

# Pervasive developmental disorder in the children of immigrant parents: comparison of different assessment instruments

Transtornos invasivos do desenvolvimento em filhos de imigrantes: comparação de diferentes instrumentos diagnósticos

Milena Pereira Pondé<sup>1</sup>, Cécile Rousseau<sup>2</sup>, Marco Antônio Costa Carlos<sup>3</sup>

## ABSTRACT

The objective of this study was to describe how the Childhood Autism Rating Scale (CARS) behaves in relation to the Autism Diagnostic Observation Schedule (ADOS) and to clinical diagnosis based on the criteria defined in the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> Edition (DSM-IV) for children of immigrant parents. Forty-nine children of parents who had immigrated to Canada were evaluated. In this sample, the ADOS and the DSM-IV showed complete agreement. Using the standard cut-off point of 30, the CARS showed high specificity and poor sensitivity. The study proposes a cut-off point for the CARS that would include pervasive developmental disorder – not otherwise specified (PDD-NOS). Reducing the cut-off point to 20/21 increased the specificity of the instrument for this group of children without significantly reducing its sensitivity.

**Keywords:** autism spectrum disorder, diagnosis.

## RESUMO

O objetivo deste estudo é descrever como a *Childhood Autism Rating Scale* (CARS) se comporta em relação à *Autism Diagnostic Observation Schedule* (ADOS) e ao diagnóstico clínico baseado nos critérios definidos pelo Manual Diagnóstico e estatístico dos Transtornos Mentais (DSM-IV - 4<sup>a</sup> Edição) do em crianças filhas de imigrantes. Foram avaliadas 49 crianças cujos pais imigraram para o Canadá. Nessa amostra os resultados das avaliações pelo ADOS e DSM-IV foram totalmente concordantes. Usando o ponto-de-corte padrão de 30, a CARS mostrou elevada especificidade e baixa sensibilidade. Esse estudo propõe um ponto de corte para a CARS que possa incluir o transtorno invasivo do desenvolvimento não especificado. A redução do ponto de corte para 20/21 aumentou a especificidade do instrumento para esse grupo de crianças, sem reduzir significativamente a sensibilidade.

**Palavras-chave:** autismo, diagnóstico, CARS, ADOS.

## INTRODUCTION

Pervasive developmental disorder (PDD) symptoms appear in the first years of life and are characterized by alterations in the development of social relationships, communication and language. Inappropriate behavior with limited and stereotypical interests are also common. According to the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> Edition (DSM-IV), the PDD group has five different categories: autistic disorder, Rett's disorder, childhood

disintegrative disorder, Asperger syndrome and pervasive developmental disorder – not otherwise specified (PDD-NOS)<sup>1</sup>. Associated symptoms such as hyperactivity<sup>2</sup>, aggressiveness, epilepsy and insomnia are common and aggravate the clinical condition, which in some cases may require pharmacological management<sup>3</sup>.

Bearing in mind that the neurobiological origin of PDDs remains to be fully clarified, there are no specific diagnostic markers of this disorder. Therefore, specialist evaluation continues to be the cornerstone for diagnosing individuals

<sup>1</sup>Professor, Bahiana School of Medicine and Public Health, Interdisciplinary Laboratory in Autism Research (LABIRINTO), Salvador BA, Brazil;

<sup>2</sup>Professor, Division of Social and Cultural Psychiatry, McGill University, Transcultural Research and Intervention Team (TRIT), Montreal, Canada;

<sup>3</sup>Undergraduate student, Bahiana School of Medicine and Public Health, Interdisciplinary Laboratory in Autism Research (LABIRINTO), Salvador BA, Brazil.

**Correspondence:** Milena Pereira Pondé; Av. Dom João VI 275 / Brotas; 40290-000 Salvador BA - Brasil; E-mail: milenaponde@bahiana.edu.br

**Conflict of interest:** There is no conflict of interest to declare.

**Support:** This study formed part of a postdoctoral thesis by the first author and was financially supported by the Bahia State Research Foundation (FAPESB), Grant N<sup>o</sup> 0086/2009.

