

Intake Assessment and Diagnostic Accuracy of Attention Deficit Hyperactivity Disorder diagnostic Scale Being Developed for Children in Nepal

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ABSTRACT

Background: Establishment of accurate diagnosis of participants is vital before starting the development of diagnostic scale. The aim of this study was to develop psychometrically sound Attention Deficit Hyperactivity Disorder diagnostic scale for children.

Methods: Informed consent was taken. Initial diagnosis of Attention Deficit Hyperactivity Disorder was made by using Diagnostic and Statistical Manual-5. Socio-demographic data were obtained. Behavior observation, parental information and teacher's report were also analyzed. Then, Kiddie-Schedule for Affective disorders and Schizophrenia, Child and Adolescent Symptoms Inventory, Stroop Color and word test were done to obtain confirmatory data. Verbatim collection was done to develop the culture specific items. Likewise, standardization was done

Results: Accurate diagnosis was established with the help of various tools and techniques. Comorbid conditions were excluded. Diagnostic accuracy was assessed where reliability of each item was ≥ 0.90 ; whereas, sensitivity and specificity were 97.0% and 96.6%, respectively with cut off score of 38.5. All items are highly co-related with Attention Deficit Hyperactivity Disorder items of Child and Adolescent Symptoms Inventory-5.

Conclusions: Results clearly indicated that diagnostic accuracy values of this scale is high.

Keywords: Attention deficit hyperactivity disorder; assessment; diagnostic accuracy; specificity-sensitivity

INTRODUCTION

Inattention, hyperactivity and impulsiveness are the core symptoms of ADHD.¹⁻³ However, other mimic conditions have been frequently co-existed with it including other developmental disorders especially autism spectrum disorder, specific learning disabilities, intellectual disability and other psychiatric disorders such as oppositional defiant, anxiety and depressive disorders.^{2,4-10} According to DSM-5 criteria of ADHD, symptoms must be presented for at least 6 months, generally observed in children before an age of 12 years and causes impairment in social, academic, or occupational functioning which must be evident in more than one setting.¹¹ Undoubtedly, diagnostic scale having poor diagnostic accuracy are of little value.¹¹ ¹² As number of clinical diagnostic tests development have been continuing to proliferate with the purpose of helping clinicians to make accurate diagnosis of

those particular disorders, it is necessary to thoroughly evaluate a test's diagnostic utility, prior to incorporating it into the clinical practice.^{13,14} The usefulness of a specific clinical diagnostic scale is dependent on its diagnostic accuracy values.

METHODS

The study sites were Kanti Children's Hospital (KCH), Rhythm Neuropsychiatry Hospital and Manowana Mental Health Services located in Kathmandu valley. Children diagnosed as ADHD and anxiety spectrum disorder along with their parents were included to obtain the clinical data. Additionally, their grade teachers were involved for the case studies. Clinicians (i.e. psychiatrists and clinical psychologists) were also involved as experts. So, altogether 653 clinical sample (verbatim from 200 parents of children diagnosed with ADHD, 40 parents of children were diagnosed with ADHD

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for pilot testing, 44 experts from the field of psychiatry and clinical psychology for discussion and expert analysis on contents, 100 clinical samples of children with ADHD & their parent (N=100), 128 Non-ADHD with having Anxiety disorder, 16 parents of children diagnosed with ADHD including their children (N=16) for test retest validity checking, 3 teachers, 3 parents and 3 children for case studies) were the sample of this study. The age range of children participants was 5-12 years.

After obtaining permission for the study from the institutional review board of Nepal Health Research Council (NHRC) and KCH, permission letter was received from Ministry of Education as well as from clinical data collection site (hospitals and a clinic). Consent forms for each participant were prepared and then clinical data collections were started. Written informed consents were taken from parents and children. Parents also provided consent form for children under the age of 18 years. Children and adolescents gave written assent for their participation.

