



# Validity of the Diagnostic Interview “CRIDI -Autism Spectrum Disorders” as a Gold Standard for the Assessment of Autism in Latinos and Mexicans

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## ABSTRACT

### Objective

To validate the Criteria Diagnostic Interview (**CRIDI-ASD/DSM-5**), a cost-effective clinical assessment tool for the diagnosis of Autism Spectrum Disorders (ASD) in children and adolescents of Mexico, Latin America or Hispanics living in the US., Latin America and Hispanic children and adolescents in the US.

### Method

The CRIDI-ASD/DSM-5 is a semi-structured observational interview based on the criteria of DSM-5. It consists of questions organized in the two dimensions: 1.- Deficits in social communication and interaction, 2.- Restricted and stereotyped patterns of behavior and interests and unusual sensory reactivity. We conducted an observational, validity study.

### Results

The final sample consisted of 88 children seeking for a diagnosis of autism, or ADHD, between 18 months to 18 years of age. Participants were assessed with ADI-R, MINI-KID, K-SADS, VEAN-Hi and CRIDI-ASD/DSM-5 Interview. Cronbach's alpha for the total items was 0.91. Interrater reliability for the recorded interviews assessed by two different evaluators (N=40) ranged from ICC 0.74-.99 (M=0.86). Discriminant validity between ASD was demonstrated through the t-Student test, showing significant higher mean raw scores for the ASD Group. Kappa coefficients between ASD diagnosis through ADI-R and/or K-SADS and/or Clinical Interview and the dichotomous result (ASD vs. no-ASD) of the CRIDI-ASD/DSM-5 Interview was  $k=0.82$ , with a Sensitivity of 92% and Specificity of 95%.

### Conclusion

The CRIDI-ASD/DSM-5 is a valid, brief and cost-effective instrument for the diagnosis of ASD in Spanish-speaking children and adolescents.

### Keywords

Autism, Validity, Hispanics, Interview, Middle income country, Assessment

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## Introduction

Autism spectrum disorders (ASD) are classified under the category of neurodevelopmental disorders in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders of the American Psychiatric Association (APA) [1], characterized by deficits in social communication and interaction, restricted patterns of behavior and interests and sensory problems.

ASD and have good prognosis an average world prevalence of 1% [2,3] and early detection and intervention have been associated with improved outcomes, such as psychosocial adaptation, academic performance and IQ of affected individuals [4-6].

In the United States Latino population has consistently shown the lowest prevalence rate compared to other racial groups, such as Caucasians, African American and Asians [7-10] more barriers to evidence-based treatments [11], more severe symptoms, and greater rates of intellectual disability at time of diagnosis [12].

In Mexico, a study in the city of León Guanajuato estimated a prevalence of 0.87% [95% CI (0.62, 1.1%)] using the same CDC methodology [13].

There is some evidence that language and culture differences may influence the delay in diagnosis and treatment [14]. In Mexico, formal diagnosis occurs at 3 years of age in 77.8% of cases and up to 5 years of age in 22.2% [13]. In contrast, Latino children (mostly Mexican) living in the US are diagnosed 2.5 years later than Caucasian children [15]. However, Windham showed that Hispanic children are identified earlier when they are assessed in their native language [9].

Several factors affect the age of diagnosis. It is recognized that autism is a complex disorder with great variability of symptoms throughout development [16], and overlapping symptoms with other disorders [7,17], and cultural differences [18,14].

Specifically, Latinos in the US receive less screening for ASD and Developmental delays

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in their native language [19], and therefore less access to autism services [20].

Many instruments for screening or diagnosing ASD are designed in languages different than Spanish and have to be translated and validated for their use in Latinos and Mexicans, however these versions have some problems.

For example, the key items of the M-CHAT Mexican version are different for Mexicans [21] compared to the key items recommended by the US study [22], the same inconsistencies have been reported for other countries like China [23], Japan [24], Spain [25] and Sri-Lanka [26], suggesting there might be some cultural bias affecting parents' responses [27].

The Mexican ABC version showed that the best cutoff score for assessing Mexican children with autism differs from the cutoff proposed in the original study [28,29].

Other instruments, like the Social Responsiveness Scale Mexican version, have shown higher total mean values compared to US or German versions [30].

There are equivalence inconsistencies even with gold standard instruments such as ADI-R and ADOS-G. Specifically, Latino adolescents and adults with autism show lower levels of restrictive-and-repetitive behaviors compared to Caucasians [31,32]. Vanegas in 2016 showed that the communication domain from the Spanish-language ADI-R did not distinguish between Latino children with ASD and children with developmental disabilities [32], affecting rates of sensitivity and specificity. Latino children with autism evaluated with the ADOS-G show more symptoms than their Anglo-speaking counterparts [33], despite this Latino mothers reported fewer symptoms in the ADI-R.

