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Behavioral and emotional profiles of school-age children with autism spectrum disorder and intellectual disability in Iran: a cross-sectional study

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Abstract

Background To date, no study has compared the psychopathologies and unique characteristics of Intellectual Disability (ID) and Autism Spectrum Disorder (ASD) among Iranian children. This study aimed to compare the behavioral and emotional profiles of school-age children with ASD and ID.

Methods Data were extracted from a large survey consisting of 250 children with ASD and 463 with ID, aged 6–17 years. Diagnoses were based on DSM-V criteria. The parent version of the Child Behavior Checklist (CBCL) was used to evaluate psychopathologies. Scores regarding the sub-scales and specific items were extracted from CBCL and compared in two groups. In the end, the diagnostic value of some specific scores for diagnosing ASD was calculated.

Results The final sample included 250 individuals with ASD and 463 with ID. The mean age of participants was 11.16 (SD = 2.67) and 12.67 (SD = 3.04) years for the ASD and ID groups, respectively. More than 95% of the ASD group were male, while in the ID group, 216 participants were male (46.7%). After adjusting subscale scores for parents' education, age, gender, and comorbidity in a linear regression model, ASD was only associated with higher withdrawn ($P < 0.001$), thought problems ($P < 0.001$), and attention problems ($P < 0.001$).

Conclusions This study highlights the distinct behavioral profiles in ASD and ID only using CBCL. Introducing this inventory as a comprehensive scale for understanding developmental disorders. Yet, our findings call for more accurate assessment and intervention strategies for each condition.

Keywords Autism spectrum disorder, Intellectual disability, Neurodevelopmental conditions, Psychopathology, Behavioral pattern

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Background

Autism Spectrum Disorder (ASD) and Intellectual Disability (ID) are distinct neurodevelopmental conditions that significantly impact people's cognitive, social, and adaptive functioning, as well as caregiver's quality of life [1]. ASD is characterized by considerable deficits in social interaction and repetitive patterns of behavior [2]. The global prevalence of ASD is estimated to be around 1% [3]. However, the global prevalence of ID is around 1.5% and is defined by significant limitations in intellectual functioning and adaptive behavior based on the Diagnostic and Statistical Manual of Mental Disorders V (DSM-V) [4, 5]. While these disorders are separate diagnoses, they often co-occur, with an estimated 30–40% of individuals with ASD also having ID [1], making accurate diagnosis and targeted interventions a substantial challenge [6].

The overlap between ASD and ID extends beyond just a co-occurrence, as both conditions can impact language development, social skills, and adaptive functioning [7]. Additionally, individuals with either condition may experience challenges in academic achievement, independent living, and employment in adulthood [8, 9]. Previous studies suggested that while individuals with ASD often exhibit intense interest in specific topics, aversion to social touch, and difficulties in sharing attention, those with ID may struggle with reasoning, problem-solving, and abstract thinking, and they seem like people with mental ages behind their actual age [10]. The severity and nature of social impairments can be a key discriminator, as noted by Wing et al. [11], with individuals with ASD typically showing more profound social deficits. Yet, up to now, there are no standard ways for distinguishing ASD from ID, especially in severe forms [1].

Accurate differentiation between ASD and ID is not just an academic pursuit but a clinical need with practical implications [12]. Misdiagnosis can lead to inadequate and wrong interventions and suboptimal outcomes [13]. Moreover, individuals with co-occurring ASD and ID face elevated risks of psychopathologies, aggression, and self-injurious behaviors compared to those with ID alone [10]. Nonetheless, understanding the similarities and differences between ASD and ID is crucial for several reasons. Accurate diagnosis makes it possible for physicians to better manage the symptoms [14, 15] and recognizing the unique profiles of each condition can help authorities provide appropriate educational and therapeutic services based on individual needs [14, 15]. Additionally, exploring the relationship between these disorders may give better insights into their underlying neuropathology and potential shared etiological factors [7].

Research on ASD in Iran is scarce, and before 2016, only 206 studies had been published on the topic [16]. Despite the importance of distinguishing between ID and ASD and identifying the characteristics most aligned with each condition, no study has compared the psychopathologies and unique characteristics of ID and ASD among Iranian children. Furthermore, there has been no comprehensive evaluation of psychopathologies in children with ID and ASD. Therefore, in this study, we aimed to uncover the differences in behavioral and emotional profiles of school-age children with ASD compared to those with ID in Tehran, Iran, using the Child Behavior Checklist (CBCL). Additionally, in the study, we evaluated the accuracy of the CBCL special scales in predicting the difference between ASD and ID in this population. We used the CBCL in our study because it is widely utilized in research on childhood psychopathologies, has been validated across multiple studies, and has established normative values. Additionally, it offers valuable practical insights into children's behavioral and social development [17].

