Validation of the developmental, dimensional and diagnostic interview -short version (3Di-sv) for diagnosis of autism spectrum disorder in Chinese children

Running Title：3Di validation in Chinese children

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Abstract

The purpose of this study was to evaluate the psychometric features of the Chinese version of the developmental diagnostic dimensional interview-short version (3Di-sv). A total sample of 138 children including 79 children with autism spectrum disorder (ASD) and 59 typically developing children completed the 3Di-sv interview. The Chinese version of the 3Di-sv has a good internal consistency (0.94). Test–retest analysis confirmed the instrument's time stability (0.89). The instrument's concurrent validity with the Autism Behavior Checklist (ABC), the Childhood Autism Rating Scale (CARS) and clinical diagnosis was verified; the correlation between total scores was 0.72, 0.82 and 0.90, respectively. The 3Di-sv significantly distinguished between autistic children and non-autistic children in every area of autism symptoms. Optimal cutoffs were derived using receiver operating characteristics curves. Using clinical diagnosis as criterion, overall sensitivity was 98% and specificity was 90%. The study determined that the Chinese version of 3Di-sv can well distinguish autistic children from typically developing children.

Keywords: the developmental diagnostic dimensional interview-short version, autism spectrum disorders, autism, diagnosis

Introduction

Autism spectrum disorders (ASD) are complex neurodevelopmental conditions characterized by typical reciprocal social interaction and communication as well as restricted, repetitive patterns of behavior, interests or activities (First, 2013). The

estimated prevalence of ASD increased one in 59 children aged 8 years in 2014 to one in 44 children in 2018 and to 1 in 36 in 2020 in the United States (Maenner et al., 2021; Maenner et al., 2023). A national multicenter population study on the prevalence of autism spectrum disorder among Chinese children aged 6-12 years showed that the estimated prevalence was one in 100, significantly higher than a previous meta-analysis of ASD in China (Sun et al., 2013; Zhou et al., 2020). Increases in prevalence estimate might indicate progress toward detection of ASD among all children.

So far, the assessment and diagnosis of ASD still requires complex procedures to gather and integrate standardized information from multiple perspectives including child observation and other information (Falkmer et al., 2013). Currently the most widely used 'gold standards' are the ADI-R (Autism Diagnostic Interview-Revised) based on parent interviews (Lord et al., 1994), as well as ADOS (Autism Diagnostic Observation Schedule) based on direct observation diagnosis (Luyster et al., 2009). Whereas ADOS only provides current behavioral information for diagnosis (Luyster et al., 2009), ADI-R requires specially trained managers to focus on current presentation and lifetime development history (Lord et al., 1994). Besides, ADI-R was developed primarily to provide discrimination of autistic children with mental retardation (Skuse et al., 2004). In fact, previous evidence suggested that nearly half of individuals with ASD had average or higher intelligence quotient (IQ) (Katusic et al., 2021). The 3Di (the developmental, dimensional and diagnostic interview) not only is used for those with moderate or severe intellectual disability, but also assesses autistic traits among children with normal-range abilities. The 3Di algorithm is a standardized computer-based parental interview and a mixture of fully structured and semi-structured systems. The algorithm comprises 183 items concerning demography, family background, developmental history and motor skills. Each item is usually coded on a three-point scale: 0 = no such behavior; 1 = minimal evidence of such behavior; 2 = definite or persistent evidence of such behavior. The 3Di is constructed of some mandatory modules related to ASD and some optional modules related to comorbidities. Algorithms speed the interview by eliminating illogicalities, such as