Frequently, in order to achieve an optimal cross-cultural validity, it is necessary to make modifications to the instruments sometimes impossible to achieve given copyright and commercial restraints.

Many of these instruments are expensive, complex, very specialized, requiring a lot of space and time frame demands difficult to achieve. In addition, many of these tools require expensive training, which represents an obstacle to expand this knowledge to other Mexican or latinamerican professionals. Some of these tools require filming the child to rate the observed behavior adding costs, time and complexity to

the diagnostic process [12,16].

As mentioned by Durkin et al. [34] the cost of using gold standard instruments such as ADI-R and ADOS-G surpasses per capita annual health expenditure for most of the world's children [35] including Mexico, Latin-America and other low and middle-income countries, This constitutes an obstacle for the regional development of research, diagnostic and treatment strategies [36].

For all these reasons, there is an urgent need to develop instruments for diagnostic assessment of autism for Mexicans and/or Latinos living in the US or Latin America. These measures should be economical, brief, reliable, valid and culturally appropriate, not requiring extensive training and oriented to the criteria of the DSM-IV, DSM-5, and ICD classifications.

There are no gold standard instruments specifically designed for Mexicans or Latinos with the mentioned characteristics.

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### Materials and Methods

#### ■ Study design

Validity, Observational and Transversal

#### ■ Sample

Participants were 100 children seeking for a diagnosis of autism or ADHD between 18 months to 18 years of age, 12 children were excluded for incomplete assessment and the final sample consisted of 88 children and adolescents. Participants were included even if they were under pharmacological treatment or nutritional interventions for ASD or ADHD, such as stimulants, atomoxetine, atypical antipsychotics, Omega 3 supplements, gluten free diet, etc. Children with associated genetic and medical conditions such as Down syndrome, Rett Syndrome, Leukemia, visual and hearing impairments, intellectual disability, etc., were excluded.

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#### Procedure:

Several instruments for assessing Autism were reviewed by a panel of experts which included ADI-R [37], ADOS-G [38], K-SADS-PL [39] and MINI-Kid [40], and also rating scales such as CHAT [41], M-CHAT [42], VEAN-Hi [43], and the DSM-IV, DSM-5 and ICD 10 classification for ASD to develop the CRIDI-ASD Interview. The criteria to select items were

the following: 1. the frequency of the behavior seen in Mexican or Latin-American children with autism, 2. The behavior reflected a criterion of any of the classifications, 3. The importance to capture symptoms from age 1 to 18. After selecting the items, from the previous instruments, we proceeded to write the items in the way a medic, psychologist or child psychiatrist would ask during an assessment to rule out autism, using very simple and colloquial language, adding probes and examples to obtain an answer that can be coded precisely. Face validity of the CRIDI-ASD Interview was achieved through a panel consensus of several clinicians from across Mexico and Latin-America. Transcultural validity was achieved through the same panel of clinicians and also through input from Hispanic mothers living in the US. A pilot study with 20 participants was done and 20 percent of items were rephrased to clarify and simplify them based on parents' and adolescents' input when appropriate. Diagnostic algorithm forms were designed to infer diagnosis according to DSM-IV-TR [44], DSM-5 and ICD-10 [45] Criteria; for the purpose of this study we utilized only the DSM-5 diagnostic algorithm.

Children and adolescents were assigned to the following groups: ASD (N=63), ADHD (N=25). Participants were assessed with ADI-R, Interview, MINI-KID, K-SADS and VEAN-Hi, 30 CRIDI-ASD/DSM-5 random interviews were recorded and distributed to assess interrater reliability.

#### ■ Instruments

**CRIDI-ASD interview:** It is a brief semi-structured observational interview based on the criteria of DSM-5 including specifiers for intellectual disability, language level, age of onset, etc. The interview allows the assessment of different autism phenotypes and its brief duration enables the presence of the child or adolescent. It has a manual for its application, it includes a screening instrument, an observational guide and diagnostic algorithm forms according to DSM IV-TR, ICD-10 and DSM-5 Criteria. It consists of 20 core items organized in the two dimensions of the criteria of the DSM-5 that are: 1. Deficits in social communication and interaction, 2. Restricted and stereotyped patterns of behavior and interests and unusual sensory reactivity. The items are scored according to the following codes of 0=neurotypical behavior, 1=probably autistic behavior, 2 definitely autistic behavior and

8=not applicable. The interview generates three different scores: raw scores to assess severity, recoded scores to establish the cutoff point, which in turn is used to assign the diagnosis. Raw scores are graded on a scale from 0 to 2, recoded scores are obtained as follows: 0=0, 1=1, 2=1. The cut-off point is established according to the classification used (ICD, DSM-IV, DSM-5) and scores are added only when the cut-off is achieved for each diagnostic dimension.