Methods

Participants

This study utilized data from a large survey investigating the quality of life and psycho-physical function in children and adolescents with developmental disabilities [18]. This study was approved by the ethics committee of the Tehran University of Medical Sciences and was consistent with the principles of the Declaration of Helsinki. The sample consisted of 1,850 participants (1,040 boys and 810 girls) aged 6–17 years from special schools in Tehran, Iran, collected from 2011 to 2024. These special schools provide appropriate education to children with various developmental disorders and disabilities, including ID, ASD, visual impairments, hearing impairments, cerebral palsy (CP), and other conditions. For the purpose of this study, however, we focused specifically on two groups: children with ID and children with ASD. Informed consent was obtained from the participant's parents or caregivers.

Eligibility criteria

Children were enrolled in the ID group if they had a mild to moderate intellectual disability with an IQ range that allowed them to be educated rather than merely trainable. On the other hand, children with ASD enrolled in special schools should have an IQ within the normal range [19]. Individuals with ASD or ID older than six years old were included in the study. The diagnoses of ASD and ID were validated by a pediatric psychiatrist according to the (DSM-V) criteria, with those enrolled before the release of DSM-V being reassessed concerning the accuracy of diagnosis [20, 21]. Individuals with severe comorbidities that significantly limited their function were excluded. It should be noted that none of the participants had both ID and ASD simultaneously.

Measures

In this study, data regarding individuals' demographic characteristics, such as age and gender, the sociodemographic characteristics of participants' families, and their parents' status, including parents' age, educational level, job, consanguineous marriages, as well as the history of psychological or neurological conditions in siblings and parents, were extracted from the survey questionnaire. For the neuropsychiatric domain, data regarding prenatal and perinatal issues, age, and impairment of developmental milestones, such as speaking and walking, were recorded. Scores from the CBCL questionnaire, previously completed by main caregivers, were used to evaluate behavioral problems. This scale assesses children in psychological domains, including somatic and social problems, thought and attention problems, rule-breaking, aggression, anxiety/depression, and withdrawal [22, 23].

The child behavior checklist (CBCL)

In this study, the latest version of CBCL/6–18 in Farsi was used [24]. The CBCL has been previously used and validated to examine children with ASD or ID [25, 26]. The CBCL parent version is a scale consisting of 113 items used to evaluate psychopathologies. It has been widely utilized in studies to identify and compare various behavioral and emotional problems in children with ASD over the past six months and to assess their treatment outcomes [25]. The parents rated each statement as 0 (not true), 1 (somewhat or sometimes true), or 2 (very true or often true). The CBCL produces eight syndrome scores: withdrawn, anxious /depressed, somatic complaints, social problems, thought problems, attention problems, delinquent behavior, and aggressive behavior. Furthermore, there are internalizing problems, which include withdrawn behavior, anxiety/depression, and somatic complaints, and externalizing problems, which include delinquent behavior and aggression. Higher scores on each subscale indicate greater problems. A T-score was used to interpret test scores, as stated by Achenbach (1991) in the CBCL manual [27]. In the scales of internalizing and externalizing behavioral problems and overall problems, if the individual's T score is less than 60, it falls within the normal range. If the T score is between 60 and 63, it falls within the borderline range, and if the T score is greater than 63, it falls within the clinical range. For each of the eight subscales, the cutoffs for these three categories are 65 and 69.

Study outcomes

The primary outcome assessed in this study was the comparison of CBCL-derived psychopathology in participants with ASD to the ones with ID. To investigate this notion, indices like the score of total CBCL and each sub-scale in classic and DSM-oriented manners were calculated and used as dependent variables in the analysis [28]. The second purpose of this study was to investigate the accuracy and sensitivity of the CBCL questionnaire and some CBCL-derived special scales in the determination of ASD from ID. For exploring this matter, the diagnosis of participants was used as a dependent variable, and other variables were inserted individually or in a group in a model, and the specificity and sensitivity of each model were reported.

