[Original Article]

Clinical Utility of the Japanese Version of *the Baby and Infant Screen for Children with aUtIsm Traits* (BISCUIT) Part 1

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Abstract

Background: Early diagnosis of autism spectrum disorder (ASD) is crucial for timely interventions. Given this, there is an urgent need for accurate, but quick ASD diagnostic tools that can be used with very young children around 2 years of age. We assessed the clinical utility of the Japanese version of the Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) Part 1 that is designed to measure ASD symptoms in children aged 17–37 months.

Method: Seventy-six children (mean age: 30.2 ± 5.1 months) referred to local specialized clinics were assessed using the BISCUIT, together with the Modified Checklist for Autism in Toddlers (M-CHAT), the Strength and Difficulties Questionnaire (SDQ), and a developmental test. Clinical diagnoses were assigned by independent practitioners. The scale's internal consistency was calculated and the mean scores were compared in terms of sex, age, and developmental quotient (DQ). To examine validity, correlational and hierarchical multiple regression analyses were performed.

Results: Cronbach's α for the scale was over 0.9. The scale scores differed by DQ. The total scores were strongly correlated with the M-CHAT and SDQ prosocial behavior scores, suggesting convergent validity. Divergent validity was demonstrated by nonsignificant correlations with the SDQ emotional and conduct subscales. M-CHAT scores were significantly associated with the BISCUIT-Part 1 total score and all three domain scores even after controlling for sex, age, DQ, and SDQ hyperactivity.

Conclusions: The Japanese version of the BISCUIT-Part 1 can measure early ASD symptoms and may therefore be useful in community clinical settings. (248 words)

Keywords: autism spectrum disorder (ASD), early diagnosis, The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT), reliability, validity

1. Introduction

Autism spectrum disorder (ASD) is a lifelong developmental disorder characterized by deficits in social communication, social interaction and restricted and repetitive behavior or interests (American Psychiatric Association, 2013). The earliest symptoms of ASD start to manifest overtly from the first few years onwards and can be detected as early as 18 months, which suggests that ASD can be diagnosed before 2 years of age (Guthrie et al., 2013). Early detection and diagnosis of ASD is crucial since initiating integrated developmental and behavioral interventions as soon as a diagnosis of ASD is given is recommended for better outcomes (Zwaigenbaum et al., 2015).

Recent increased awareness of ASD and an improved ability to detect potential cases earlier with the use of autism-specific screeners, has highlighted the need for further comprehensive evaluation tools to confirm an ASD diagnosis for high risk infants and toddlers. However, the current gold standard ASD diagnostic tools such as the Autism Diagnostic Observation Schedule (ADOS) toddler module (Luyster, et al., 2009) and the Autism Diagnostic Interview-Revised (ADI-R) for toddlers and young preschool children (Kim & Lord, 2012) require specialized training and a considerable amount of time to administer. Because of this, a barrier remains to their widespread use in community pediatric clinics or developmental centers that are not highly specialized in ASD, especially in countries with fewer resources. Thus, there is an urgent need for accurate and quick ASD diagnostic tools that can be used by non-ASD specialists with very young children around 2 years of age.

Comorbid symptoms that are frequently observed in school-age children with ASD (Simonoff, et al., 2008) have also been reported in very young children with ASD as early as 2 years of age in the form of hyperactivity, anxiety, aggression and tantrums (Davis et al., 2010; Fodstad, et al., 2012). These conditions need to be detected as early as possible because their persistence may further worsen children's quality of life and complicate assessment of ASD-related symptoms (Joshi et al., 2010). Thus, when identifying ASD in very young children, clinical evaluations should be comprehensive and include comorbid problems.