**ADI-R [37]:** The ADI-R is a semi-structured interview administered by an experienced clinician to parents or caregivers familiar with the subject's developmental history and daily behavior. It can be used in children whose mental development is greater than 2 years 0 months. The interview evaluates 3 functioning domains: language / communication, reciprocal social interactions, behaviors and restricted, repetitive and stereotyped interests. It also assesses the period between 4 and 5 years (when the symptoms of autism are more intense). It consists of 93 elements and the results are categorical.

The inter-rater validity was reported with a  $k=0.63$  to  $0.89$  for each element, in addition to the intraclass correlation coefficients (ICC) were greater than  $0.92$  for all the scores of the domains and subdomains. For this reason, it is considered the gold standard instrument.

**K-SADS-PL-2009/ASD [39]:** It is a semi-structured interview that evaluates psychopathology in a categorical way according to the diagnostic criteria of the DSM-IV. Birmaher demonstrated its use and validity in children less than six years of age. The autism spectrum disorders section was validated in Mexico in 2014 [46] demonstrating good psychometric properties. Inter-rater reliability: intraclass correlation coefficients were good to excellent for the following diagnoses in the present and past: autism  $0.79$  and  $0.74$ ; Asperger's disorder  $0.85$  and  $1.0$ ; Generalized developmental disorder not specified (PDDNOS)  $0.72$  and  $0.41$ . The kappa coefficients for the evaluations made by the experts were good to excellent for the following diagnoses in the present and in the past: autism  $0.89$  and  $0.87$ ; Asperger  $0.77$  and  $1.00$ ; PDDNOS  $0.69$  and  $0.64$ .

**Mini international neuropsychiatric interview for children and adolescents (MINI-Kid) [40]:** MINI-Kid is a structured diagnostic interview, oriented towards the DSM-IV and ICD-10 criteria, to assess the most common psychiatric

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disorders affecting children and adolescents aged 6 to 17 years 11 months. It can be administered in approximately 25 minutes and explores 23 psychiatric disorders, such as: Depression, Dysthymia, Agoraphobia, Separation anxiety, Social phobia, Specific phobia, ADHD, Obsessive compulsive, Post-traumatic stress, Tics, Conduct, Oppositional defiant, Generalized anxiety and Adaptive disorders. The inter-rater and were 0.9 to 1 and 0.60 to 0.75 respectively, and the concurrent validity with clinical interview was 0.35 to 0.50.

**VEAN-Hi assessment of the autistic spectrum for hispanic children** [43]: It is a screening instrument to detect autism spectrum with sound psychometric properties, with an internal consistency of  $\alpha=0.81$  [26 items],  $p<0.01$ . The one-week test-retest reliability was 0.92, (95% CI 0.83 - 0.97),  $p<0.001$ . The best cutoff raw score for the instrument is 17, with a sensitivity of 75.6 %, specificity of 87.5%, and positive predictive value of 93.9% and negative predictive value of 58.3%. The kappa value is  $k=0.60$ , for the K-SADS/ASD which is higher for children <9 years-old Kappa coefficient of  $k=0.72$ , and for children <5 years-old  $k=0.87$ , for DSM-IV criteria was  $k=0.39$ , and for DSM-5 criteria was  $k=0.88$ .

■ **Statistical analysis**

Internal consistency was analyzed through Cronbach’s alpha coefficient for the total items and for items of every dimension of the instrument. Inter-rater reliability was analyzed through the intraclass correlation coefficients for all the items coded by all the evaluators. The kappa coefficients were calculated between the diagnosis of ASD vs. Non-ASD from the ADI-R, K-SADS and/or Clinical Assessment and the CRIDI-ASD Interview according to the criteria of the DSM-5 (CRIDI-ASD/DSM-5). Criterion validity of the interview was analyzed through the kappa coefficient between the dichotomic diagnosis of the CRIDI-ASD/DSM-5 interview and the dichotomous result of the ADI-R of ASD vs. Non-ASD for all children in the ASD group and children with ADHD identified through the Mini-kid.