Children first received the accurate DSM-5 ADHD diagnosis based on a comprehensive psychiatric clinical evaluation at OPD. This evaluation utilizes multiple assessment procedures designed to identify other psychiatric and neurological factors that may influence or better account for ADHD symptoms with the help of various tools and techniques. So, initial ADHD diagnoses have been assessed by using standardized parent report of symptoms with in-depth clinical evaluation of other behavioral, medical or developmental diagnoses that may mimic ADHD symptoms. History taking included reasons for clinic referral or seeking help, age at onset of symptoms, classroom behavior via teacher's verbal report on the basis of parental information as reported by the teacher with the parents of children diagnosed as ADHD, evidence of impairment, parent ratings of behavior, medical history, etc. Then, participants were excluded from the study if their history provided evidence of any other psychiatric comorbidities, intellectual disability, autism spectrum disorder, presence of sensory impairments, diagnoses of epilepsy or other neurological disorders and remaining participants were asked to fill socio-demographic proforma. Assessment was done by using Socio-demographic Proforma with four other assessment tools i.e. KIDDI-SADS-PL, CASI-5, Proposed ADHD diagnostic scale and Stroop color-word test for comprehensive evaluation (Table1) of the children. Behavior observations were done at OPD. Interactive interviews were done on multiple sessions with multiple set up to understand the detailed phenomenon and consistency of the given information as well as consistency of behaviors regarding ADHD. During the OPD visit, Verbatim were

collected. Information regarding behavior of children at home, school and social situations was collected from parents of children diagnosed with ADHD (N=200) who were presented or referred for consultation at OPD was jotted in Nepali language in their own words in verbatim collection form. Those problem items were utilized to form an initial draft of the ADHD Diagnostic Scale for children. The scale was prepared undergoing several discussions with the professionals (experts). Thereafter, pilot study was done. The first pilot study was targeted to test the 10% sample (N=20) of the total samples included for verbatim collection. Few interview questionnaires were prepared regarding item clarity for each participant involved in pilot study which was conducted after filling up the given draft scale. Then, next target of the pilot study was professionals (N=20) but 5 of them dropped out. The data from remaining 15 professionals (5 consultant psychiatrists, 2 psychiatry residents, 5 clinical psychologists and 3 clinical psychology residents) were included for analysis. Most of the participants found that statements were lengthy and difficult to comprehend by the parents who had no exposure to academics and education; therefore, they suggested to collect relevant examples for every statement so that it would be easier to understand on the basis of interview findings. So, the discussion based on these findings was held with an experts' team. Then, previously collected verbatim from the parent with ADHD children were reanalyzed again by the same team and examples were also collected. Those examples were put under each relevant statement and rating scale was constructed accordingly. Again, second pilot study was conducted with a similar type of respondents (N=40, 20 parents of ADHD children and 20 professionals). Most of them found that the rating scale was very useful and comprehensive. These examples were again tested with another (N=20) parents of ADHD children presented at OPD where it was found that all examples were relevant for every statement. Subsequently, final rating scale was constructed. Each child's parent was asked to read all of the items in the scale thoroughly and were also asked to identify items that are confusing. Based on these reviews, items identified as confusing were modified by an experts' team. However, they still found few grammatical errors which were again corrected and final scale was eventually constructed to collect data for this study. The final scale was given into two groups of parents for validation proposed. The first group was a comparison group of parents from a child psychiatry clinic participants (anxiety disorder, N=128) and the second group was a comparison group of parent of children referred to a child psychiatry clinic who met an operational definition of ADHD and an inclusion criterion (N=100). These samples (all parents who were included in this study) were individually administered the proposed

ADHD rating scale. Stroop color and word test were done with children diagnosed as ADHD. Besides this, CASI-5 (translated Nepalese parent version) was given to parents of clinical group. Data collection techniques

were both qualitative (case study) and quantitative methods. For quantitative methods, there were seven materials or tools used as shown in (Table 1).

Table 1. Tools used to collect the data during the Study.