The Baby and Infant Screen for Children with aUtIsm Traits (BISCUIT) is a diagnostic instrument which was designed as a comprehensive assessment battery for the purpose of measuring not only the core symptoms of ASD but also comorbid symptoms frequently observed in very young children with ASD aged 17-37 months (Matson, 2007). BISCUIT is composed of three informant-based components and one observational component. The three informant-based components are: (1) BISCUIT-Part 1 which is used for the assessment of autistic symptomatology (Matson, et al., 2011); (2) BISCUIT-Part 2 which assesses comorbid symptoms commonly seen in ASD (Matson, et al., 2009a); and (3) BISCUIT-Part 3 which assesses the occurrence of problem behaviors such as aggressiveness and self-injurious behaviors (Matson, et al., 2010). BISCUIT-Part 1 includes 62 items which assess daily observed behaviors related to symptoms across all of the core ASD domains (i.e., socialization, communication, repetitive behaviors and restricted interests) through a parent-interview. Compared to the gold standard diagnostic tools, the test administration time of BISCUIT-Part 1 is relatively short (approximately 20-30 min), which means that it might be ideally suited for the early assessment of ASD in community clinical settings with greater time constraints.

In Japan, although awareness of early ASD signs has increased in primary health care settings, in most cases diagnostic procedures are not comprehensive and are often delayed due to a relative lack of specialized clinics. Thus, to fill the practice gap between clinical needs and appropriate

service provision for young children with ASD, we aimed to assess the clinical utility of the Japanese version of the BISCUIT-Part 1 as an early ASD diagnostic tool. In this paper we report on the reliability, and convergent and divergent validity of the Japanese version of the BISCUIT-Part 1. Theoretically, the BISCUIT Part 1 total score was expected to converge with the total number of ASD symptoms listed by diagnostic criteria, total number of failed items on the Modified Checklist for Autism in Toddlers (M-CHAT) (Robins, et al., 2001), and with the social relatedness subscale scores of the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997). In contrast, the scale score was expected not to correlate with the SDQ subscales that are non-specific to ASD such as emotional or conduct problems.

2. Methods

2.1 Participants

Seventy six children were recruited from four specialized clinics in different geographical regions of Japan. The study inclusion criteria were as follows: (1) children were aged between 17-37 months; (2) they were suspected of having ASD or other developmental delay/disabilities such as global developmental delay, language disorder; (3) they had no severe physical and/or sensory impairments. Among the 76 children, 73 met the diagnostic criteria for ASD according to DSM-5 (Table 1). Three children were diagnosed as not having ASD but clinically judged as exhibiting atypical development.

2.2 Measures

2.2.1 The Baby and Infant Screen for Children with aUtIsm Traits Part 1

BISCUIT-Part 1 consists of 62 items including 24 socialization/nonverbal communication domain items, 7 communication domain items, and 23 repetitive behavior/restricted interests domain items, as well as 8 items that are not included in the three abovementioned domains (the other domain) (Matson, 2007). Using a parent-interview format, caregivers are instructed to rate each item on a 3-point Likert scale while comparing the child to a typically developing peer of the same age. A rating of 0 indicates "not different; no impairment", a rating of 1 indicates "somewhat different; mild impairment", and a rating of 2 indicates "very different; severe impairment". The scale in its original form is reported to have acceptable psychometric properties (Matson & Tureck, 2012). For 276 children aged 17 to 37 months who were at risk for developmental and/or physical disability, Cronbach's α was 0.97 (Matson, et al., 2009b). In a study that used a mixed clinical sample, a cutoff score of 17 differentiated ASD from non-ASD cases with a sensitivity of 0.84 and a specificity of 0.86 (Matson, et al., 2009c). A large positive correlation was also observed between the scale score and the total number of failed M-CHAT items (r=.80) (Matson et al., 2011). The Japanese translation of BISCUIT-Part 1 was undertaken by the last author (Y.K.) with permission from the original developers, and was back-translated into English by independent translators. The last author (Y.K.) and original developers then confirmed that there was content equivalence between the two languages. The final version authorized by the original developers was used in this study.