Discriminant validity between ASD and ADHD groups was analyzed thus: Scores of items 8 to 26, corresponding to the DSM-5 diagnostic algorithm, were recoded as follows: 0=0 (neurotypical behavior), 1=1, 2=1 (autistic behavior), 8=0 (not assessable). The frequency

of the items endorsed by the ADHD and ASD groups was compared individually using the chi-square test; mean total raw scores of dimensions A, B, and total were analyzed by means of the student t-test. To determine concurrent validity the total raw scores of the VEAN-Hi and the CRIDI-ASD/DSM-5 interview were analyzed through Spearman correlation coefficients.

**Results**

■ **Internal consistency and interrater reliability**

Cronbach’s alpha for the total items was 0.91. Interrater reliability for the recorded interviews assessed by two different evaluators (N=40) was ICC 0.91 (CI 95% .85-.95)  $p=.001$  (Table 1).

■ **Construct validity**

**Discriminant validity:** We analyzed the discriminant validity of the CRIDI-ASD/DSM-

**Table 1: Intra-class correlations coefficients for Items 8-26.**

#	Item	ICC (CI 95%)
8	Gaze	0.87 (0.77-0.93)
9	Social smiling	0.74 (0.53-0.85)
10	Facial gestures	0.81 (0.66-0.89)
11	Body gestures	0.91 (0.85-0.95)
12	Imaginative play	0.76 (0.56-0.80)
13	Initiating and maintaining friendships	0.85 (0.73-0.91)
14	Sharing and showing interests	0.92 (0.86-0.95)
15	Comforting others	0.82 (0.68-0.90)
16	Using another person’s body to communicate	0.85 (0.72-0.91)
17	Proto-declarative pointing	0.86 (0.75-0.92)
18	Unusual interests	0.80 (0.64-0.99)
19	Insistence on sameness	0.84 (0.71-0.91)
20	Stereotyped movements	0.88 (0.79-0.93)
21	Interests in parts of objects	0.86 (0.76-0.92)
22	Hyper/hyposensitivity	0.81 (0.66-0.89)
23	Echolalia	0.90 (0.79-0.95)
24	Pronoun reversal	0.90 (0.76-0.95)
25	Holds a conversation	0.95 (0.89-0.98)
26	Literality	0.99 (0.98-0.99)
29	Clinical impression	0.93 (0.86-0.96)

**Table 2: Differences between average scores of ASD symptoms according to DSM-5 dimensions by diagnostic group.**

DSM-5 Dimensions	ASD M (SD)	ADHD M (SD)	r	p
<b>A. Social communication</b>	13.09 (4.4)	2.34 (3.0)	0.84	0.0001
<b>B. Restricted, repetitive patterns of behavior, interests or activities</b>	8.49 (3.0)	1.72 (2.4)	0.81	0.0001
<b>C. Total (A+B)</b>	21.58 (6.5)	4.06 (5.0)	0.86	0.0001

Note: DSM-5: Diagnostic and Statistical Manual of Mental Disorders; Fifth Edition. ASD: Autism Spectrum Disorder; ADHD: Attention-Deficit/ Hyperactivity Disorder, M: Mean, SD: Standard Deviation, r: Effect Size

**Table 3: Frequency of responses in the CRIDI-ASD/DSM-5 Interview.**

#	Item	Frequency (%)	
		ADHD	ASD
8	Gaze	32.1	82.4
9	Social smiling	14.3	82.4
10	Facial gestures	10.7	73.6
11	Body gestures	10.7	88.2
12	Imaginative play	7.1	79.4
13	Initiating and maintaining friendships	25.0	91.2
14	Sharing and showing interests	14.3	70.6
15	Comforting others	35.7	85.3
16	Using another person's body to communicate	7.1	52.9
17	Proto-declarative pointing	7.7	61.8
18	Unusual interests	10.7	70.6
19	Insistence on sameness	7.1	52.9
20	Stereotyped movements	10.7	44.1
21	Interests in parts of objects	15.8	84.2
22	Hyper/hyposensitivity	35.7	85.3
23	Echolalia	17.9	75.0
24	Pronoun reversal	10.7	22.2
25	Holds a conversation	17.9	93.3
26	Literality	19.2	85.7

ASD: Autism Spectrum Disorder; ADHD: Attention-Deficit/Hyperactivity Disorder

**Table 4: Spearman correlations between the VEAN-Hi and CRIDI-ASD/DSM-5 interview.**

		VEAN-Hi	CRIDI-ASD/DSM-5		
			A.	B.	C.
CRIDI/ASD DSM-5	VEAN-Hi	1			
	A. Social communication	0.73	1		
	B. Restricted, repetitive patterns of behavior, interests, or activities	0.66	0.75	1	
	C. Total (A+B)	0.76	0.94	0.91	1

Note: VEAN-Hi (Autism Spectrum Assessment for Hispanic Children) Total-score, CRIDI-ASD/DSM 5 (Autism Spectrum Disorders DSM-5 interview)

5 Interview between ASD and ADHD through the t-student test to compare differences between average scores of ASD symptoms according to DSM-5 dimensions. Results are shown in **Table 2**. Differences in the frequency of responses to recorded items 8-26 according to diagnostic group is shown in **Table 3**.