questions about spoken language in a nonverbal child. The full interview can be completed in 90 minutes. Its original validation study showed the 3Di's reliabilities and validity were excellent, and sensitivity and specificity are nearly perfect (sensitivity 1.0; specificity >0.97) (Skuse et al., 2004). The original interview is designed to quantitatively evaluate three main dimensions of ASDs, including reciprocal social interaction, abnormalities in communication, and restricted, repetitive, and stereotyped patterns of behavior, based on DSM-IV-TR and ICD-10's definition of pervasive developmental disorders. In 2013, ASD diagnostic criteria changed from the DSM-IV PDD three domain criteria that included social reciprocity, communication and restricted and repetitive behaviors (RRB) to two DSM-5 ASD domain criteria composed of social communication/interaction and RRB (Blashfield et al., 2014). With the changing view of autism traits, only the 3Di, DISCO (the Diagnostic Interview for Social and Communication Disorders) and ADOS use specially developed algorithms to measure the DSM-5 standard for ASD presently (Evers et al., 2021). Subsequently, Mandy et al. have constructed a diagnostic algorithm that maps 3Di items to the DSM-5 definition of ASD (Mandy et al., 2012).

Then, the Developmental Diagnostic Dimensional Interview-short version (3Di-sv) was constructed using reliability analysis from the original 3Di. And Santosh et al. validated that agreement of the new shortened 3Di with the 3Di's original algorithm was excellent in both dimensional and categorical terms (Santosh et al., 2009). 3Di-sv containing 53 items obtains a dimensional autism in less than 45 minutes. A series of studies in other countries also confirmed excellent reliability and validity of 3Di-sv (Chuthapisith et al., 2012). The Cantonese version of 3Di has also been verified in Hong Kong, China, and has been shown to have good psychometric properties (Lai et al., 2015).

Previous research found that for Chinese children with ASD, the median age for the initial diagnosis was 29 months. In particular, children with ASDs who live in rural areas or whose parents have less education experience a later age of initial diagnosis (Long et al., 2022). Despite the large population base in China, only 0.53% of mental

health institutions currently have child psychiatric wards (Ning et al., 2022). In this busy clinical environment, psychiatrists often need to stabilize patients and make correct diagnoses with limited clinical information, time, and resources. The psychometric properties of Chinese version of social responsiveness scale-2(SRS-2) and Broad Autism Phenotype Questionnaire (BAPQ) were validated, but neither could be used as a diagnostic tool for ASD (Lin et al., 2021; Yang et al., 2023). Therefore at present in China, there is an urgent need for a highly accessible autism diagnosis tool to serve the diagnosis of a large number of autistic children every year, which can be identified and diagnosed early, so as to facilitate early support. Therefore, the primary purpose of our study is to verify whether 3Di-sv translated into Chinese can distinguish between children with ASD and typically developing children.

Methods

Participants

Two groups of Chinese children aged 2-14 years were recruited; one group of 79 children with clinical diagnoses of ASD (based on the DSM-5 criteria), who attended Guangdong Provincial People's Hospital from four tertiary care clinic in Guangzhou over the period from June 2021 to May 2022. The ASD group included 68 patients with ASD as the sole diagnosis, 8 patients were co-morbid with ADHD and 3 patients comorbid Tic disorder. Sixty-one percent of the ASD group were male and their mean age was 6.15 years (SD=2.46). The other matched group of 67 typically developing children (non-ASD group) came from Guangdong Mental Health Center of Guangdong Provincial People's Hospital, 8 were excluded due to age mismatch. Therefore, the non-ASD group consisted of 59 children without identified mental or physical health difficulties (n=49), and others with diagnosed child psychiatric problems such as emotional disorder (n=10). Forty-nine percent of the typically developing group was male with mean age of 7.08 years. All participants were initially assessed by two developmental and behavioral psychiatrists according to DSM-5 criteria prior to the interview in order to diagnose children with ASD or other developmental problems. Children in typically developing group were excluded if

they had epilepsy, Attention deficit hyperactivity disorder (ADHD) and other severe mental and physical illnesses. Caregivers in the ASD group were roughly aware of their child's clinical diagnosis before attending the interview. Autism community members were not involved as partners in the design, implementation, interpretation, or dissemination of this study.

Ethical considerations

All data came from primary caregivers and children. The primary caregiver, who was usually the parent, was the sole informant for children. The written consent was obtained from caregivers, and oral consent was obtained from children. Informed consent was obtained from all participants before completing interview. This study was performed in line with the principles of the Declaration of Helsinki. Approved was granted by the Clinical Research Ethics Committees of Guangdong Provincial People's Hospital.