2.2.2 The Modified Checklist for Autism in Toddlers (M-CHAT)

M-CHAT is a parent-reported ASD screening tool for children aged 16-30 months consisting of 23 questions (Robins, et al., 2001), which has been widely used in countries throughout the world. Its Japanese version (M-CHAT-JV) has been shown to have good inter-rater and test-retest reliability and sufficient convergent and discriminant validity (Inada, et al., 2011). When it was used in the

Table 1 Sample characteristics (n=76)

Diagnosis, n	
ASD	73
Non-ASD	3
Age at examination (months), Mean ± SD (range)	30.2 ± 5.1 (17-37)
Gender, Male: Female	58 : 18
Symptom checklist (n=76), Mean ± SD (range)	
Impairments in social interaction	2.5 ± 1.3 (0-5)
Impairments in communication	4.7 ± 1.3 (2-7)
Restricted, stereotyped patterns of behavior	2.5 ± 1.4 (0-5)
Total	11.6 ± 3.4 (3-18)
KSPD total DQ (n=63), Mean ± SD (range)	74.8 ± 15.6 (42 -107)
Developmental delay, n (%)	
Present	38 (60.3%)
Absent	25 (39.7%)
Birth order, n (%)	
First child	37 (48.6%)
Second child later	39 (51.4%)
Siblings diagnosed with ASD, n (%)	
Present	27 (35.5%)
Absent	49 (64.5%)
Medical diagnoses (epilepsy, allergy, gastrointestinal disorders), n (%)	
Present	24 (31.5%)
Absent	52 (68.5%)
M-CHAT-JV (number of failed items), Mean ± SD (range)	
Mother-reported (n=75)	5.1 ± 4.6 (0-19)
Clinician-reported (n=73)	9.9 ± 5.5 (0-20)
SDQ (n=76), mother-reported, Mean ± SD (range)	
Total difficulties score	16.1 ± 5.9 (5-31)
Emotional symptoms	2.1 ± 1.9 (0-7)
Conduct problems	3.2 ± 1.9 (0-9)
Hyperactivity/inattention	6.1 ± 2.6 (1-10)
Peer Problems	4.7 ± 2.1 (0-8)
Prosocial behavior	3.1 ± 2.5 (0-8)

M-CHAT-JV: The Japanese version of Modified Checklist for Autism in Toddlers; KSPD: Kyoto Scale of Psychological Development; DQ: developmental quotient.
Note: KSPD data were available for 61 children with an ASD diagnosis and two with a non-ASD diagnosis. Developmental delay was defined as a developmental quotient lower than 70

primary screening of ASD, sensitivity and specificity values of 0.476 and 0.986 were respectively reported, while its positive predictive value was 0.455 (Kamio et al., 2014). Following the lead of an earlier study (Matson et al., 2011), we used the total number of failed M-CHAT-JV items as an index of autistic symptomatology. In this study, we collected mother- and clinician-reported M-CHAT-JV data. The internal consistency of the 23 items for the ASD children in this study was excellent (α =.860 for mother ratings, α =.859 for clinician ratings).

2.2.3 Symptom checklist

The 18-item checklist (see Appendix) included symptoms from the three core areas of ASD;

impairment in social interaction (5 items), impairment in communication (7 items), and restricted, repetitive and stereotyped patterns of behavior, interest or activities (6 items) (Matson, et al., 2008). In the original study (Matson et al., 2008), the internal consistency was robust (α =.95) and the mean number of endorsed items for the ASD group (aged 2 to 16 years) was 11.76 with a range of 4-19. In our ASD sample in this study, Cronbach's α was .652 and the mean number of endorsed items was 11.9 ± 3.0 (4-18).

2.2.4 Strengths and Difficulties Questionnaire (SDQ)

The SDQ is a 25-item questionnaire that assesses both psychopathology and the positive strength of children aged 4-16 years (Goodman, 1997), which has been validated in Japan (Moriwaki & Kamio, 2014). The twenty-five items are classified into five subscales; four difficulties subscales relating to emotional symptoms, conduct problems, hyperactivity/inattention, and peer problems and one strengths subscale relating to prosocial behavior. Each item is scored on a 3-point scale (0 = not true, 1 = somewhat true, 2 = certainly true). Higher difficulties scores indicate more problems and the scores of the four difficulties subscales can be summed to obtain a total difficulties score (range 0-40), while the prosocial subscale score is reverse coded. A preschool version has been shown to have satisfactory psychometric properties with a five-factor structure for 2-year olds (D' Souza, Waldie, Peterson, Underwood, & Morton, 2016). The Japanese version of the parent-reported preschool SDQ was used in this study.