Received 18 September 2012; Received in final form 25 April 2013; Accepted 02 May 2013.

in whom this disorder is suspected<sup>4,5</sup>. Diagnosis is essentially clinical and is based on criteria defined in manuals such as the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV)<sup>1</sup>. In children, diagnosis performed by a clinical specialist is considered the ideal standard<sup>6</sup>. Other instruments such as the Childhood Autism Rating Scale (CARS) and the Autism Diagnostic Observation Schedule (ADOS) are used to hasten diagnosis. The ADOS is widely used to confirm a PDD diagnosis in cases of patients whose symptomatology is not clearly specific<sup>6,7</sup>, while the CARS is used for screening and is particularly useful in community settings.

The overall score of the CARS ranges from 15 to 60, with scores <30 indicating that the individual is not autistic, scores of 30–36.5 indicating mild to moderate autism, and scores of 37–60 indicating more severe degrees of autism<sup>8,9</sup>. Some studies, however, have suggested lowering the CARS cut-off point in order to include diagnosis of the other PDDs. The Japanese version of the CARS (CARS-Tokyo Version) suggests cut-off points of 25.5 or 26 to distinguish individuals with PDD from mentally retarded individuals, with a sensitivity of 0.86, a specificity of 0.83, a positive predictive value of 0.97 and a negative predictive value of 0.5<sup>10</sup>. A study conducted in Caucasian children suggested a cut-off point of 25.5 to distinguish four-year-old children with PDD from those without PDD, with a sensitivity of 0.82, a specificity of 0.95, a positive predictive value of 0.97 and a negative predictive value of 0.74<sup>9</sup>. These studies raised the possibility that cultural factors may influence the validity of the CARS cut-off point. This may be important for multi-ethnic societies in which services have a large clientele of immigrant families from diverse cultural backgrounds. The objective of the present study is to describe how the CARS performs in relation to the ADOS and to clinical diagnosis reached in accordance with the criteria defined by the DSM-IV in a population of children of immigrants with a suspected diagnosis of some form of PDD. A secondary objective is to propose, if appropriate, a CARS cut-off point that would provide a diagnosis of PDD, including PDD-NOS and Asperger syndrome, for an immigrant population. The importance of this study is to increase the use of a simple, inexpensive screening tool such as the CARS, allowing it to be used to screen for milder clinical conditions within the autism spectrum. With the growth in migration to large urban centers, it is important to evaluate the appropriateness of these instruments for use in first-generation immigrant populations.

## METHOD

### Sample and recruitment

The study was first presented in a formal meeting to professionals working with children with either mental retardation and/or an autism spectrum disorder (ASD) in a

primary care facility located in a multi-ethnic neighborhood in Montreal, Canada. Montreal is a multi-ethnic city that receives large numbers of immigrants from very diverse backgrounds. More than 53% of children in the metropolitan area are first- or second-generation immigrants<sup>11</sup>. The target population consisted of the children of immigrant parents, who had been referred to that primary care facility on account of autistic traits. These children were considered by professionals or by their parents as being in need of a formal psychiatric assessment to establish a treatment plan and to evaluate their needs for social support or a special school. The study protocol was explained to the parents and they were informed that, if they so wished, a psychiatric assessment of their child would subsequently be made available to them. They also received a written informed consent form containing detailed information about the study: the objective, the justification for performing the research, procedures, advantages, risks, confidentiality and their right to withdraw their consent at any time. Fifty-one children were screened for the study. Two were excluded because their parents refused to participate. These children were assessed, however, and a report was made available at their parents' request. Therefore, 49 children were included in the present study.

## INSTRUMENTS

Sociodemographic data and information regarding immigration were collected from the children's parents. Each child was evaluated using three instruments: the CARS, the ADOS and DSM-IV criteria, using the same psychiatrist. The CARS is essentially an observational scale. It is short and can be applied to children of two years of age or older<sup>8</sup>. A trained observer evaluates the child's behavior in the 15 domains that are affected in autism: relating to people; imitation; emotional response; body use; object use; adaptation to change; visual response; listening response; taste/smell/touch response; use, fear or nervousness; verbal communication; nonverbal communication; activity level; level and consistency of intellectual response; and general impressions<sup>8</sup>. The examiner then awards scores that range from 1 to 4 for each domain, 1 being indicative of age-appropriate behavior and 4 of a major deviation from normal. The CARS is applied within the context of a common clinical evaluation, with no pre-established activities to evaluate the child's response.