Statistical analysis

We reported mean and standard deviation (SD) for continuous variables and the count and percentages for categorical ones. For statistical analysis, at the beginning Chi-square and Fisher's exact tests were used to compare the categorical variables between groups. For the numeric variables, the Kolmogorov-Smirnov test was used to determine the normality of variable distributions, and accordingly, t-tests, analysis of variance (ANOVA), or non-parametric analyses were used to assess between-group differences yet as the adjusted P value was reported based on regression models(linear, logistic or ordinal) we reported the p-value obtained from equivalent simple single variable regression models. As for subscales T-scores and raw scores, the significance of differences reported either unadjusted or entered in linear regression models adjusting for age, gender, parents' educational level, other neurodevelopmental comorbidities, and subjects' current medications.

In the end, for assessing the predictive value of CBCL for diagnosing ASD, the pathological states of subscales (categorized by the manual cutoff) were used in the logistic model, and sensitivity, specificity, and accuracy were reported, as well, for comparison some other special ASD scores claiming to differentiate ASD from other conditions were extracted from literature [29–33] the sensitivity, specificity, and accuracy were assessed using logistic regression model and afterward, the receiver operating characteristic (ROC) curves were drawn and based on Kolmogorov-Smirnov graph the cutoffs were determined [34]. All the models were adjusted for age and gender. Analyses were performed using SPSS version 26. $P < 0.05$ was considered statistically significant.

Results

The final sample included 250 individuals with ASD and 463 with ID. The mean age of participants was 11.16 (SD = 2.67) and 12.66 (SD = 3.04) years for the ASD and ID groups, respectively. More than 95% of the ASD group were male, while in the ID group, 216 participants were male (46.7%). The basic and demographic characteristics of participants are shown in Table 1.

Table 1 Basic and demographic characteristics of participants, participants' comorbidity, family history, and their medications at the time of study

Variable		ASD (*N* = 250)	ID (*N* = 463)	*P*-value
Gender	Male, n (%)	241 (96.4%)	216 (46.7%)	< 0.001
	Female, n (%)	9 (3.6%)	247 (53.3%)	
Age (year)	Mean (SD)	11.16 (2.67)	12.67 (3.04)	0.002
Mother's age at birth (year)	Mean (SD)	27.10 (5.70)	28.58 (6.9)	< 0.001
Father age at birth (year)	Mean (SD)	32.75 (5.87)	33.64 (7.22)	0.001
Mother's education	Lower than a diploma, n (%)	35 (14.4%)	209 (47.4%)	< 0.001
	Diploma n (%)	86 (35.4%)	162 (36.7%)	
	Higher than a diploma, n (%)	122 (50.2%)	70 (15.9%)	
Father's education	Lower than a diploma, n (%)	37 (15.5%)	207 (46.7%)	< 0.001
	Diploma n (%)	72 (30.3%)	140 (31.6%)	
	Higher than a diploma, n (%)	129 (54.2%)	96 (21.7%)	
Parental consanguinity	yes	66 (26.4%)	130 (28.1%)	0.63
	No	184 (73.6%)	333 (71.9%)	
	10-25%	71 (30.7%)	168 (41.6%)	
	More than 25-50%	99 (42.9%)	134 (33.2%)	
	More than 50%	52 (22.5%)	76 (18.8%)	
Grades behind the age-appropriate grade	(median,25th-75th Q)	2 (1–4)	3 (1–5)	< 0.001
Comorbidity	ADHD	89 (35.6%)	97 (21%)	< 0.001
	Hearing impairment	11(4.4%)	23(5%)	0.734
	Speech problem	29(11.6%)	23(5%)	0.001
	Epilepsy	60(24%)	113(24.4%)	0.904
	Anxiety and Mood disorder	37(14.8%)	50(10.8%)	0.119
Medications	Antipsychotic, n (%)	158 (63.2%)	80 (17.3%)	< 0.001
	Antidepressant, Anxiolytic n (%)	36 (14.4%)	37(8%)	0.007
	Antiepileptic, n (%)	75 (30%)	78 (16.8%)	< 0.001
	Stimulant, n (%)	31 (12.4%)	73 (15.8%)	0.266
	No medication, n (%)	63 (25.2%)	295 (63.7%)	< 0.001
Family history	Speech disorder, n (%)	19 (7.6%)	35 (7.6%)	1
	ADHD, n (%)	25 (10%)	31 (6.7%)	0.144
	ASD, n (%)	8 (3.2%)	7 (1.5%)	0.171
	Psychological disorders, n (%)	30 (12%)	43 (9.3%)	0.3
	Learning problems, n (%)	16 (6.4%)	59 (12.7%)	0.01
	No family history of psychological or neurological disorders, n (%)	185 (74%)	367 (79.3%)	0.112