2.2.5 Kyoto Scale of Psychological Development (KSPD)

The child's development was assessed using the Kyoto Scale of Psychological Development Test (KSPD) (Society for the Kyoto Scale of Psychological Development Test, 2008), which is widely used in Japanese clinical settings for young and/or developmentally delayed children. The KSPD is comparable to the Bayley Scales of Infant Development second edition (BSID-II) (Bayley,1993) (KSPD cognitive-adaptive (C-A) DQ and the BSID-II Cognitive facet, KSPD language-social (L-S) DQ and the BSID-II Language facet, KSPD postural-motor (P-M) DQ and the BSID-II Motor facet) (Tatsuta et al, 2013).

2.3 Procedure

Before the administration of the BISCUIT, the administrators (experienced pediatricians, child psychiatrists or clinical psychologists) at the four sites mentioned above read the BISCUIT manual and then received one-day's training from the first author (M.I). In parallel, clinicians who were not involved in the BISCUIT administration and blind to the results were required to obtain information using the M-CHAT-JV, SDQ, KSPD, symptom checklist and to assign a diagnostic classification (ASD/non-ASD) based on all available clinical information except the BISCUIT results. Those diagnoses were confirmed by M.I. and Y.K according to DSM-5.

2.4 Ethical issues

The study protocol was approved by the ethics committee of the National Center of Neurology and Psychiatry, Japan and the work was carried out in accordance with the Declaration of Helsinki as revised in 2000. Written informed consent to participate in this study was obtained from the parent of each child.

2.5 Data analyses

To examine the internal consistency of the Japanese version of the BISCUIT-Part 1, Cronbach's α was calculated for its total and three domain scores. As the scale scores were found to be normally

distributed (Shapiro-Wilk test, p> .05), parametric tests were used for the subsequent statistical analyses. The effect of sex, the presence of developmental delay, age and diagnostic subcategory on the scale scores was examined with a t-test. To investigate convergent and divergent validity, Pearson's correlation coefficients were calculated for the scale total score, the symptom checklist total score, the M-CHAT-JV, the SDQ scores and the KSPD DQs. Finally, hierarchical multiple regression analyses were conducted with the scale total scores and three domain scores as the dependent variable, respectively. In Step 1, children's gender and age were entered as control variables. In Step 2, DQ was also entered, and in Step 3, SDQ problems scores were added. In Step 4, M-CHAT-JV scores were entered. The statistical analysis was performed using SPSS Version 21.0 J (SPSS Inc.).

3. Results

Descriptive statistics for the 76 children are presented in Table 1. Given the small number of non-ASD children (n=3), only data from ASD children (n=73) were used in the subsequent analyses. These children all scored above the original cut-off score of 17 (Matson, et al., 2009c)

3.1 Internal consistency

Cronbach's α for the total scale was .954 while for each domain the α value was greater than .874 in the ASD children, indicating that the BISCUIT-Part 1 had a high degree of internal consistency (Table 2). Cronbach's α values for the total and individual domains were very similar for males and females, as well as for children with and without developmental delay.

Table 2 Cronbach's alpha coefficients for the BISCUIT-Part1

	ASD total (n=73)	Male (n= 57)	Female (n=16)	With Developmental Delay (n=24)	Without Developmental Delay (n=37)
Socialization (24 items)	.942	.945	.918	.931	.932
Communication (7 items)	.882	.884	.864	.800	.854
Repetitive Behavior (23 items)	.874	.884	.818	.785	.891
Total (62 items)	.954	.956	.934	.933	.953

Note: Developmental delay was defined as a developmental quotient lower than 70.