The ADOS is an instrument designed to evaluate the child's behavior with respect to certain structured activities that have been proposed<sup>12</sup>. It consists of four modules, all of which have been found to show good reliability, sensitivity and specificity for both autism and ASD, both in English and Spanish<sup>13</sup>. The ADOS has also been used in other countries

such as Greece<sup>14</sup> and Germany<sup>15</sup>, and its psychometric properties were maintained in the different settings. Each one of the four modules in the ADOS is aimed at individuals with specific language development levels. In each of the modules, there are protocols of structured activities and interactive dynamics that are conducted by a trained examiner over a period of approximately 45 minutes. The objective of the different tasks is to provide the observer with information on the social behavior, communication and general actions of the individual being evaluated. Based on observations on how the individual completes the suggested tasks, the professional answers a questionnaire, awarding scores for the different behaviors. The questions are organized on a 4-point scale, in which 0 indicates no abnormality and 3 indicates moderate to severe abnormalities<sup>12</sup>. To be classified as having autism or an autism spectrum disorder according to the ADOS, the sum of the scores defined in the algorithms of the four modules has to reach the minimum cut-off points in the domains referring to communication and reciprocal social interaction<sup>16,17</sup>.

The children also underwent a clinical assessment after which they were given a multi-axial diagnosis using DSM-IV Text Revision (DSM-IV-TR) criteria<sup>1</sup>. The severity of their impairment was assessed in accordance with the Global Assessment of Functioning (GAF) scale, a numerical scale ranging from 0 to 100 that is used by mental health clinicians and physicians in general to subjectively rate the social, occupational and psychological functioning of children and adolescents<sup>18</sup>. The highest scores are 91–100, reflecting “superior functioning in a wide range of activities”, while the lowest scores are 1–10, indicating “persistent danger of severely hurting self or others or persistent inability to maintain minimal personal hygiene or serious suicidal act with clear expectation of death”.

## DATA ANALYSIS

The database was constructed using the SPSS statistical software package, version 14.0 for Windows. In the sample studied, measures of simple frequency and percentages were obtained for the qualitative variables, and measures of central tendency and dispersion for the quantitative variables.

## RESULTS

The study sample consisted of 49 patients: 34 boys (69.4%) and 15 girls (30.6%). The mean age of the overall sample was  $5.75 \pm 3.46$  years (mean  $\pm$  standard deviation), range 2–15 years. With respect to the origin of the patients included in the study, 61.2% were Canadian; however, they were children of first-generation immigrants. A further 32.7% were born in

their parents' country of origin. The parents came from 33 different countries, which were identified and, for the purposes of analysis, grouped into: Asia, the Arab world, Latin America and the Caribbean, North America and Europe. The children's mothers came from Asia (38.8%), the Arab world (20.4%), Latin America and the Caribbean (16.3%), North America (12.2%) and Europe (12.2%). Percentages for the fathers' place of birth showed a similar geographical distribution, with a predominance of individuals from Asia (42.9%), followed by the Arab world (22.4%), Latin America and the Caribbean (14.3%), North America (8.2%) and Europe (12.2%).

The fact that the parents were immigrants affected the evaluation process in two ways. Firstly, the parents found it comforting that the psychiatrist who interviewed them was also a foreigner; they were able to identify with him or her. At various moments during the evaluation, they mentioned feeling at ease and stated that they identified with the interviewer's strong accent. Secondly, the word “problem” or “difficulty”, when mentioned to families of Asian origin, particularly those from Bangladesh, India and Pakistan, was emphatically rejected. The parents responded that their child had no “problem” or “difficulty”. Substituting these words for more indirect questions such as “how is your child doing at school?” and “how does he/she get on with his/her siblings?” resulted in more comprehensive answers on the child's actual limitations. In relation to the application of the ADOS, the only task that was found to be inappropriate for some of the children was imitating a birthday party, singing “Happy Birthday” and blowing out the candles on the cake, as this kind of celebration did not exist in the parents' country of origin (the Asian countries mentioned above).