S.N	Tools Used	Purpose of using Tool
1	Semi-structured proforma	To obtain Demographic data
2	Verbatim Collection form	For Item Generation
3	Content validation Checklist	To check Contain adequacy
4	Proposed ADHD Diagnostic Scale	For main tool development & validation
5	KIDDIE-Schedule for Affective Disorders and Schizophrenia	To Diagnose ADHD
6	Child and Adolescence Symptom Inventory (CASI-5) parent version	To exclude comorbidity, diagnose anxiety, calculate correlation of the parallel items with Proposed ADHD Diagnostic Scale
7	Stroop Colour and Word test (SCWT)	To test executive function
8	Behaviour Observation Sheet	Methodological Triangulation
9	Interview	To identify content adequacy & cultural understanding of phenomeon

RESULTS

Accurate diagnosis was established with the help of DSM-5 criteria, behavior observation, parental information and teacher's verbal report with parents followed by Kiddie-SADS-PL, CASI-5 and Stroop test where male respondents were slightly higher (n=65, 52.7%) than female respondents (n=34, 47.5%). Mean age of children with ADHD was 6.61 ± 2.24 years. There were altogether 160 chief complaints collected from the parents. The wordings were matched nearly possible to the verbatim of the parents in Nepal. The initial revision of the scale was made after the consultation with experts' team where the chief complaints with similar meaning were grouped together and definition for each group was identified. Initially defined 29 items including an impact question were used to develop first draft of the scale. After many discussion on the basis of pretesting, the experts' team had decided to generate 21 items scale.¹⁵ Consequently, content adequacy of the scale was confirmed. Most of the professionals (N=20) found that the rating scale was highly relevant or useful and clear or comprehensible. Then construct validity ratio (CVR) was calculated from this sample where minimum CVR was found to be 0.80. This CVR was greater than the critical value of CVR (i.e. 0.42). This indicates that all the items are useful and comprehensive and they were included to construct a scale. The final version of the scale had 21 items. Three sub-scales (Inattention, Impulsivity and Hyperactivity) were identified by using Principal Axis Factor Analysis.¹⁶ All factors showed strong statistically significant construct reliability (CR > 0.92) and Cronbach alfa is more than 0.90 (Table 2).

Table 2. Cronbach Alpha and Construct Reliability.

Constructs	AVE	CR	Cronbach Alpha	No. of items
Inattention factor (factor1)	0.672	0.948	0.946	9
Impulsivity Factor (factor 2)	0.618	0.935	0.921	9
Hyperactivity Factor (factor 3)	0.863	0.926	0.922	2

All of these items are highly correlated with the ADHD assessment items of CASI-5. It has demonstrated best test-retest reliability in all the items (Table 3).

Table 3. Test-Retest Reliability.

Test	Retest	Pearson's Correlation	Test	Retest	Pearson's correlation
Q1	Q 1.R	1.000**	Q 12	Q 12.R	1.000**
Q 2	Q 2.R	1.000**	Q 13	Q 13.R	1.000**
Q 3	Q 3.R	1.000**	Q 14	Q 14.R	1.000**
Q 4	Q 4.R	1.000**	Q 15	Q 15.R	1.000**
Q 5	Q 5.R	1.000**	Q 16	Q 16.R	1.000**
Q 6	Q 6.R	1.000**	Q 17	Q 17.R	1.000**
Q 7	Q 7.R	1.000**	Q 18	Q 18.R	1.000**
Q 8	Q 8.R	1.000**	Q 19	Q 19.R	1.000**
Q 9	Q 9.R	1.000**	Q 20	Q 20.R	1.000**
Q 10	Q 10.R	1.000**	Q 21	Q 21.R	1.000**
Q 11	Q 11.R	1.000**			

Inter rater reliability seems to be good (ICC > 0.94). This scale has 97.0% sensitivity and 96.6% specificity (Figure 1) as optimum probability with a total score of 38.5. Hence, 38.5 is considered as the best cut-off point as Total score criteria.

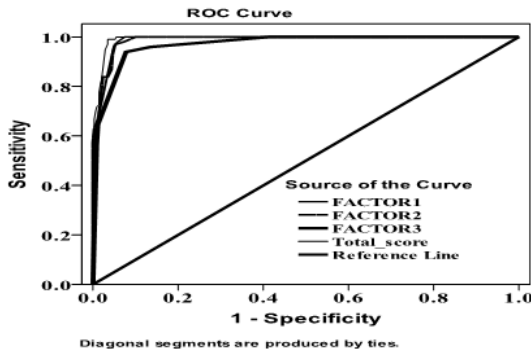


Figure 1. ROC curve.