Procedure

Gender, age, education level, and other clinical and demographic information were noted prior to formal assessment. All children were assessed with the Autism Behavior Checklist (ABC), the Childhood Autism Rating Scale (CARS) and the 3Di-sv. All procedures were implemented by the trained researchers. The whole interview is for the child’s main caregivers and child to obtain detailed history and observations of the child. Interviewers were blind to the original diagnosis of participants.

Interrater Reliability. All sections of the interview were administered to 5 parents of ASD children and 5 parents of non-ASD children. They were interviewed by one member of the assessment team, while another member scored independently on another computer.

Internal and External Reliability of the 3Di-sv. Twenty (10 cases, 10 comparisons) participants were rescored 7 to 14 days later by the original interviewer.

Concurrent Validity. To determine concurrent validity, a psychiatrist diagnoses children using the DSM-5 criteria and scores on the ABC, CARS. Then, a comparison was made between the 3Di-sv output and ABC score, CARS score and the original DSM-5 diagnosis made independently by the clinician.

Discriminant Validity. The ability of the 3Di-sv to discriminate ASD was determined by comparing the 79 ASD children with 59 non-ASD comparisons.

Criterion Validity. We examined agreement in terms of case status for 3Di-sv diagnosis and case status achieved on the ABC, CARS scale, and case status for clinical diagnosis.

ROC Curve, Specificities and Sensitivities. We have used only DSM-5 based clinical diagnoses to draw ROC curve establish sensitivity and specificity for 3Di-sv.

Measure

The developmental, dimensional and diagnostic interview (3Di) was translated into Chinese by a team of experienced child psychiatrists and psychologists. Then a back-translation into English was carried out by a professional bilingual PHD student of department of pediatrics of the University of Hong Kong. The research team had many discussions for content and semantic equivalence in more detail. The cross-cultural adaptation process followed the steps outlined by Beaton et al. (Varjú et al., 2008). We then evaluated the semantic equivalence of each back translation, and made adjustments accordingly to suit Chinese context. For the entire interview, the developmental part has been changed more, but the ASD symptoms have not been significantly adjusted. For example, we adjusted one item concerning the use of knives and forks into using chopsticks, that is "holding a piece of meat with a fork and cutting with a knife " to" holding a bowl with one hand, picking out and eating food from the bowl with a pair of chopsticks in the other hand ". All the members of the research team received 3Di intensive training given by experienced instructor, software designer, developer and lead instructor. The dimensional scores and categorical diagnoses are based on the original authors' computer-scoring algorithm.

The Autism Behavior Checklist (ABC) consists of five items covering five dimensions, Sensory, Relating, Body and Object use, Language, and Social and Self-help skills. Krug et al. assigned the cut-off point of 53 as a score to screen children who were suspected of having autism, a score of 68 is the diagnostic autism cutoff(Krug et al., 1980). Kat S et al. confirmed that the simplified Chinese version of ABC has satisfactory psychometric properties in a Chinese autism population. In the

study by Kat et al. Cronbach's α of subscales and the total score ranged from 0.75 to 0.96 (Kat et al., 2020).

Childhood Autism Rating Scale (CARS) is a widely-used and validated tool for assessing for autism spectrum disorder (ASD). A series of meta-analysis showed that the CARS scale had the highest value when the diagnostic boundary was 30(Schopler et al., 1980). A study reported that the Cronbach alpha coefficients of CARS and ABC were 0.772 in the Chinese population (Chu et al., 2022). The severity of ASD was also assessed according to the CARS.