Comparison of the diagnoses obtained by the ADOS with those obtained using the DSM-IV-RT criteria showed almost total agreement between these two diagnostic methods. Table 1 shows the agreement between the CARS and the other diagnostic instruments. Using the DSM-IV-RT, children diagnosed as having an autism spectrum disorder, PDD-NOS or Asperger syndrome were considered to have a positive diagnosis of PDD; patients diagnosed with a language disorder or attention deficit hyperactivity disorder (ADHD) and those who were not classified as having any of the disorders described in the DSM-IV-RT were considered negative for PDD. Taking the DSM-IV-RT as the ideal standard, the sensitivity of the CARS with a cut-off point of 30 was 41%, with a negative predictive value of 16%, a specificity of 100% and a positive predictive value of 100%.

The children diagnosed with autism or an autism spectrum disorder in accordance with the ADOS were considered positive for PDD, whereas those diagnosed as non-autistic by the ADOS were considered negative for PDD. Taking the ADOS as the ideal standard, the sensitivity of the CARS was

39%, with a negative predictive value of 16%, a specificity of 100% and a positive predictive value of 100%.

The results obtained using the CARS were compared with those of the GAF. According to the scores obtained by applying the GAF, symptoms were dichotomized into “mild” or “severe” autism or ASD. The children with a GAF score ≤60 were rated as “mild”, whereas those with scores >60 were rated as “severe”. Therefore, by considering greater functional impairment (severe) as a positive diagnosis and less impairment (mild) as a negative diagnosis, the sensitivity of the CARS was 73%, with a specificity of 96%, a negative predictive value of 94% and a positive predictive value of 80%.

Table 2 shows that 95% of the 20 children diagnosed as PDD-NOS by the DSM-IV-RT were classified as non-autistic

**Table 1.** Results obtained using CARS and other diagnostic instruments.

		CARS positive	CARS negative
		n	n
DSM-IV	Positive	18	26
	Negative	0	5
ADOS	Positive	17	26
	Negative	0	5
GAF	Severe	17	6
	Mild	1	25

ADOS: Autism Diagnostic Observation Schedule; CARS: Childhood Autism Rating Scale; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders IV-TR; GAF: Global Assessment of Functioning.

**Table 2.** Association between results obtained with the CARS and diagnosis by the DSM-IV, ADOS and GAF.

Ideal standard	CARS diagnosis		
	Negative	Mild/moderate	Severe
DSM-IV			
Autism spectrum disorder	6 (27.3%)	10 (45.5%)	6 (27.3%)
PDD-NOS	19 (95%)	1 (5%)	0
Language disorder	4 (100%)	0	0
Asperger syndrome	1 (100%)	0	0
ADHD	1 (100%)	0	0
No disorder	1 (100%)		
ADOS			
Autism	14 (46.7%)	10 (33.3%)	6 (20%)
Autism spectrum disorder	12 (100%)	0	0
Negative	6 (100%)	0	0
GAF			
Severe	6 (27.3%)	10 (45.5%)	6 (27.3%)
Mild	26 (96.3%)	1 (3.7%)	0

ADHD: attention deficit hyperactivity disorder; ADOS: Autism Diagnostic Observation Schedule; CARS: Childhood Autism Rating Scale; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders IV-TR; GAF: Global Assessment of Functioning; PDD-NOS: pervasive developmental disorder - not otherwise specified.

by the CARS, while 5% were classified as having mild/moderate autism. The child diagnosed with Asperger syndrome in accordance with the DSM-IV was classified as non-autistic by the CARS. All the children with language disorders, ADHD and no psychiatric diagnosis according to the DSM-IV had a negative diagnosis with the CARS. Of the 22 children diagnosed as having an autism spectrum disorder according to the DSM-IV, 27.3% were not considered autistic according to the CARS, while 45.5% had mild/moderate autism and 27.3% had severe autism. Table 3 shows that when symptoms were more severe (severe GAF), only 11% of the children considered to have an autism spectrum disorder according to the DSM-IV were considered non-autistic by the CARS, whereas for those with less severe symptoms (mild GAF), 80% of the children considered autistic by the DSM-IV were considered non-autistic by the CARS.