Table 3 Mean BISCUIT-Part1 scores in children with ASD (n=73)

BISCUIT-Part1 Mean ± SD, (Range)	Gender		*p*	Developmental delay[a]		*p*	Age		*p*
	Male (n=57)	Female (n=16)		absent (n=37)	present (n=24)		≧24 months (n=64)	<24 months (n=9)	
Total score	59.9 ± 24.8 (11-101)	48.8 ± 20.0 (16-84)	.104	48.7 ± 23.4 (11-97)	70.1 ± 19.0 (40-100)	<.001	55.4 ± 23.6 (11-101)	71.9 ± 23.9 (35-100)	.054
Socialization	28.1 ± 12.6 (2-48)	22.4 ± 10.6 (4-42)	<.001	22.5 ± 11.6 (2-45)	33.4 ± 10.3 (12-47)	<.001	25.9 ± 12.2 (2-48)	34.1 ± 11.3 (16-45)	.059
Communication	9.1 ± 4.0 (0-14)	7.6 ± 4.0 (1-14)	.174	7.2 ± 3.8 (0-14)	11.4 ± 2.6 (5-14)	<.001	8.3 ± 4.0 (0-14)	12.3 ± 2.1 (9-14)	<.001
Repetitive Behavior	17.0 ± 9.2 (1-36)	14.4 ± 7.4 (5-29)	.305	13.8 ± 9.1 (1-35)	19.5 ± 7.1 (6-32)	<.05	15.9 ± 8.7 (1-36)	19.9 ± 9.4 (8-32)	.209

[a] Developmental delay was defined as a developmental quotient lower than 70.

3.2 Mean differences in the BISCUIT-Part1 total score by gender, developmental level, and age

The BISCUIT-Part1 total scores did not differ significantly by gender, while gender differences were observed only in the socialization domain (Table 3). ASD children with developmental delay (DQ<70) had significantly higher scores than those without developmental delay for all three domains. Among them, the presence of developmental delay had a large effect on the communication domain scores (Cohen's d=1.29). An age effect was observed only in the communication domain: ASD children aged <24 months scored significantly higher than ASD children aged ≧24 months, although these two groups had similar DQs (80.4 ± 14.4 for children aged <24 months, 73.9 ± 15.8 for children aged ≧24 months).

3.3 Convergent and divergent validity

As shown in Table 4, the correlation between the BISCUIT-Part 1 total scores and the total number of failed items on the mother-reported M-CHAT-JV was strong, and those with symptom checklist total scores, mother-reported SDQ total difficulties scores were moderate, indicating the convergent validity of this scale. On the other hand, the BISCUIT-Part 1 total scores were not significantly correlated with either the SDQ emotional symptoms or conduct problems subscale scores, indicating divergent validity.

The scale total scores, however, were also moderately correlated with the SDQ hyperactivity subscale scores and DQ (Table 4). To investigate whether the BISCUIT-Part 1 total scores are explained by ASD-specific difficulties rather than developmental problems nonspecific to ASD, hierarchical multiple regression analyses were conducted. Multicollinearity was not a problem in these analyses, since the VIF (Variance Inflation Factor) was 1.81 or under for all variables.

Table 4 Correlations of the BISCUIT-Part 1 total score with other measures

Scale	Pearson's correlation coefficients (r)	95% CI
Symptom checklist [a]	.484***	.286 - .643
M-CHAT-JV		
Mother-reported [a]	.735***	.608 - .826
Clinician-reported [b]	.391***	.177 - .570
SDQ, mother-reported [a]		
Total difficulties	.486***	.288 - .644
Emotional symptoms	.099	−.134 - .322
Conduct problems	.213	−.018 - .422
Hyperactivity/inattention	.492***	.295 - .649
Peer problems	.437***	.230 - .606
Prosocial behavior	−.536***	−.682 - −.349
DQ (KSPD) [a]		
Total	−.370**	−.553 - −.153
Cognitive-adaptive	−.402**	−.579 - −.189
Language-social	−.398**	−.575 - −.185
Postural-Motor	.195	−.037 - .407

*p <.05 , **p <.01 , ***p <.001

CI: confidence interval; M-CHAT-JV: The Japanese version of Modified Checklist for Autism in Toddlers; SDQ: Strengths and Difficulties Questionnaire.