Intelligence was measured by a variety of means, depending on the center from which the child was recruited and their age. The Gesell Developmental Scale (GDS) is used to measure intelligence in children less than 3 years of age, and the Wechsler Preschool and Primary Scale of Intelligence (fourth edition)(WPPSI-IV) in those aged 3 to 6 years. Both GDS and WPPSI-IV have been revised and widely used in China (Ji et al., 2022; Jin et al., 2007). The intelligence tests used in children aged 6 to 14 years were the China-Wechsler Intelligence Scale for Children (C-WISC). The C-WISC consists of 11 individual tests, including six verbal tests and five performance tests. Previous research evaluation found that a correlation coefficient remained above 0.8.(Yu et al., 2012)

Clinical diagnoses were made based on DSM-5 criteria by experienced child psychiatrists from detailed history obtained from the child's main caregivers and observations of the child.

Data Analysis

Analyses were performed using SPSS 26.0. Bivariate analysis of discrete variables used Chi-square tests, and t-tests were used for continuous variables. Intra-class correlation coefficients (ICC) was used to test the consistency of 3Di interview between 10 participants through two independently trained raters in the same time period. The internal consistency reliability was evaluated using Cronbach alpha. Test–retest reliabilities of the dimensional scores were analyzed by ICC. The concurrent validity of the 3Di-sv was investigated using the correlation coefficients between, on the one hand, total 3Di-sv scores and, on the other hand, the ABC, the CARS and

clinical diagnosis. Independent t-test between the ASD group and non-ASD group was performed to assess discriminant validity of the 3Di-sv. Criterion validity of the 3Di-sv was evaluated by determining correlations evaluated by determining correlations between the ABC score, CARS score, clinical diagnosis and the 3Di-sv. With clinical diagnosis as the criterion, AUC (Area under ROC curves) of the dimensional scores were analyzed to determine optimal cutoff values for differentiation between autism and typically developing children.

Results

Of the 79 children with clinical diagnoses of ASDs, intellectual ability was computed, from GDS, WPPSI-IV, and C-WISC, standardized to have a mean of 78.43 and a standard deviation of 21.20. All children in the non-ASD group attended mainstream school. Of the 59 children in the non-ASD group, 49 supplied IQ data (mean IQ =99.95, SD=28.77). Test-retest reliability of the 3Di-sv was evaluated by re-interviewing 20 caregivers of children with ASD (mean age = 6.38, SD = 3.05) with an interval of 7-14 days.

In terms of demographic characteristics, the sample included 79 participants from the ASD group and 59 from typically developing group. There was no significant difference in age between the two groups. However, as shown in Table 1, the groups were not matched in terms of gender. As expected, there were significant differences in ABC score and CARS score between children with and without ASD ($p<0.001$). Based on ABC score≥53, for the ASD group, 71(89.8%) children had diagnosis of suspected ASD, 30 of them had ASD as definitive diagnosis. Regarding CARS score>30, mean score (SD) was 33.30 (4.07) in the ASD group and was 17.73 (3.86) in the typically developing group. Please refer to Table 1 for details.

Interrater Reliability

Interrater reliability scores were ICC= 0.93 for 3Di-sv, indicating very good interrater reliability.

Internal and External Reliability

Cronbach's alpha coefficient was used to assess the internal consistency of the items on 3Di-sv. In the reliability analysis of this study, the language/social

communication domain and gesture and non-verbal play domain were integrated into the communication domain to facilitate comparison with the original version 3Di. The internal consistency for the 3Di-sv total score was α=0.94. Cronbach's alpha for the subscales ranged from 0.71 to 0.91 (see Table 2). Item-total correlations and inter-item correlations for the total scale and the subscales are presented in Table 2. The total ICC for test-retest 3Di-sv on a clinical sample of 20 children was 0.89. ICC for the Social reciprocity domain, Communication, Restrictive / repetitive behavior and hobbies were 0.79, 0.90 and 0.91, respectively. The correlation between subscales is displayed in Table 3.

Concurrent Validity

Agreement was 90.9% (kappa=0.87) between clinical diagnosis and 3DI-sv diagnosis, 89.7% (kappa=0.83) between ABC diagnosis and 3DI-sv diagnosis, and 95.9% (kappa=0.82) between CARS diagnosis and 3DI-sv diagnosis. For the overall comparison, Kappa was 0.84. In terms of diagnosing cases, the 3di-sv was found to be better, 2 children from ASD group who did not meet a diagnosis of autism but had certain autistic traits in social interaction and RRBI dimensions.