All the children who were considered to have an autism spectrum disorder or who tested negative for PDD in the ADOS were classified as non-autistic by the CARS (Table 2). Of the 30 children considered autistic according to the ADOS, 46.7% were not considered autistic by the CARS, all of them having lower scores (between 14 and 21) in the ADOS. Of those who were considered autistic by the CARS, i.e. the remaining 53.3%, all had higher scores (between 19 and 31) in the ADOS.

Table 4 shows the sensitivity, specificity, and positive and negative predictive values for the different cut-off points in the CARS scale for distinguishing between children with and without a diagnosis of PDD. The cut-off point of 20/21 offered the best relationship between specificity (0.93), sensitivity (0.83), positive predictive value (0.97) and negative predictive value (0.63).

**Table 3.** Association between results obtained using the CARS and diagnosis by the DSM-IV criteria as a function of the severity of the symptoms by GAF.

Diagnosis DSM-IV		CARS		
		Non-autistic	Mild/moderate autism	Severe autism
Autism	GAF Severe	2 (11.8%)	9 (52.9%)	6 (35.3%)
	GAF Mild	4 (80%)	1 (20%)	0
PDD-NOS	GAF Severe	3 (75%)	1 (25%)	
	GAF Mild	16 (100%)	0	
Language disorder	GAF Severe	1 (100%)		
	GAF Mild	3 (100%)		
Asperger syndrome	GAF Mild	1 (100%)		
ADHD	GAF Mild	1 (100%)		
None	GAF Mild	1 (100%)		

ADHD: attention deficit - hyperactivity disorder; ADOS: Autism Diagnostic Observation Schedule; CARS: Childhood Autism Rating Scale; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders IV-TR; GAF: Global Assessment of Functioning; PDD-NOS: pervasive developmental disorder - not otherwise specified.

**Table 4.** Sensitivity, specificity, positive predictive value and negative predictive value for different cut-off points in the CARS for a diagnosis of PDD.

Cut-off point	Sensitivity	Specificity	PPV	NPV
CARS 18	1	0.17	0.91	1
CARS 19	1	0.33	0.91	1
CARS 20	0.93	0.83	0.97	0.63
CARS 21	0.93	0.83	0.97	0.63
CARS 22	0.84	0.83	0.97	0.42
CARS 23	0.77	1	1	0.38
CARS 24	0.77	1	1	0.38
CARS 25	0.77	1	1	0.38
CARS 26	0.65	1	1	0.29
CARS 27	0.58	1	1	0.25
CARS 28	0.54	1	1	0.23
CARS 29	0.47	1	1	0.21
CARS 30	0.41	1	1	0.19

CARS: Childhood Autism Rating Scale; NPV: negative predictive value; PDD: pervasive developmental disorder; PPV: positive predictive value.

## DISCUSSION

Despite the fact that the majority of the children and adolescents in the study were born in Canada, their parents were all first-generation immigrants who had come to Canada from various parts of the world. At the medical interview, any difficulties in obtaining the patient's medical history for the purpose of reaching a diagnosis in accordance with the DSM-IV and applying the ADOS were not so marked as to prevent the data required for diagnosis from being collected. The task related to simulating a birthday party was not performed as part of the ADOS series of tests and did not affect how the scores were calculated, as other tasks evaluate similar aspects.

Taking the DSM-IV as the ideal standard, sensitivity and specificity were found to be good with the ADOS for the diagnosis of PDD. These results are in agreement with the pertinent literature for children of non-immigrants in which studies have reported sensitivity of 90–97% and specificity of 87–94% for each one of the four different applicable modules in the ADOS<sup>16</sup>. Therefore, the results of the present study suggest that the standard diagnostic instruments for autism spectrum disorders are well adapted for use with the children of immigrant parents, even for those who immigrated less than five years earlier.