Note: [a] calculated for 73 ASD children; [b] calculated for 70 ASD children; [c] calculated for 61 ASD children.

Table 5 Results from hierarchical multiple regression analyses (n=61)

		BISCUIT-Part 1 total			Socialization			Communication			Repetitive behavior		
		B (SE)	β	ΔR^2	*B* (*SE*)	β	ΔR^2	B (SE)	β	ΔR^2	B (SE)	β	ΔR^2
Step 1	Gender (0 for girls, 1 for boys)	−.329 (5.44)	−.006	.041	−.565 (2.85)	−.020	.043	.926 (.946)	.102	.142*	.537 (2.23)	.027	.015
	Age (months)	.133 (.426)	.029		.123 (.223)	.053		−.214 (.074)	−.285**		.085 (.174)	.051	
Step 2	DQ	−.022 (.157)	−.014	.124**	−.021 (.082)	−.026	.123**	−.099 (.027)	−.393**	.278**	.061 (.064)	.110	.052
Step 3	SDQ hyperactivity/ inattention	1.63 (.992)	.178	.169**	.660 (.519)	.142	.143**	−.113 (.173)	−.075	.007	.785 (.406)	.237	.194**
Step 4	M-CHAT-JV	3.35 (.609)	.653**	.236**	1.70 (.318)	.654**	.237**	.344 (.106)	.408**	.092**	1.10 (.249)	.592**	.194**
R^2		.570			.545			.520			.455		
adj R^2		.531			.504			.476			.406		

*$p < .05$, **$p < .01$

B (SE), β, R^2, and *adj* R^2 are for Step 4 when all dependent variables are included in the analyses.

In the models explaining the BISCUIT-Part 1 scores, the coefficients of determination increased significantly when the M-CHAT-JV scores were included in Step 4 in addition to the DQ and SDQ hyperactivity variables added in Step 2 and 3 (Table 5).

4. Discussion

The present study demonstrates satisfactory reliability and validity of the Japanese version of the BISCUIT-Part 1 for toddlers with ASD aged from17 to 37 months in Japan.

The internal consistency of the BISCUIT-Part 1 in our sample was generally satisfactory and comparable to that of the original version (Matson, et al., 2009b).

The convergent validity of this scale was indicated by a large correlation between the scale total score and the mother-reported M-CHAT score, which is consistent with the original study (Matson et al., 2011). In addition, the large correlation that occurred between the BISCUIT-Part 1 and the SDQ prosocial behavior subscale scores concurs with an earlier study where a sizeable correlation was observed between the BISCUIT-Part 1 and the Personal-Social domain of the Battelle Developmental Inventory-second Edition (BDI-2) (Matson, et al., 2011), indicating convergent validity. At the same time, the divergent validity of the scale was demonstrated by nonsignificant correlations with SDQ subscales that measure conceptually different behaviors, emotional symptoms and conduct problems.

Hierarchical multiple regression analyses revealed that the M-CHAT-JV scores were significantly associated with total and all domain scores of the BISCUIT-Part 1 scale even after controlling for gender, age, DQ, and hyperactivity scores. These findings also suggest that the scale reflects ASD-specific difficulties rather than developmental problems nonspecific to ASD.

In this study, there were no evident gender differences in the scale total scores except socialization scores, which is in line with earlier studies. A study that examined autistic symptoms in 390 toddlers with ASD aged 17 to 37 months using the BISCUIT-Part 1 found no gender differences even when DQ was taken into account (Sipes, et al., 2011). A systematic review of gender differences in autistic symptoms that used data from 4195 subjects with ASD revealed that there were no gender differences in children under age 6 (Van Wijngaarden-Cremers et al., 2014). A more recently published study (Lawson et al., 2018) reported that there were no gender differences in overall autistic severity but females were found to exhibit more social-communication impairments than males.

