.72			Parent Education	.14	1.01	.32		
Initiative	.17	.87	.39			Social Support	.18	1.17	.25		
Working memory	-.06	-.07	.74			Engagement	.34	2.09	.04*		
Monitoring	-.40	-1.3	.18								

Note: Family F.= Family factors; RRB= Restrictive Repetitive Behaviours; ToM= Theory of Mind; ToMI= Theory of Mind Inventory; SCQ= Social Communication Questionnaire
*p ≤ .05, **p ≤ .01

Table 5.
Hierarchical regression analysis to predict transition to the Secondary Education at 5-year follow-up.

	Beta	t	p	R^2	F		Beta	t	p	R^2	F
ToM				.11	1.5	SCQ				.44	3.1*
Verbal ToM	.10	.61	.55			Social Interaction	-.39	-2.2	.03*		
Contextual ToM	.25	1.62	.11			Communication	-.01	-.07	.95		
ToMI Advanced	.11	1.71	.48			RRB	-.16	-1.1	.31		
Executive Function				.15	.31	Family F.				.16	1.7
Inhibition	-.57	-2.1	.04*			Parental Stress	-.22	-1.4	.18		
Shift	.23	1.2	.24			Parent Education	.10	.65	.52		
Initiative	-.34	-1.6	.11			Social Support	.33	1.96	.05*		
Working memory	.01	.02	.91			Engagement	-.14	-.81	.43		
Monitoring	.58	2.02	.05*								

Note: Family F.= Family factors; RRB= Restrictive Repetitive Behaviours; ToM= Theory of Mind; ToMI= Theory of Mind Inventory; SCQ= Social Communication Questionnaire
*p ≤ .05, **p ≤ .01

Discussion

Our objective was to examine whether childhood executive functions, ToM skills, autism symptoms and family factors could predict four functional outcomes in adolescence, namely, emotional/behavioral problems, daily living and socialization skills and the transition to secondary education. The consideration of multiple predictors of different nature made it possible to identify the relative value of each predictor in the various outcomes evaluated in adolescence.

First, our results indicate that middle-childhood EF, particularly deficits in inhibition and monitoring, may predict externalizing (hyperactivity, behavior problems, peer problems) and emotional symptoms of individuals with ASD in adolescence. Therefore, problems with deliberately suppress impulsive behavioral responses and monitoring one's actions by adjusting one's behavior to achieve goals predicted greater emotional and behavioral difficulties five years later. The small body of prospective research has also suggested the power of behavior regulation in predicting anxiety, depression, aggression, and oppositional problems (Vogan et al., 2018). Moreover, EF in middle-childhood seems to mediate the association between early childhood autism symptoms and later mental health problems (Ameis et al., 2022).

Similarly, inhibition and monitoring showed a predictive role in the successful transition to secondary education of students diagnosed with ASD, again demonstrating the individual contribution of these cognitive processes in the challenging period of adolescence (Ameis et al., 2022). These results are probably related with the mediator role of EF in learning-related behaviors of children with ASD, that is, the attitudes and behaviors that allow them to participate in and benefit from structure in class (Rosello et al., 2018). However, unlike other studies (Kenny et al., 2019; Pugliese et al., 2016), neither behavior regulation (inhibition, shift) or metacognitive (planning, working memory, monitoring) executive components demonstrated longitudinal prognostic significance neither in socialization nor in daily living adaptive skills. The divergence might be explained, at least partly, by the assessment procedure (Kenny et al., 2019 used four tasks tapping EF) or the type of informants (in Pugliese et al., 2016, the BRIEF was completed by parents).

Second, our data identified ToM skills such as the ability to share feelings, exchange ideas, and anticipate others' behavior, as important predictors of social life after five years. ToM advanced skills, that inform about competence in understanding inferences and complex social judgments, played a significant role in predicting future adaptive behavior scores in both domains, socialization and daily living. Furthermore, poorer advanced and verbal ToM skills had a predictive value in emotional/behavioral problems in adolescence. Several cross-sectional studies in children and adolescents with ASD-without ID have reported a positive relationship between ToM and ASD symptoms of communication and reciprocal social interaction (Berenguer et al., 2018; Jones et al., 2018). In contrast, performance in ToM tasks did not contribute to later outcomes in a longitudinal study (Kenny et al., 2019) but it is possible that the exclusive use of 'false-belief understanding' tasks reduced the possibility of finding significant associations between ToM and behavioral outcomes.