Discriminant Validity

An independent t-test was performed between the two groups to examine the 3Di-sv algorithm's discriminant validity. There was a significant difference in total scores and subscale scores between the two groups; and autism group had a significantly higher scores than the typically group ($p<.001$) (Table 1). By exploring item endorsement of 3Di-sv, results showed only 4 items were no significant difference between the groups after controlling for gender and IQ. Item endorsements found that 68.2 % ("0=not applicable"), 67.1 % ("2=always"), 65.7% ("0= never")and 55.7 % ("0=not applicable") of the ASD group received ratings on this four items, respectively, (i.e. ''use of embarrassing or inappropriate words to others'', ''focus on caregivers at a distance in a crowded room'', ''insist that others follow his instructions when playing with peer '' and ''seems to make up some meaningless words'') vs 64.4% ("0=not applicable"), 66.1% ("2=always"), 50.8% ("0= never") and 55.7 %("0=not applicable")respectively for non-ASD group. Behaviors

that had the highest endorsement rates belonged to the 3Di-sv of ‘‘focus on caregivers at a distance in a crowded room’’.

Criterion Validity

Of 73 cases with a clinical diagnosis were consistent with a diagnosis of 3Di-sv. According to ABC criteria, 67 met all criteria for autism. The results were almost identical, whether the first interview had been the ABC or the 3Di-sv. On the basis of comparing total scores on the 3Di-sv with the CARS equivalent algorithm output to assess criterion validity, 65 cases were found to be concordant. The correlation between 3DI-sv total score, clinical diagnosis and ABC total score, as well as CARS total score was 0.90, 0.82 and0.82, respectively, suggesting good calibration and high validity (Table 4).

ROC Curve, Specificities and Sensitivities

Receiver operating characteristics (ROC) were examined to find optimal cut-off points for differentiation. The area under the ROC curve (AUC) is an accuracy measure for testing whether 3Di-sv can discriminate between autistic groups. The best cut-off score for each domain is similar to the score obtained in the original 3Di interview. The minimum cut-off scores with clinical significance of subscale for diagnosing ASD were all 10.35, 8.10, 4.60, 2.50, when the clinical diagnosis based on DSM-5 is used as criteria. Comparison between clinical diagnosed ASD vs non-ASD groups yielded an AUC of 0.99(0.98-1.00), 0.97(0.93-1.00), 0.94(0.91-0.98) and 0.95(0.91-0.98) for social reciprocity domain, language/Social communication, gesture and non-verbal play and repetitive and stereotypies, respectively (Table5; Fig 1). By combining the three dimensional scores, we found an overall sensitivity of 98% and specificity of 90%.

Discussion

The purpose of this study was to evaluate the psychometric features of the Chinese 3Di-short version when applied to distinguish children with clinically diagnosed ASD from non-ASD children in China.

In the current study, Cronbach’s alpha was 0.94 for the 3Di-sv, which is much higher than the original English version (Santosh et al., 2009). Inter-rater reliability

was similar to the Cantonese version of 3Di(Lai et al., 2015). In general, we found good internal consistencies for the total scale and the subscales. Cronbach's alpha for subscales ranged from 0.71 to 0.91 which were a little lower than reported by Santosh et al. which ranged from 0.81 to 0.94. The lowest Cronbach's alpha was found for restrictive/repetitive behavior and interests likely because of higher proportion of patients with mild autism in the sample (66/79). Test-retest reliability of the 3Di was 0.89 in our study which was acceptable and indicated that the results of the 3Di were stable over time.

Although 3Di-sv was able to distinguish ASD children from non-ASD children, there were still 4 items that were not significantly different between the two groups. Parents' reported, "seems to make up some meaningless words," generally were the same for ASD and non-ASD group in the present study. 74% of Chinese citizens think ASD is a communication disorder (Yu et al., 2020), so they pay more attention to the communication ability of children with ASD. Most parents reported they did not recognize this behavior was an autistic trait.