After adjusting for gender disparity

ASD - Autism Spectrum Disorder, ID - Intellectual Disability, ADHD - Attention Deficit Hyperactivity Disorder, SD - Standard Deviation, Q - Quartile

After comparing the confirmed neuropsychiatric comorbidity and current medication, people with ASD were more likely to have concurrent ADHD (35.6% vs. 21%, $p < 0.001$) and speech problems (11.6% vs. 5%, $p = 0.001$). However, the prevalence of other comorbidities was not significantly different between groups ($p > 0.05$). Meanwhile, children and adolescents with ASD were prescribed antidepressant/anxiolytic, antiepileptic, and antipsychotic medication more commonly than children with ID ($p < 0.05$). Moreover, most individuals with ID (63.7%) did not receive any neurotropic or psychotropic medications (Table 1).

Comparing the family history of disorders among first-degree relatives, the prevalence of learning disorders was significantly higher among children with ID (12.7% vs. 6.4%, $p = 0.01$). However, there were no other significant differences between groups ($p > 0.05$).

The comparison of CBCL scores between ASD and ID groups is shown in Table 2. The T score of withdrawn ($p < 0.001$), thought problems ($p < 0.001$), attention problems ($p < 0.001$), delinquent behavior ($p = 0.001$), externalizing problems ($P = 0.013$), and total CBCL scores ($P < 0.001$) were significantly higher in individuals with ASD compared to those with ID. After adjusting subscale scores for other variables, namely parents' education,

Table 2 CBCL questionnaire comparing psychopathologies in subjects with ASD and ID

CBCL questionnaire					
Subdomains	**ASD, mean (SD)**	**ID, mean (SD)**	**P-value**	**Adjusted beta[*b]**	**P-value**
Withdrawn	59.07 (11.05)	54.81 (11.63)	< 0.001	-5.17	< 0.001
Somatic complaints	56.69 (10.6)	57.88 (11)	0.164	1.66	0.13
Anxious/Depressed	54.44 (10.17)	53.16 (10.04)	0.105	-0.76	0.45
Social problems	61.38 (9.91)	60.96 (9.94)	0.591	1.36	0.16
Thought problems	68.13 (9.23)	61.29 (10.09)	< 0.001	-4.99	< 0.001
Attention problems	68.84 (9.24)	62.47 (10.71)	< 0.001	-3.2	0.001
Delinquent behavior	63.36 (12.01)	60.26 (11.26)	0.001	-0.12	0.91
Aggressive behavior	58.79 (9.35)	57.66 (10.84)	0.166	0.56	0.52
Internalizing problems	58.41 (10.5)	57.19 (10.52)	0.139	-1.87	0.08
Externalizing problems	61.26 (10.19)	59.18 (10.79)	0.013	0.21	0.84
Total problems score	66.6 (9.52)	63.29 (9.84)	< 0.001	-1.56	0.11
CBCL DSM-V-oriented scores	ASD, mean(SD)	ID, mean(SD)	P value- unadjusted		P value- adjusted[*b]
Conduct problems(17 items)	5.29 (4.42)	4.62 (4.72)	0.007	0.34	0.47
ODD problems(five items)	2.82(1.96)	2.96(2.25)	0.65	0.26	0.24
ADHD problems(seven items)	6.31(2.47)	4.76(2.94)	< 0.001	-0.52	0.06
Somatization problems(seven items)	0.89(1.61)	1.34(2.01)	< 0.001	0.03	0.87
Anxiety problems(nine items)	4.59(2.98)	4.25(2.83)	0.15	-0.28	0.33
Depressive problems(13 items)	3.77(3.14)	3.78(3.36)	0.72	-0.15	0.64

*Adjusted for age, gender, caregivers' educational level, and comorbidity (visual problem, speech problem, hearing problem and epilepsy) and medication use

b: ASD is the reference

CBCL - Child Behavior Checklist, ASD - Autism Spectrum Disorder, ID - Intellectual Disability, SD - Standard Deviation, DSM-V - Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, ODD - Oppositional Defiant Disorder, ADHD - Attention Deficit Hyperactivity Disorder

age, gender, medication use, and comorbidity in a linear regression model, ASD was only associated with higher withdrawn ($P < 0.001$), thought problems ($P < 0.001$), and attention problems ($P < 0.001$) independently.

