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Translation and validation of the developmental, dimensional and diagnostic interview (3Di) for diagnosis of autism spectrum disorder in Thai children

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Abstract

This study aimed to examine the effectiveness of a translated version of the short version of the Developmental, Dimensional and Diagnostic Interview (3Di) in discriminating children with autism spectrum disorders (ASDs) from typically developing children. Two groups, comprising 63 children with clinically ascertained ASDs and 67 typically developing children, were interviewed with the short 3Di translated version. Mean 3Di scale scores in each domain of autistic symptoms (social reciprocity, communication, and repetitive/stereotyped behaviors) were significantly

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higher in the ASD group than in the typically developing group. The optimal receiver operating characteristics curve cut-off scores were found to be 10, 8, and 3 for social reciprocity domain, communication domain, and repetitive/stereotyped behaviors domain, respectively, which are identical to the original English standardization. Corresponding sensitivities and specificities were 76.2% and 80.9% for the social reciprocity domain; 85.7% and 73.5% for the communication domain; and 66.7% and 80.9% for the repetitive behaviors domain. The areas under the curve were 0.89 (95% CI = 0.84–0.94), 0.88 (95% CI = 0.82–0.94), and 0.79 (95% CI = 0.71–0.87), respectively. The short 3Di-Thai version is found to be a useful diagnostic instrument for differentiating between clinically diagnosed children with ASDs and typically developing children, although further replication is needed.

Keywords
3Di, autism spectrum disorders, ASDs, autism, diagnosis

Introduction

Autism Spectrum Disorders (ASDs) are neurodevelopmental disorders characterized by distinctive language impairments, social deficits, and patterns of restricted and stereotyped behavior. Upward trends in prevalence rates for all ASDs have been observed worldwide over the past 15 years (Prior, 2003; Wing and Potter, 2002; Zaroff and Uhm, 2011). Recent research estimated the prevalence of ASDs to be around 1 in 110 school-age children (Centers for Disease Control and Prevention (CDC), 2009; Kogan et al., 2009). In contrast, in Thailand, the prevalence of autism was found to be only 0.1 per 100 children (Poolsuppasit, 2005). Methodological variables, diagnostic methods, socioeconomic status, and/or limited access to and use of services may be responsible for differences in the apparent prevalence between countries (Zaroff and Uhm, 2011).

Currently, there are few standardized instruments to facilitate diagnosis of ASDs. The Autism Diagnostic Interview – Revised (ADI-R) (Le Couteur et al., 2003; Lord et al., 1994) and the Autism Diagnostic Observation Schedule (ADOS) (Lord et al., 2000) are widely used. In light of more recent evidence for dimensionality of the autism spectrum (Constantino and Todd, 2003; Skuse et al, 2009) an alternative interview with the capacity to capture greater phenotypic detail, and to derive dimensional measures of severity across multiple quantitative scales was developed. The Developmental, Dimensional and Diagnostic Interview (3Di) (Skuse et al., 2004) is a standardized, computer-based diagnostic interview in which individual symptoms can be scored in terms of their severity and frequency from information provided by parents and teachers of children with suspected ASDs. The 3Di offers a dimensional assessment of each domain of the triad of ASDs, and emulates ADI algorithm scoring (Le Couteur et al., 2003) to allow direct comparisons across studies. There is excellent agreement between the 3Di and ADI for 'probable ASDs diagnosis' on all three major dimensions of the autism spectrum (Skuse et al, 2004). Unlike the ADI, the 3Di focuses largely on current behavior in the age range 3–18 years. High levels of inter-rater reliability can be achieved with a relatively brief training. In the original validation of the 3Di, psychometric properties in a formal evaluation of the instrument's agreement with clinician diagnosis revealed a sensitivity of 1 and specificity of 0.98, with a positive predictive value of 0.93 (Skuse et al., 2004). The original 3Di interview contains 266 questions. Recently, a 53 item version of the interview was developed, which has similar predictive validity to the full original interview (Santosh et al., 2009).

In Thailand, the standardized diagnosis of ASDs has been restricted by the limitation that there are no validated translations of existing diagnostic tools. Therefore, this research is the first study in Thai population with the aim to examine the effectiveness of a translated abbreviated version of the 3Di in discriminating children with ASDs from typically developing children.

Methods

Participants

Two groups of samples were recruited; first, a group of 63 children with clinical diagnoses of ASDs (based on the DSM-IV-TR criteria), who attended the developmental and behavioral clinic, Ramathibodi Hospital, Bangkok, Thailand, over the period from June 2009 to May 2011. These diagnoses were made by at least two developmental and behavioral pediatricians. Second, we recruited a comparison sample of 67 typically developing children from the well-child clinic, Ramathibodi Hospital. None of the typically developing children had any autistic features or any developmental problems, as determined by the same developmental and behavioral pediatricians as the first group.