Reporting on the "use of embarrassing or inappropriate words to others" may be related to being stigmatized by ASD. Previous studies have shown that nearly 40% of Chinese people have misconceptions about ASD (Yu et al., 2020). Caregivers in this study chose this item very carefully.

The "focus on caregivers at a distance in a crowded room" score was associated with higher use of rehabilitation services the ASD group (87%). This behavior was related to the safety of ASD children, and it is essential to intervene as early as possible for rehabilitation institutions.

There was no statistically significant difference between the two groups in terms of" insist that others follow his instructions when playing with peer". Most caregivers report fewer social opportunities for children with ASD, so they make more conservative choices. The reasons may be (a) social exclusion (Sedgewick et al., 2019), or (b) children with ASD were characterized by lower social engagement (Bovery et al., 2021).

Regardless of whether ABC or CARS or clinical diagnosis were used as criteria,

the 3Di-sv had high validity. Compared with clinical diagnosis, the 3Di-sv showed satisfactory sensitivity and specificity, similar to the results of other studies reported by Chuthapisith et al and Lai et al (Chuthapisith et al., 2012; Lai et al., 2015). However, in a previous study, 3Di-sv had good sensitivity but less specificity compared to the clinical diagnosis confirmed by ADOS-2 (Slappendel et al., 2016). A possible explanation for this may be related to a sample of children at high risk for ASD in this previous study. This may suggest that the 3Di-sv as a single instrument for identifying ASD should be carefully evaluated by the interviewer, supplemented by other information. In addition, Slappendel et al. found a better fit against a DSM-5 model than a DSM-IV-TR model of 3Di-sv. Our results also confirmed that the diagnostic results of 3Di-sv are consistent with the diagnostic results of DSM-5. The study confirmed its excellent reliability and validity when used in a Chinese context.

Then, the similar cut-off scores optimally discriminated children with ASD from typically developing children in social reciprocity domain and language/Social communication domain, and slightly higher. However, cutoff scores in gesture and non-verbal play, as well as repetitive and stereotypies were lower than the original authors' recommended cutoffs (Skuse et al., 2004). Firstly, about 77.2% of the children in the ASD group had mild ASD as assessed by the CARS, most participants of ASD group with milder ASD symptoms used rehabilitation services and this may lead to the reduction of symptoms. Secondly, in terms of repetitive and stereotypies dimension, only few items evaluated this dimension. In addition, ritualistic behaviors commonly encountered in children, for example, following the same route, were not included in the items of 3Di-sv. As de Leeuw A et al. stated in a review, differences may occur in ASD behaviors, severity and frequency of symptoms under different cultural background (de Leeuw et al., 2020). Research has also shown that a large number of Chinese parents disagreed that their child with ASD showed a particular interest in stereotyped behavior, such as numbers and patterns (Liu et al., 2022). And Most Chinese parents prefer that ASD children integrate into society, so they pay more attention to social reciprocity domain and language/Social communication domain in the culture of China, and the similar result was also observed by Lai et al in

2015(Lai et al., 2015). Similarly, Mandy et al have suggested that cross-cultural variability may be greatest for milder autistic characteristics (Mandy et al., 2014). Finally, as proposed by Slappendel et al., Creating a new DSM-5 version of 3Di-sv will require some adjustments; items are needed to be added to better cover DSM-5 diagnostic criteria, such as insistence on sameness and sensory abnormalities (Slappendel et al., 2016). Therefore, some items from the full interview need to be added to 3Di-sv in future research to be better compatible with DSM-5.

There were some limitations of the study. We were unable to conduct a study on the agreement of the 3Di China version with the ADI-R or ADOS score, which is unavailable in our clinical setting, currently. Secondly, due to our groups not being matched on gender and incomplete IQ data in the non-ASD group; further work will be needed to verify the current results in a more carefully controlled design. Finally, this study is just the first step, suggesting that 3Di-sv can discriminate between those who definitely are autistic and those who are definitely not autistic. A consecutive referral study is the next logical step to test whether 3DI-sv can distinguish those with ASD from marginal cases.