Apart from the classic subscales of CBCL, we compared the DSM-V-oriented scales between groups (Table 2). Considering that this part of the questionnaire was not validated in the Persian version, the raw scores were used for analysis. Even though the raw scores of conduct problems, ADHD, and somatization subscales were significantly different between groups ($p < 0.05$), after adjusting for age and gender, comorbidities, medication, and caregiver education, no significant difference was observed between groups ($p > 0.05$).

For total CBCL scores, 62.8% of individuals with ASD exhibited clinical-level problems compared to 49.2% of those with ID ($p < 0.001$, after adjusting for age, gender, and ADHD, p-value was 0.12). Regarding internalizing problems, 33.6% of the ASD group showed clinical scores versus 28.1% of the ID group ($p = 0.12$). For externalizing problems, clinical scores were observed in 41.2% of the ASD group compared to 32.4% of the ID group ($p = 0.02$, after adjusting for age, gender, and ADHD, p-value was 0.6).

After applying the CBCL sub-domain cutoff, considering scores above the normal range as pathological, abnormal scores were more prevalent in the ASD group than in the ID group across all domains. Internalizing scores showed a trend toward significance (ID: 44.9% vs. ASD: 52%, $p = 0.07$) while externalizing scores (ID: 44.5% vs. ASD: 54%, $p = 0.01$) and total scores (ID: 66% vs. ASD: 75.2%, $p = 0.01$) were significantly higher in the ASD group. Yet as for subdomains, thought problems, attention problems, withdrawn, and delinquent behavior were more common in children with ASD ($p < 0.001$) (Table 3).

As CBCL has been used in recent years for screening ASD patients, we used all subscales in the uniform model to predict the underlying diagnosis in this sample. The results have shown that CBCL abnormal subdomains considering age and gender could accurately differentiate 77% of our samples (81.2% for ID and 69.2% for ASD). Adjusting for age and sex improved the overall accuracy by 6.5% and the accuracy of ASD diagnosis by 30% (Table 3). Afterward, we used six other scores claimed in previous studies that could discriminate ASD from typically developing children and measured each subscale sensitivity and specificity for ASD. The results illustrated that these scales could differentiate these two conditions by at least 72.9%, while a model assigning all samples to the ID group could reach an accuracy of 64%. The best fit belonged to the scales proposed by So et al. with an overall accuracy of 79.1% and AUC of 72.2%.

Discussion

This study compared behavioral profiles in children and adolescents with ASD and ID. Our findings reveal that individuals with ASD initially exhibited higher rates of clinical-level behavioral problems in total and

Table 3 Odds ratio of abnormal score in ASD vs. ID and accuracy of different models and subscales for diagnosing ASD

Domain		Pathologic score in ASD vs. ID	Unadjusted Odds ratio	*p*-value	Adjusted odds ratio*	*p*-value
Aggressive behavior		60(24%) vs. 107(23.1%)	0.95(0.66–1.37)	0.789	1.90(1.09–3.33)	0.02
Delinquent behavior		127(50.8%) vs. 174(37.6%)	0.58(0.43–0.8)	< 0.001	1.22	0.51
Attention problems		172(68.8%) vs. 219(47.3%)	0.41(0.29–0.56)	< 0.001	0.53(0.32–0.87)	0.01
Thought problems		156(62.4%) vs. 163(35.2%)	0.33(0.24–0.45)	< 0.001	0.41(0.25–0.67)	< 0.001
Social problems		106(42.4%) vs. 184(39.7%)	0.896(0.66–1.22)	0.49	1.58	0.07
Anxious/Depressed tendency		47(18.8%) vs. 73(15.8%)	0.81(0.54–1.2)	0.3	1.14	0.66
Somatic complaints		64(25.6%) vs. 141(30.5%)	1.27(0.9–1.8)	0.17	1.45	0.14
Withdrawn/depressive		107(42.8%) vs. 122(26.3%)	0.478(0.35–0.66)	< 0.001	0.53(0.32–0.88)	0.01
Model[@]		Sensitivity of differentiating ASD from ID	Specificity of differentiating ASD from ID	Overall model accuracy	AUC%	K-S determined cutoff
All sub-scales as categorical, adjusted for age and gender		69.2%	81.2%	77%		
Using combination of withdrawn-thought problem score(WTP) = 23 items		64.8%	78.6%	73.8%	67.5%	120.5
Using a combination of Withdrawn, Thought Problems, and Social Problems scres = 44 items		64.4%	77.5%	72.9%	63.6%	181.5
The score proposed by Ooie et al., 2011 = 9 items		68.4%	82.7%	77.7%	73.5%	6.5
The score proposed by So et al., 2013 = 10 items		69.6%	84.2%	79.1%	72.2%	6.5
The score proposed by Offermans et al.,2022	Data-driven ASD scale = 15 items	66%	78.8%	74.3%	62.1%	6.5
	Expert-extracted ASD scale = 23 items	66.8%	77.1%	73.5%	63%	11