**Concurrent validity:** In **Table 4** we show the correlations between total scores in the VEAN-Hi and DSM 5 dimensions of the CRIDI-ASD/DSM-5 Interview algorithm.

■ **Sensitivity and specificity**

The Kappa coefficient between ASD diagnosis through ADI-R and/or K-SADS and/or Clinical Interview and the dichotomous result (ASD vs. no-ASD) of the CRIDI-ASD/DSM-5 Interview was  $k=0.82$ , with a Sensitivity of 92% and Specificity of 95%.

**Discussion**

The purpose of our study was to design a culturally appropriate semi-structured observational diagnostic interview in Spanish for Mexico and Latin-America. Our aim is for the interview to be used by any health professional with minimal training (general practitioners, family physicians, pediatricians, language therapists, psychologists, psychiatrists, neurologists, etcetera...) as a rapid and efficient diagnostic tool useful for research and clinical purposes. The psychometric data of the instrument were sound.

The overlap between ASD and ADHD symptoms [47] makes discriminant validity of the instrument important since up to 60% of children with ADHD show symptoms of Autism [48] and the comorbidity of both disorders is between 2-78% [49]. Distinguishing between both diagnostics allows the implementation of more appropriate interventions. The interview discriminates between ASD and ADHD groups.

The CRIDI-ASD/DSM-5 interview has several advantages over other instruments considered the gold standard. It is culturally appropriate for Mexico and Latin-America and could also be useful for the diagnosis of Hispanic children in the United States who often go unnoticed as most instruments have not been adapted for use in this population [50].

The diagnostic algorithms of the CRIDI-ASD/DSM-5 Interview allow clinicians to obtain an accurate diagnosis and identification of different phenotypes, such as, regressive, verbal and non-verbal autism, savant traits, etc., An additional strength of the interview is the integration of information from the parents and adolescents and the direct observation of the child's behavior; this avoids the need for using more than one instrument to assess each individual.

**Limitations**

As limitations for the validation of our instrument we can point out that, for lack of time and resources, we did not carry out IQ assessments, likewise, children with known intellectual disability were excluded from the study. Also, the small number of female children in our sample precluded us from making a reliable analysis based on gender. Finally, future studies should validate the observational guide of the CRIDI-ASD Interview, include test-retest reliability analysis and discriminant validity between intellectual disability, communication disorders and ASD

**Table 1: Baseline Characteristics.**

	Acupuncture group			Control group			P value
	N	Mean	SD	N	Mean	SD	
Chronological age (year)	24	3.03	1.42	19	3.40	1.28	0.212
Gender (Male/female)	20/4			17/2			0.568
Birth Weeks	24	38.98	2.13	19	39.31	1.33	0.806
Birth Weight	24	3159.58	699.57	19	3365.26	397.92	0.419
Severity of autism (CARS)	24	35.65	3.23	19	35.24	3.53	0.484
Social status (parents)							
Professional	2			2			0.406
Managerial & Technical	14			9			
Clerical and minor supervisory and skilled manual	18			11			
Semi-skill manual	4			6			
Unskilled manual	10			10			
Parent education status (Parental/Maternal education)							
University or above	27 (15/12)			20 (11/9)			0.660
Middle school	19 (8/11)			15 (6/9)			
Primary school	2 (1/1)			3 (2/1)			
Illiterate	0 (0/0)			0 (0/0)			
Accepted acupuncture before							
Yes	0			0			1.000
No	24			19			
Acceptance of neuroleptic drug							
Yes	0			0			1.000
No	24			19			

CARS: Childhood Autism Rating Scale

**Conclusions**

Our interview is a brief instrument, free of cost and easily available through the first author of this paper. In the future, we hope for the CRIDI-ASD/DSM 5 interview to be adopted

by the health institutes of Spanish-speaking low and middle-income countries, as well as by anyone interested in evaluating Hispanic children (children in the US); which will result in great savings of time, materials and human resources and encourage ASD regional research.

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