Conclusion

This study provided good evidence that the Chinese 3Di-sv may be a useful instrument to facilitate making ASD diagnosis in young children. 3Di-sv can meet the need for a making feasible, thorough, dimensional and quick standardized assessment in the busy clinical environment, achieving an excellent sensitivity and specificity.

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The authors declare that they have no financial relationships with other people or organizations that could inappropriately influence (bias) their work. None of the authors received royalties/training fees from 3Di.

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CRediT authorship contribution statement

Chen HB conducted the collection of the data, statistical analysis and drafted the manuscript. Warrington R was responsible for the development of the Chinese version of 3Di-sv and the in-depth training of its use. Yang F, Tang Y, Yang JJ and Li Ai did the interview. Lin YQ was responsible for liaison with autism rehabilitation agencies. Jia FJ and Xu MZ put forward the design conception of the study. Hou CL was overall responsible for the study and revised the manuscript. All authors have read the manuscript and agreed to the above contribution statement.

Declaration of Competing Interest

The authors declare that they have no competing interests. None of the authors received royalties/training fees from 3Di.

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Table 1. The demographic characteristics, ABC scores, CARS and 3Di scores of children with ASD and children with non-ASD

Characteristics	Children with ASD (N = 79)		Children without ASD (N = 59)		Statistics	
	Mean	SD	Mean	SD	T^a	P
Mean age (years)	6.15	2.46	7.08	3.49	2.01	0.07
Onset age(years)	2.54	1.34	-	-	-	-
IQ	78.43	21.20	99.95	28.77	4.96	<0.001
Birth weight(kg)	3.12	0.68	3.06	0.51	-0.33	0.58
Body length(cm)	50.47	3.11	52.81	4.75	3.27	0.001
ABC total score	62.81	15.95	9.22	16.63	-21.16	<0.001
ABC Sensory score	12.13	4.64	0.85	2.48	-17.02	<0.001
ABC Relating score	16.77	5.44	2.47	3.48	-17.09	<0.001
ABC Body and object use score	8.35	7.00	1.66	3.11	-6.85	<0.001
ABC Language score	14.57	6.78	1.05	2.70	-14.67	<0.001
ABC Social and self-help score	12.65	4.72	3.49	4.31	-11.25	<0.001
CARS total score	33.30	4.07	17.73	3.86	-23.11	<0.001
3Di Social reciprocity domain	16.31	4.01	5.12	2.02	-20.58	<0.001
3Di Language/Social communication	12.51	3.33	4.91	5.62	-10.63	<0.001
3Di Gesture and non-verbal play	7.30	2.65	2.44	1.47	-13.44	<0.001
3Di Repetitive and stereotypies	3.44	1.80	0.44	0.80	-11.95	<0.001

	N	%	N	%	$\chi 2^b$	P
%Male	61	77.21	29	49.15	10.63	0.001
%Urban	75	94.93	50	84.74	4.33	0.04
%ASD family history	15	18.98	3	3.79	8.51	0.001
Grade					63.13	<0.001
Kindergarten and below	54	68.35	24	40.67		
Primary school	21	26.58	27	45.76		
Junior high school	4	5.06	8	13.55		
Parents' educational level					7.22	0.14
High school and below	28	35.44	13	22.03		
Junior college	19	24.05	13	22.03		
University and above	32	40.50	33	55.93		

ABC: Autism Behavior Checklist; ASD: Autism spectrum disorder; CARS: Childhood Autism Rating Scale; IQ: intelligence quotient; SD: Standard deviation; 3Di: The developmental, dimensional and diagnostic interview;

[a] :Independent-Samples T Test; [b]:Pearson chi-square test

Table 2. Internal Consistencies and Item Correlations of 3Di

	Cronbach's α	Item–total correlations	Inter-item correlations
Social reciprocity domain	0.85	0.31-0.70	0.17-0.71
Communication	0.91	0.24-0.77	0.20-0.69
Restrictive / repetitive behavior and hobbies	0.71	0.33-0.54	0.18-0.55
3Di–sv Total	0.94	0.33-0.77	0.17-0.71