Primarily presented symptoms of the ADHD children were: less concentration in studies and poor academic performance. Higher number of children having diagnosis of ADHD i.e. 55 (18.7) were from the government school and remaining children i.e. 44 (15.3) were from the private school. Regarding the academic performance of children having diagnosis of ADHD, almost all children were under-performer where 70 children had below average level of academic performance, 22 children were failing in all subjects and only 7 children had average level of academic performance; whereas no one found to have above average and outstanding level of academic performance. Nineteen pre-termed children had ADHD. It was found that about half of children having diagnosis of ADHD had low birth weight. Similarly, it was found that about half of the children having diagnosis of ADHD had history of parental substance abuse during pregnancy where almost all mothers were using either cigarettes or alcohol on regular basis. Seventy four children having diagnosis of ADHD had no family history of mental illness, whereas 25 children had family history of ADHD like symptoms among closed family members (Table 4).

Table 4. Socio-Demographic Characteristics of ADHD Subjects [N (%)].

Demographic Characteristics of ADHD Subjects	Frequency (N=99)
Public school	55 (18.7)
Private school	44 (15.3)
Failing many subjects	22 (84.6)
Less than average	70 (51.9)
Average	7 (3.1)
Full termed baby	80 (15.2)

Pre-termed baby	19 (38.0)
Low birth weight	49 (60.5)
Average birth weight	50 (10.2)
Substance abuse during pregnancy (Present)	49 (38.6)
Substance abuse during pregnancy (Absent)	50 (11.1)

DISCUSSION

Information collection from the false positive cases, lead to increased decision errors. Moreover, test's diagnostic utility will be questionable as well as invalid. There might be few chances of misleading the result. Therefore, test maker should be very conscious while making the diagnostic scale. Diagnostic information gained from the standardized clinical interview and diagnostic scale during the assessment period is vital for treatment decision-making in behavioral disorders. The proposed ADHD diagnostic scale was constructed with good reliability (Cronbach's alpha of each item is ≥ 0.90) as it has been said that: Cronbach's alpha value 0.00 means no consistency in measurement while a value of 1.0 indicates perfect consistency in measurement in which the acceptable range is between 0.70 and 0.90 or higher.¹⁷ The most widely used scale, ADHD rating scale-IV was also constructed with reliability of 0.86-0.92 (Pappas, 2006). Generally, if $\alpha \geq 0.9$, the internal consistency is considered to be excellent indicating that the proposed scale is accurate and suitable in measuring the constructs. CR must be greater than 0.7. CR is a less biased estimate of reliability than Cronbach's alpha (Table 2). Eighteen out of twenty items and an impact measurement item are highly co-related with ADHD items as given in CASI-5, which is a behavior rating scale for DSM-5-defined emotional and behavioral disorder in youths between 5 and 18 years old.^{18,19} However, other two new culture specific items were identified in this study besides CASI-5. The total cut off score for ADHD is 38.5 which gives 97.0% sensitivity and 96.6% specificity as optimum probability in this scale. So, 38.5 is considered as the best cut-off point as total score criteria for accurate diagnosis of ADHD for Nepalese children. Where, it may misclassify ADHD as Normal (Non-ADHD) with 3.0% chance and Normal (Non-ADHD) as ADHD with 3.7% chance. Further depending on the problem, one can choose more sensitivity and thus 37.5 may be next best cut-off point, or if one wants to choose more specificity, 39.5 may be best next cut-off point. But this study uses 38.5 as the applicable cut-off point. However, combination of clinical judgement is vital with this scale to minimize misclassification issues. It was found that almost all children were under-performer and one of primary symptoms led parent to seek treatment was poor academic performance. Nevertheless, ADHD is

a major public health concern as it has marked long-term impairment on academic performance, vocational success and social-emotional development leaving a profound impact on individuals, families, schools and society.²⁰

CONCLUSIONS

By selecting right participants with the help of standardized assessment tools and methodology, a valid and reliable ADHD diagnostic scale has been developed in Nepalese culture and language. This scale may be the most effective diagnostic tool in assessing ADHD because of its high diagnostic accuracy constructed with good validity, reliability, sensitivity and specificity. Our findings provide further support for the notion that evaluation of academic functioning is very essential while doing the diagnosis of ADHD children.

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