Measure and procedure

Fifty-three questions in the abbreviated interview of the 3Di were initially translated from English into Thai. A back-translation was then carried out by a professional proficient in the English language. Owing to the widely differing ages and levels of functioning of children in both groups, all were assessed with the Vineland Adaptive Behavior Scales (VABS) (Sparrow et al., 1984). The VABS is a semistructured interview that assesses social competence. The total score from the VABS, the Adaptive Behavior Composite score (ABC) for children younger than 6 years, is computed from the subscores of four domains: communication, motor skills, daily living skills and socialization. For children older than 6 years, the composite score is computed from the three domains, not including motor skills. The mean is 100 and standard deviation (SD) is 15. Subsequently, the translated version of the 3Di was administered to all parents of the two groups by a 3Di-trained developmental and behavioral pediatrician (JC). All parents were given information on the purpose of the research and all gave written informed consent to the study in accordance with guidelines from the Mahidol University ethics committees.

Data analysis

Chi-square tests of significance were used for bivariate analysis of discrete variables, and t-tests were used to compare the ASD group and the typically developing group differences on continuous variables. Discriminant function analysis (sensitivity, specificity, positive predictive value and negative predictive value) was used to evaluate how well the score would be able to differentiate between the ASD and typically developing groups. Analyses using receiver operating characteristics (ROC), the optimal cut-off score, which predicts ASDs diagnosis (determined clinically) with the greatest sensitivity and specificity, is then determined, and the area under that curve is measured. If the optimal score is associated with an area under the curve of 50% the prediction is no better than chance, whereas an area of 100% implies perfect agreement with the criterion (in this case, clinical diagnosis).

Results

The ASD group consisted of 63 children. Mean age was 5.4 years (SD 1.2). Fifty-four (85.7%) were male. For the typically developing children group, there were 67 children with mean age of

Table 1. The demographic characteristics, VABS scores and 3Di scores of children with ASDs and typically developing children

Characteristics	Children with ASD (N = 63)	Typically developing children (N= 67)	Level of significance
Mean age (years) (SD)	5.4 (1.2)	5.5 (1.6)	p = 0.2
Range (years)	2.8–12.7	3.2–10.7	
% male	85.7	51.5	p < 0.05
Maternal educational level (%)			p = 0.9
≤ 12 years	19.0	28.4	
≥ 12 years	81.0	71.6	
Family income (%)			p = 0.2
< 50,000 baht*	58.7	50.7	
≥ 50,000 baht*	41.3	49.3	
VABS scores: mean (SD)	66.9 (17.7)	100.0 (14.8)	p < 0.001
3Di scores: mean (SD)			
Social reciprocity domain	13.4 (4.1)	7.0 (3.1)	p < 0.001
Communication domain	11.6 (3.7)	6.0 (3.1)	p < 0.001
Repetitive behaviors domain	3.5 (1.9)	1.7 (1.2)	p < 0.001

*1 US$ = 33 baht.

Table 2. Sensitivity, specificity, positive predictive value and negative predictive value for the 3Di cut-offs in each domain for differentiating between children with ASDs and typically developing children

Domains	Cut-offs	Sensitivity (%)	Specificity (%)	Positive predictive value	Negative predictive value
Social reciprocity	10	76.2	80.9	78.7	78.6
Communication	8	85.7	73.5	75.0	84.7
Repetitive behaviors	3	66.7	80.9	76.4	72.4

5.5 years (SD 1.6) and 51.5% were male. There were no significant differences among group in terms of age, parental level of education and family income. The demographic characteristics are illustrated in Table 1.

Regarding the VABS, the mean score (SD) was 66.9 (17.7) in the ASD group and was 100 (14.8) in the typically developing group; there was a significant difference between groups ($p < 0.001$). Among the 63 children with ASDs, the number (%) of children with intellectual disability (IQ < 70) was 35 (55.6%). No children in the typically developing group had an intellectual disability.

The original 3Di algorithms have the following minimum scores with clinical significance: i) 10 in the social reciprocity domain; ii) 8 in the communication domain; iii) 3 in the repetitive and stereotyped behavior domain. In this study, the mean 3Di scores in each domain were significantly higher in the ASD than in the typically developing group (Table 1). After the analysis of predictive validity, using ROC curves for each subscale, we found optimal cut-off points for differentiation, as shown in Table 2. The optimal cut-off scores for each domain are the same as those obtained in the original 3Di interview (Skuse et al, 2004).