3Di: The developmental, dimensional and diagnostic interview

Table 3.Subscale -total Correlation and subscale scores Correlations of 3Di

	3DI Social reciprocity domain	3DI Language/Social communication	3DI Gesture and non-verbal play	3DI Repetitive and stereotypies	3DI Diagnosis
3Di Social reciprocity domain	-	0.80	0.78	0.69	0.81
3Di Language/Social communication	-	-	0.87	0.68	0.76
3Di Gesture and non-verbal play	-	-	-	0.61	0.74
3Di Repetitive and stereotypies	-	-	-	-	0.73

3Di: The developmental, dimensional and diagnostic interview

Table 4. ABC-3Di Correlation, CARS-3Di Correlation, and Clinical diagnosis-3Di Correlation

	ABC diagnosis	CARS diagnosis	Clinical diagnosis	3DI diagnosis
ABC diagnosis	-	0.77	0.87	0.72
CARS diagnosis	-	-	0.85	0.82
Clinical diagnosis	-	-	-	0.90

ABC: Autism Behavior Checklist; CARS: Childhood Autism Rating Scale; 3DI: The developmental, dimensional and diagnostic interview

Table 5.sensitivity and specificity of diagnostic dimensions

	Cut-offs	Clinical diagnosis		
		AUC (95 % CI)	SE (%)	SP (%)
3Di Social reciprocity domain	10.35	0.99(0.98-1.00)	1.00	94
3Di Language/Social communication	8.10	0.97(0.93-1.00)	96	93
3Di Gesture and non-verbal play	4.60	0.94(0.91-0.98)	91	82
3Di Repetitive and stereotypies	2.50	0.95(0.91-0.98)	93	65
3Di-sv Total	-	-	98	90

AUC: Area under curve; ABC：Autism Behavior Checklist; CARS: Childhood Autism Rating Scale; SE: sensitivity ; SP: specificity;3DI: The developmental, dimensional and diagnostic interview

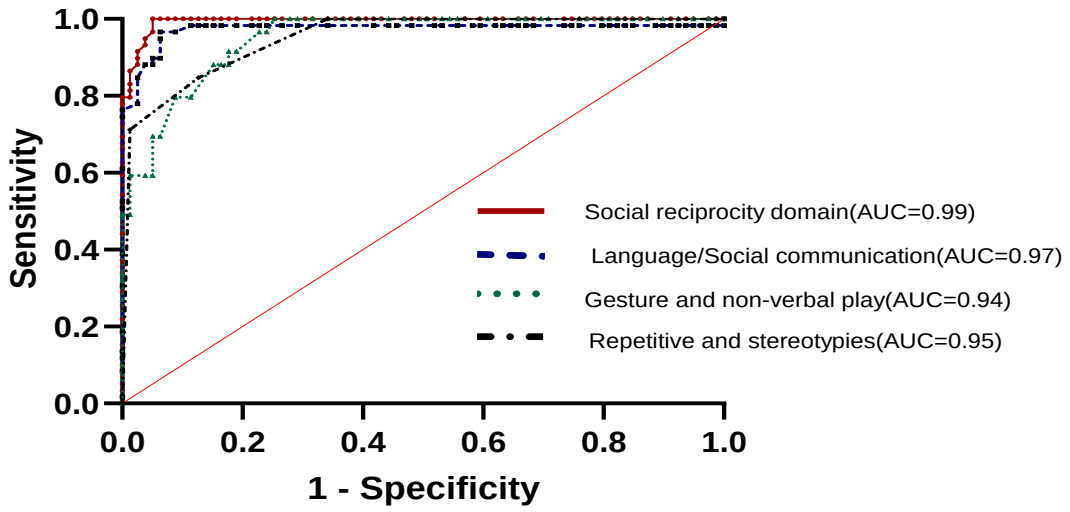

Fig 1. ROC curve of the sensitivity and specificity of the 3Di scores in each domain using clinical diagnosis as criterion