Children with developmental delay scored higher on all BISCUIT domains than those without developmental delay in this study. These findings are similar to those obtained for toddlers with ASD aged between 12 to 30 months when using the ADOS toddler module (Guthrie, et al., 2013).

In terms of age differences, children aged <24 months scored significantly higher than those aged ≥ 24 months only on the communication domain. This finding might reflect a natural referral bias, given that toddlers with lower receptive and expressive language are more likely to be referred for an ASD evaluation (Bickel, et al., 2015).

We also found that there was a positive and moderate correlation between the BISCUIT-Part 1 and SDQ hyperactivity subscale scores which also accords with a study that reported a moderate correlation between BISCUIT-Part 1 total scores and BISCUIT-Part 2 inattention/impulsivity scores (Cervantes & Matson, 2015). This is not surprising given that overactivity is often reported in preschool children with ASD (Reetzke et al., 2022). Our finding highlights the importance of undertaking further research on co-occurring overactivity in toddlers with ASD, as it may cause a delay in diagnosing ASD due to possible diagnostic over-shadowing in some cases (Miodovnik, et al., 2015).

There are several study limitations to be considered. First, the sample size was small and every child included in the analysis had an ASD diagnosis. Second, we did not use the current gold standard diagnostic tools such as ADOS and ADI-R to assign a clinical diagnosis because they had not been standardized for Japanese toddlers at the time of this study. Instead, we used best practice clinical diagnoses by experienced diagnosticians where full agreement between them was obtained for DSM diagnoses.

In conclusion, the results of this study indicate that the Japanese version of the BISCUIT-Part 1 may be a potentially useful tool for aiding early ASD diagnosis in primary settings. Specifically, its adoption and use may lead to the timely referral of, and earlier interventions for young children with possible ASD while placing less of a work burden on community pediatricians.

Conflict of interests

The authors declare no conflict of interest associated with this manuscript.

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Appendix

Symptom Checklist

Please indicate if the following applies to the child. Place a "1" in the blank if the statement does apply to the child and place a "2" in the blank if the statement does not apply to the child.

1 = yes, 2 = no

1. Impairment in social interaction, such as:

_____ a. Impairment in the use of multiple nonverbal behavior, such as eye-to-eye gaze (e.g., eye contact), body posture, or gestures.

_____ b. Failure to develop peer relationships appropriate to developmental level (e.g., little to no interest in forming friendships or lack understanding of how to interact socially with others).

_____ c. Lack of spontaneous seeking to share enjoyment, interest or achievements with others (e.g., not showing, bringing, or pointing out objects he/she finds interesting)

_____ d. Lack of social or emotional reciprocity (e.g., not actively participating in social play or games, preferring solitary activities).

_____ e. Rarely seeking or using others for comfort in times of stress or offering comfort or affection to others in distress.

2. Impairments in communication, such as:

_____ a. Delay in development or lack of spoken language (i.e., not accompanied by an attempt to communicate through alternative ways to communicate such as gestures or mime).

_____ b. In those with adequate speech, impairment to initiate or sustain conversations with others.

_____ c. Stereotyped and repetitive use of language or idiosyncratic language (e.g., using words in a peculiar or odd way).

_____ d. Lack of varied, spontaneous make-believe play (e.g., pretend play) or social imitative play (e.g., imitating adults) appropriate to developmental level.

_____ e. Lack of emotional response to others' verbal or non-verbal communication.

_____ f. Lack of variation in the rhythm or emphasis of speech (e.g., speech is monotone)

_____ g. Impaired use of gestures to aid spoken communication.

3. Restricted, repetitive and stereotyped patterns of behavior, interest or activities such as:

_____ a. Preoccupation with one or more stereotyped and restricted patterns of interest of abnormal intensity or focus (e.g., few interests).

_____ b. Inflexible adherence to specific, nonfunctional routines or rituals.

_____ c. Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or other complex whole-body movements such as rocking, dipping or swaying).

_____ d. Persistent preoccupation with parts of objects (e.g., buttons, parts of the body).

_____ e. Specific attachments to unusual objects (e.g., string).

_____ f. Distress over changes in small, non-functional details of the environment.