

# Validation of Attention Deficit Hyperactivity Disorder Diagnostic Scale for Children

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## ABSTRACT

**Background:** There is no valid Attention Deficit Hyperactivity Disorder diagnostic tool to fit Nepalese culture and language till date. Current study is intended to develop and validate the Attention Deficit Hyperactivity Disorder scale for children in Nepal.

**Methods:** Mixed method study was conducted with 840 samples (i.e. children with Attention Deficit Hyperactivity Disorder =356, Anxiety =128 and General Population=356). Items generation, scale development and scale evaluation were the three consecutive steps followed to develop and validate the scale. Children with Attention Deficit Hyperactivity Disorder (already met the Diagnostic and statistical Manual-5 criteria) were further assessed by Kiddie-Schedule for Affective disorders and Schizophrenia (K-SADS-PL), Child and Adolescent Symptoms Inventory (CASI-5) to confirm the diagnosis and psychometric validation. Pilot studies were done for items clarity. Each data obtained from three comparison groups (Attention Deficit Hyperactivity Disorder, Anxiety and General Population) were included for standardization process where tests of dimensionality, reliability, validity, calculating norms (cut off) were done as scale evaluation process.

**Results:** The final version of the scale had 21 items. Three sub-scales (Inattention, Impulsivity and Hyperactivity) were identified by using Principal Axis Factor Analysis. All factors showed strong statistically significant convergent validity and Discriminant validity Cronbach's alpha of each item is  $\geq 0.91$ . As total score criteria, 38.5 is considered as the best cut-off point for this scale.

**Conclusions:** By using systematic process, a valid and reliable Attention Deficit Hyperactivity Disorder diagnostic scale is being developed in Nepalese culture and language.

**Keywords:** ADHD; development and validation; executive function.

## INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is a neuro-developmental disorder, which has significant problems in executive functions.<sup>1-4</sup> It is the most common childhood disorder that persists up to adulthood in majority of cases.<sup>5</sup> Inattention, hyperactivity/impulsiveness are the major problems<sup>6</sup> resulting in significant impairment on academic performance<sup>7,8</sup> vocational success, social-emotional development with profound impact on individuals, families and societies.<sup>8</sup> Children with untreated ADHD are sometimes mislabeled as troublemakers,<sup>9</sup> often subjected to harsh measures of discipline. A hospital-based study found 10% prevalence rate of ADHD in Nepal<sup>10</sup> which is even higher than global prevalence (i.e. 5.29% and 7.2%).<sup>11,12</sup>

The most common rating scale using by clinicians to

evaluate ADHD symptoms in Nepal is ADHD Rating Scale (ADHD-RS). However, it is developed in other culture and language which may mislead the results. As of now no any ADHD diagnostic tool has been developed in Nepal. In an attempt to fill up this critical need, we are developing a new tool called "Proposed ADHD diagnostic scale for Nepalese children". We believe that this tool will assist in clinical evaluation, progress monitoring, educational plan, rehabilitation and further researches.

## METHODS

The study design was both quantitative and qualitative. Qualitative method (Case Study) was used to examine, understand and describe a phenomenon. This was a cross-sectional study. There were two major types of participants had included in this study. One was clinical participants, and another was the community

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participants. Parent of school children from age group of 5 to 12 years was taken as a community sample (GP) and similar aged children with ADHD as well as their parents who were presented in OPD were taken as clinical sample.

The sample size was 840 where 356 ADHD samples (verbatim 200 from parents of children diagnosed with ADHD, 40 pilot test samples, 100 clinical test samples and remaining 16 samples for test-retest), 128 Non-ADHD children having Anxiety disorder and 356 community samples (256 children from GP and 100 pilot study samples). Regarding community participants (GP), 256 participants (i.e. 32 students x 8 age groups) were chosen. For further clarification of the community participants, according to the system of 32 students per class and 8 schools (4 districts and 2 types of schools) with 8 age levels (age group 5-12 years consist of 8 age groups in each). These participants were further divided to get 4 students in each sample resulting 32 students per school (4 students and 8 age groups) and altogether 8 schools gave us 256 participants (32 students x 8 age groups). Government and private schools of Nepal from each Echo belts (Mountain, Terai, Hill and Valley) were the study sites to obtain data of GP. For clinical participants, data collection was done from outpatient department (OPD) in Kanti Children's Hospital (KCH), Rhythm Neuropsychiatry Hospital and Manowawana Mental Health Services in Kathmandu.