Third, the child´s autism symptoms were a strong and consistent predictor across all the domains of outcomes that were assessed in adolescence. This finding is coherent with prior literature. In individuals characterized by high ASD symptom severity on the DSM-5 criteria and SCQ in childhood, poorer socialization, daily living skills and prosocial behavior in adolescence are observed in adolescence (Rosello et al., 2021). In particular, more severe impairments in social interaction and RRB in childhood significantly contributed to explaining emotional/behavioral problems in the adolescence. The findings are consistent with those of other prospective investigations (Andersen et al., 2017) where the level of autistic symptoms at baseline was the most significant predictor of emotional and behavioral problems in children and adolescents with ASD two years later. An increase in the severity of autism symptoms has been linked to a decrease in adaptive functioning across childhood (Waizbard-Bartov et al., 2022). Furthermore, autism severity along with executive functions has been shown to be a significant predictor of trajectories in the socialization domain of adaptive behavior from toddlerhood to middle childhood (Tomaszewski et al., 2020).

Finally, it is not surprising that family factors globally explained one-third of the variance in adaptive behavior, highlighting above all higher parent educational level and social support along with low parental distress for the socialization domain, whereas for later daily living skills, the engagement coping strategy played a significant role. This finding is consistent with a recent study that explored the value of psychosocial variables, particularly the family context, in middle childhood outcomes (Szatmari et al., 2021). The suggested explanatory hypothesis is that families' opportunities to access appropriately applied evidence-based treatments might increase in those with higher education and better functioning.

A number of important implications for practice can be extracted from our findings, contributing to a better understanding of the heterogeneity and significance of factors that could influence on the course of autism over time. Given the important role of better developed childhood EF and ToM processes in the functioning of adolescents with ASD, structured assessments and multidisciplinary treatment programs in this regard are necessary in the child and family´s care plan. The predictive power of EF was relevant in behavioral/emotional and academic progress whereas ToM performance mainly predicted adolescent socialization and daily living outcomes. Most of the EF interventions (computerized an non-computerized) have been shown to be effective in enhancing EF and reducing symptoms in children and young people with ASD. The efficacy is greater when the intervention is administered in therapeutic settings and also in daily life contexts, that is, school and home (Pasqualotto et al., 2021). Additionally, through interventions including perspective-taking tasks, belief training and other social elements, ToM competence may be promoted in ASD (Othman & Collet-Klingenberg, 2017), without forgetting the active involvement of parents and teachers in order to achieve the generalization of learned skills from the therapy framework to natural contexts.

In addition, the finding that the family environment is relevant for long-term social adjustment and everyday activities of adolescents with ASD suggests an interesting pathway for future

research focusing on contextual factors as well as for clinical practice. Given the important predictive role of ASD symptoms in the development of emotional, adaptive and school adjustment, it is essential to try to control them. In this regard, there is sufficient evidence of the effectiveness of early programs for parents of children with ASD based on positive parenting and principles of behavioral analysis: structuring the learning environments, monitoring routines and stimulus control (see Rojas-Torres et alt., 2020). Furthermore, the systematic and comprehensive evaluation of family characteristics could help to better identify barriers to treatment involvement such as parenting stress or negative cognitions. This information would be the basis of therapeutic interventions for enhancing positive coping strategies and social support, which would improve life satisfaction (Luque Salas et al., 2017) and parents' resilience (Schwartzman et al., 2022), social support and positive attitudes.

Several limitations must be taken into consideration. The modest sample size of the present study could be exposed to overfitting; more complex models could be tested in a larger sample which might improve the accuracy of the predictions. The percentage of females in our sample was very low. One possible justification is that the apparent greater social skills of females with ASD, could be contributing to the under/misdiagnosis, especially at higher functioning levels (Hervás, 2022). For the assessment, the study used questionnaires filled out by different informants, which are less robust than standardized interviews. We did not systematically collect information on other contextual factors related to the school environment, that is, tensions over school choice, delays in placement decisions, lack of primary preparation and communication between schools which could influence transition success.

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