*All subdomain scores were enrolled in binary form in a logistic regression model to predict the diagnosis of ASD or ID corrected for age and gender//the reference is ASD

@ age and gender as covariates

CBCL - Child Behavior Checklist, ASD - Autism Spectrum Disorder, ID - Intellectual Disability, vs.– versus, WTP - Withdrawn-Thought Problem score, AUC - Area Under the Curve, K-S - Kolmogorov-Smirnov

externalizing domains of the CBCL, although most of these differences became non-significant after adjusting for confounding factors. Notably, the ASD group showed significantly higher scores in withdrawn behavior, thought problems, and attention problems, even after adjustment. These findings are consistent with previous studies using the CBCL in ASD populations [35–37]. These results highlight the complex behavioral profiles in ASD and ID, emphasizing the need for tailored assessment and intervention strategies for each condition while also underscoring the importance of considering confounding factors in interpreting behavioral differences.

Aside from CBCL attention scores, the higher prevalence of comorbid ADHD in the ASD group (35.6% vs. 21%) aligns with previous research indicating a stronger association between ASD and ADHD compared to ID [38, 39]. Notably, in both groups, the prevalence of ADHD is significantly higher than in the general population. Large international studies have reported ADHD comorbidity rates of up to 39% in children with ID and 78% in those with ASD [38, 39].

Our study also revealed a high level of internalizing and externalizing psychopathology in both ASD and ID children. This prevalence is notably higher than previous studies, which reported internalizing problems in around 30% and externalizing problems in 6–27% of cases among children with ASD [40, 41]. However, as shown in the study by Carta et al., comorbid ADHD is associated with higher levels of both externalizing and internalizing problems [42]. When scores were calculated based on clinical cutoffs and comorbid ADHD cases were excluded, the prevalence decreased to 34% and 27%, which is comparable to existing evidence. Furthermore, the total CBCL score was higher among our sample compared to previous studies. In Guerrera et al.'s study [40], 48% of the ASD population showed abnormal total scores. In two meta-analyses on individuals with intellectual disabilities, this percentage ranged from 32 to

74%, with an overall average of 49% [43, 44]. On the other hand, it should be noted that elevated rates in our study may reflect less efficient management in our sample. One possible reason could be the lack of sufficient knowledge about these conditions, particularly ASD, not only among the general Iranian population but also among healthcare professionals, potentially resulting in inadequate care for these children [45, 46]. This finding underscores the critical importance of improving the detection and treatment of these issues [47], as the presence of internalizing and externalizing problems is associated with significantly higher parental stress and other consequences [48].

The use of DSM-based scores in identifying pathology in children with ASD and ID is of great importance. For instance, in the classical subscale of withdrawn/depressed problems, ASD children may exhibit isolated-like behavior without necessarily being depressed [49]. Thus, using more sensitive and specific criteria is crucial. Our findings show that the prevalence of anxiety and depression in these students was similar, as were the median scores of the DSM-oriented CBCL subscale. As well, in our population, the prevalence of diagnosed mood and anxiety disorders remained similar between the two groups. This contrasts with some previous studies that have found higher rates of anxiety and mood disorders in ASD compared to ID [50] as well as ASD with normal IQ compared to concurrent ASD and ID [51], hinting that lower intellectual ability could be protective against some psychiatric problems. Comparing the score of our population to populations described by Offermans et al. [33] shows that the severity of DSM-based psychopathology in our population is lower than what they found, and we could not find studies comparing these two conditions.