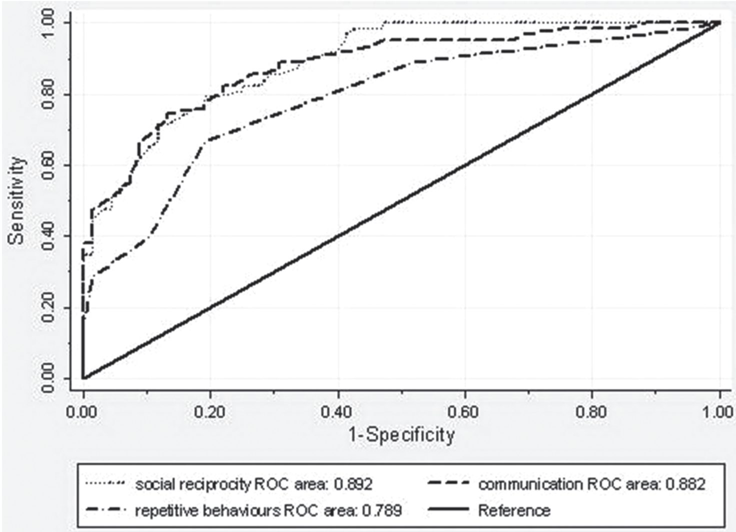

Figure 1. ROC curve of the sensitivity and specificity of the 3Di scores in each domain.

We used a ROC curve to determine the optimal cut-off point for each domain to differentiate between children with ASDs and typically developing children (Figure 1). The areas under the ROC curve were 0.89 (95% CI = 0.84–0.94), 0.88 (95% CI = 0.82–0.94), and 0.79 (95% CI = 0.71–0.87) for social reciprocity domain, communication domain, and repetitive behaviors domain, respectively.

Discussion

Our study was the first to determine whether the 3Di could be used to distinguish children with clinically diagnosed ASDs from typically developing children in Thailand. The clinic in which we performed the study is a tertiary care center, where the number of clinicians is limited. We studied the validity of the 3Di-short version because we did not have the time to carry out the longer interviews. The 3Di-short version takes approximately 20 minutes to administer; it is therefore useful in a busy clinical setting in Thailand.

The study showed that this instrument demonstrated acceptable sensitivity and specificity for each domain. The clinical population studied in the original validation of the short 3Di were from the United Kingdom and Finland (Skuse et al., 2004) and differed from those seen in this study in terms of mean age (UK/Finnish sample 9.9 years; SD 3.1: Thai sample 5.4; 1.2). In the Thai sample, most children with ASDs were referred for a primary opinion in the preschool years, but children in the UK/Finnish validation study were often referred for a second opinion. The mean age of children in this study was younger than in the original study. Despite these differences, our Thai study found, using ROC analysis, that the same cut-off scores optimally discriminated children with ASDs from typically developing children in all three main domains that are applicable to those with normal or low-normal verbal abilities. Furthermore, the areas under the ROC curve for each subscale were in the range 0.79 to 0.89, which shows that the instrument had acceptable agreement with clinician diagnosis (taken to be the ‘gold-standard predictor’ for this analysis). Our findings confirm that the 3Di may be a useful instrument to facilitate making ASD diagnosis in young children.

In the Thai study, we had heterogeneous samples in terms of age and ability, and therefore we obtained a standardized measure of adaptive functioning. In general, the VABS score of adaptive functioning is closely correlated with cognitive level (verbal IQ, performance IQ, full scale IQ or mental age) (Liss et al., 2001). In our study, about 55% of children with ASDs had the VABS scores in the range that implies intellectual disability. In comparison with the previous validity studies of the 3Di, both of the full interview (Skuse et al., 2004) and the abbreviated interview (Santosh et al., 2009), the proportion with significant intellectual disability was higher in the Thai sample than the UK/Finnish validations. VABS scores were not reported in the 3Di validation studies. However, in the original study of the full 3Di (Skuse et al., 2004), only 14% of children were non-verbal, and those who participated in the criterion validity study had a mean verbal IQ of 90. In the validation of the short-3Di (Santosh et al., 2009), the mean verbal IQ of the sample was 93.4. It is therefore perhaps surprising that there was such a close agreement between the UK and the Thai samples in terms of the optimal cut-off scores for the prediction of clinical diagnosis, based on the main dimensions of autistic behavior measured by the 3Di. However, the VABS scores that were different between the two groups might affect the scores of the 3Di because the VABS tends to ask similar questions. Further study regarding correlation should be done.

It was a limitation of the study that it was not possible to administer the ADOS, which is not available in Thai translation. Therefore, we could not perform the study regarding the agreement of the 3Di Thai version with ADOS scores.

We conducted this study without controlling for gender in both groups, which might affect the scores of the 3Di. Another limitation is the participants were recruited from one center, so they may not be representative of all children with ASDs in the general population. Further studies in other centers in Thailand using a larger sample size should be conducted.

In conclusion, we found good evidence that the short 3Di Thai version offers a promising and useful diagnostic instrument in the diagnosis of children who are suspected of having such a disorder.

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