Comparing the CARS with the ideal standard DSM-IV and with the ADOS, and using the standard cut-off point of 30 for the CARS, sensitivity was poor with this method for a diagnosis of any PDD and the negative predictive value was low, while specificity was high and the positive predictive value was also high. If the severity of symptoms (measured by GAF) is taken as the ideal standard, the sensitivity of the CARS was higher, as was the negative predictive value, thus indicating that the CARS is a useful instrument for diagnosing cases of PDD in which the degree of functional

impairment is greater, or in which symptomatology is more severe. This hypothesis is corroborated by the descriptive findings, suggesting that the majority of children diagnosed with less severe PDDs, such as Asperger syndrome or PDD-NOS according to the DSM-IV, and with an autism spectrum disorder according to the ADOS, are considered non-autistic by the CARS. Furthermore, the majority of children considered as having an autism spectrum disorder by the DSM-IV, and who had more severe symptoms according to their GAF score and the ADOS, are considered autistic by the CARS. On the other hand, the majority of children considered as having an autism spectrum disorder according to the DSM-IV, with milder symptoms according to their GAF score and the ADOS, are considered non-autistic when evaluated by the CARS.

The cut-off point of 20/21 for the use of the CARS as a screening instrument for PDD in the study population was lower than the cut-off point used with children in Japan, where the CARS-Tokyo Version suggested 25.5/26 as the cut-off point for differentiating between PDD and non-PDD<sup>10</sup>. In Caucasian children, the cut-off point was reported as 25.5 for children of 2–4 years in age<sup>9</sup>. The population in the present study included older children (age range 2–15 years), which may have contributed to lowering the score because symptoms may decrease in older children with PDD-NOS as they acquire skills over time. Another aspect to be taken into consideration in relation to the cut-off point is that, according to the present study, the severity of symptoms may interfere in the CARS classification. Consequently, children with a diagnosis of PDD-NOS and more severe symptoms (severe GAF) were more likely to be classified as autistic by the CARS than those with milder symptoms (mild GAF). Therefore, it is possible that the population in the present study may have included more patients with less severe symptoms compared with earlier studies, thus lowering the cut-off point.

The results of this study contribute to validating the use of instruments for the diagnosis of autism, specifically the CARS, the ADOS and the DSM-IV, in populations of children of recent immigrants who do not speak the language of the host country fluently and whose cultural background differs considerably from that of the countries in which the instruments were conceived. As the CARS is a simple screening tool used worldwide, it is advantageous that the present findings have contributed towards defining a CARS cut-off point that includes PDD-NOS, even when symptoms are mild.

## LIMITATIONS

Definition of the CARS cut-off point was based on two instruments used as the ideal standard – the DSM-IV and the ADOS – as complete agreement was found between these two diagnostic methods. The new criteria contained in the DSM-V will eliminate diagnoses of Asperger syndrome and

PDD-NO, including both under the category of “a mild autism spectrum disorder”<sup>19</sup>. It is expected therefore, that the data from the present study will remain valid following publication of the DSM-V.

The scales were applied by a single psychiatrist who had trained for more than 10 years in the evaluation, diagnosis and treatment of children with PDD. As the CARS can be used in various settings and by professionals with various levels of training, the results obtained with it in the present study may not be comparable with the findings of professionals with less experience in diagnosing autism or in settings in which such a detailed evaluation is impossible. Clinical judgment is an important component of the CARS score and is reflected in the results. In this study, the clinical diagnosis was not made separately from the CARS score, as the clinician who calculated the CARS score was the same

individual who evaluated the patient using the DSM-IV criteria. This may have increased the association between the CARS scores and the clinical diagnosis. As the association between the CARS and the DSM-IV was poor with respect to the usual CARS scores, this bias does not appear to have affected the results.

## ACKNOWLEDGMENTS

The authors gratefully acknowledge the collaboration of H el ene Laperri ere, psycho-educator at C SSS de la Montagne. She developed a stimulation group for children with autism spectrum disorders, supported parents in the community, and helped to recruit families and reach a multi-professional diagnosis.