CBCL, in recent years, has been used in different studies as a diagnostic test for ASD, and it has shown rather good fitting and overall accuracy [52]. In a recently published study by Offermans et al. in 2022 [33], this team compared several scores and scales for detecting ASD [29, 31–33, 53], which showed specificity and sensitivity around 55–80% in confirmatory samples as well, our evaluation of various CBCL-derived scales for differentiating ASD from ID yielded promising results. The scale proposed by So et al., 2013 [32]demonstrated the highest overall accuracy (79.1%) and AUC (72.2%) in our sample. This performance is comparable to its original validation study, suggesting its potential utility in differentiating ASD from other neurodevelopmental disorders. However, the lower specificity for ASD diagnosis compared to ID highlights the ongoing challenge of differentiating these conditions, particularly in culturally diverse settings, as our sample was just from Iran. These findings underscore the need for culturally adapted and validated screening tools, as well as the importance of comprehensive clinical assessment in diagnosis, and also highlight the complex interplay of behavioral, emotional, and developmental factors in ASD and ID populations. Future research should focus on developing more sensitive diagnostic tools and targeted therapeutic approaches to address these challenges in neurodevelopmental disorders [7].

Limitations

This study had several limitations worth mentioning. First, although the prevalence of ASD is four to five times higher in males than in females, potentially explaining the male dominance in our ASD sample [54], only nine females with ASD (3.6%) were included in our study. This underrepresentation of females may introduce gender bias and limit the generalizability of our findings. Furthermore, the restriction of our study sample to children living in Tehran may also affect the generalizability of our findings. Second, we used a subjective questionnaire to assess psychopathologies, subject to biases. In fact, no comprehensive psychiatric assessments were performed to verify the psychopathologies. Third, since we assumed the ID as a non-typical control group for ASD, the underlying syndromes affecting the pattern of psychopathologies and individuals' vulnerabilities to psychopathologies in children with ID were not included in this study. On the other hand, due to the small sample size, we did not use separate training and testing samples for our predictive model, which makes the model performance less reliable. Thus, future research should focus on longitudinal studies with larger sample sizes to allow for proper model validation, and specific items from CBCL should be compared objectively to other measures of behavior. Additionally, validation of all scales in the Persian version of CBCL will improve the robustness of future studies in this population. Finally, 21.7% of children with ASD have concurrent ID [55], which was excluded from this study, highlighting another limitation, and there is a need for future studies also including children with concurrent ID and ASD.

Conclusion

This study provides valuable insights into the behavioral profiles of children and adolescents with ASD and ID, highlighting both similarities and differences between these neurodevelopmental disorders. The CBCL, when appropriately administered and interpreted, offered a comprehensive view of psychopathology in these populations. Key findings include higher rates of withdrawn behavior, thought problems, and attention problems in the ASD group; and promising performance of CBCL-derived scales in differentiating ASD from ID. Future research should address the limitations of this study, including the need for longitudinal designs, larger sample sizes, and culturally validated tools to enhance our

understanding of the developmental trajectories and specific needs of individuals with ASD and ID, ultimately improving diagnostic accuracy and targeted interventions.

Abbreviations

ASD	Autism Spectrum Disorder
ID	Intellectual Disability
ADHD	Attention Deficit Hyperactivity Disorder
CBCL	Child Behavior Checklist
DSM-V	Diagnostic and Statistical Manual of Mental Disorders, 5th Edition
IQ	Intelligence Quotient
CP	Cerebral Palsy
C/S	Caesarean Section
ODD	Oppositional Defiant Disorder
ROC	Receiver Operating Characteristic
OR	Odds Ratio
AUC	Area Under the Curve

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All authors, KD, NSA, MM, TAP, AH, MS, MKF, ANA, and AM, have contributed to either the study design, data collection, analysis, writing, or editing of the draft. They have also read and approved the final manuscript and agreed to be accountable for all aspects of the work.

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Data availability
The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval and consent to participate
The data was extracted from the database on children with neurodevelopmental disorders. Confidentiality and anonymity of all participants were strictly maintained throughout the research process. Informed consent was obtained from the participants' parents or caregivers. Ethics committee of Tehran University of Medical Sciences approved the study protocolIR.TUMS.NI.REC.1402.051.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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