## References

1. American Psychiatric Association (APA). DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders. Washington, DC: American Psychiatric Association; 2000.
2. Pond e MP, Novaes CM, Losapio MF. Frequency of symptoms of attention deficit and hyperactivity disorder in autistic children. *Arq Neuropsiquiatr* 2010;68:103-106.
3. Novaes CM, Pond e MP, Freire AC. Control of psychomotor agitation and aggressive behavior in patients with autistic disorders: a retrospective chart review. *Arq Neuropsiquiatr* 2008;66:646-651.
4. Volkmar F, Chawarska K, Klin A. Autism in infancy and early childhood. *Annu Rev Psychol* 2005;56:315-336.
5. Minshew NJ, Williams DL. The new neurobiology of autism: cortex, connectivity, and neuronal organization. *Arch Neurol* 2007;64:945-950.
6. Kleinman JM, Ventola PE, Pandey J, et al. Diagnostic stability in very young children with autism spectrum disorders. *J Autism Dev Disord* 2008;38:606-615.
7. Rellini E, Tortolani D, Trillo S, Carbone S, Montecchi F. Childhood Autism Rating Scale (CARS) and Autism Behavior Checklist (ABC) correspondence and conflicts with DSM-IV criteria in diagnosis of autism. *J Autism Dev Disord* 2004;34:703-708.
8. Schopler E, Reichler R, Renner BR. The Childhood Autism Rating Scale (CARS). 10th ed. Los Angeles, CA: Western Psychological Services; 1988.
9. Chlebowski C, Green JA, Barton ML, Fein D. Using the childhood autism rating scale to diagnose autism spectrum disorders. *J Autism Dev Disord* 2010;40:787-799.
10. Tachimori H, Osada H, Kurita H. Childhood autism rating scale - Tokyo version for screening pervasive developmental disorders. *Psychiatry Clin Neurosci* 2003;57:113-118.
11. Rousseau C, Hassan G, Measham T, Lashley M. Prevalence and correlates of conduct disorder and problem behavior in Caribbean and Filipino immigrant adolescents. *Eur Child Adolesc Psychiatry* 2008;17:264-273.
12. Lord C, Risi S, Lambrecht L, et al. The autism diagnostic observation schedule-generic: a standard measure of social and communication deficits associated with the spectrum of autism. *J Autism Dev Disord* 2000;30:205-223.
13. Lord C, Rutter M, DiLavore P, Risi S. Autism Diagnostic Observation Schedule: Manual. Los Angeles: Western Psychological Services; 2006.
14. Papanikolaou K, Paliokosta E, Houliaras G, et al. Using the Autism Diagnostic Interview-Revised and the Autism Diagnostic Observation Schedule-Generic for the diagnosis of autism spectrum disorders in a Greek sample with a wide range of intellectual abilities. *J Autism Dev Disord* 2009;39:414-420.
15. B olte S, Poustka F. [Diagnostic observation scale for autistic disorders: initial results of reliability and validity]. *Z Kinder Jugendpsychiatr Psychother* 2004;32:45-50.
16. Gotham K, Risi S, Dawson G, et al. A replication of the Autism Diagnostic Observation Schedule (ADOS) revised algorithms. *J Am Acad Child Adolesc Psychiatry* 2008;47:642-651.
17. Gotham K, Pickles A, Lord C. Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *J Autism Dev Disord* 2009;39:693-705.
18. Shaffer D, Gould MS, Brasic J, et al. A Children's Global Assessment Scale (CGAS). *Arch Gen Psychiatry* 1983;40:1228-1231.
19. American Psychiatric Association (APA). DSM-5 Proposed Criteria for Autism Spectrum Disorder Designed to Provide More Accurate Diagnosis and Treatment. Release No. 12-03; January 20, 2012. Available at <http://www.dsm5.org/Documents/12-03%20Autism%20Spectrum%20Disorders%20-%20DSM5.pdf> Accessed 6 August, 2013.