Random sampling (multi-stage sampling) for community participants and purposive sampling with clinical participants was done. After obtaining permission from the Institutional review board of Nepal Health Research Council and KCH, permission letter was taken from Ministry of Education as well as from hospitals and clinic, a complete list of PABSON (Public and Boarding Schools of Nepal) and N-PABSON (National-Public and Boarding Schools of Nepal) were obtained from Ministry of Education. Both type of schools was searched from each eco-belts of Nepal randomly to collect the data from the community. A format of requesting letter was prepared for school to get permission from school authority. The two male and two female children were selected randomly from each age group through record kept on class register. Consent forms for each participant were prepared and sent to the respective parents. Participants who gave the consent were considered as community participants. However, all children who met the inclusion criteria and attending in OPD with in a set period of data collection were recruited as a clinical sample.

Study variables were heredity, age, parental education, parental occupation, and prenatal exposure to nicotine,

alcohol, infections, birth injuries, birth weight, executive function and hyperactivity/Impulsivity, Inattention. The exclusion criteria were non-coeducational school, intellectual disability, autism spectrum disorder, ADHD like symptoms due to other medical and psychiatry disorders.

Interview, behavior observation, questionnaires were used for qualitative data collection. However, Semi-structured proforma, K-SADS-PL, CASI-5 parent version and Stroop test were used to collect the quantitative data. Here, CASI-5 parent version was translated into Nepali by a bilingual clinical psychologist and discussed with expert team for finalization after taking permission from the author, Kenneth Gadow. By incorporating all suggestions, the tool translation was finalized. Back translation was done by experienced professional without providing the original version. Pre-testing was done after informed consent prior to using this tool where parents had filled the form. However, K-SADS-PL was used without translation as it is a clinical interview and experienced clinician had completed the interview.

Regarding clinical data, verbatim collection from parents of children diagnosed with ADHD (N=200) in OPD was done by the service team of consultant psychiatrists and clinical psychologists. Then, information reported by parents were written in Nepali language on their own words and first draft of scale was developed with discussion among experts (team of psychiatrist and clinical psychologists). The first pilot study was targeted to test with 10% sample (N=20) of the total sample included for verbatim collection (N=200). Four parents were dropped out and the study was conducted with sixteen parents from GP. 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 and 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 have less education; whereby they suggested to collect relevant examples for every statement so that it would be easier to understand. So, the discussion based on these findings were reviewed by an expert team. Then, previously collected verbatim from parent with ADHD children were again analyzed by the same team and examples were collected. Those examples were put under each relevant statements and rating scale was constructed. Again, second pilot study was conducted with the 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. Thereafter, final rating was constructed, and third pilot study was conducted with 10% of each type of GP sample (N=100). Here, the total sample selected were 102 but two samples were found invalid and excluded as most of data were left uncompleted. To minimize urban / rural cultural differences in the test, half of them were selected from Kathmandu district and another half from Gorkha district were asked for permission to join such a pilot study. (10% participants from governmental schools of rural area and another 10% participants from governmental schools of urban area were included from Kathmandu district as well as 10% participants from private schools of rural area and another 10% from private schools of urban area of Gorkha district).

Each child's parent read through all of the items in the scale thoroughly and they were asked to identify items that are confusing. Based on these reviews, items identified as confusing were modified by the expert team. However, they still found some grammatical errors which were again corrected, and final scale was constructed with 21 items to collect data for this study. These data were also used for final analysis.

There after, three comparison group were identified for the purpose of scale evaluation. The first group was parents of (GP) school children (N=256). Another group was a group of children referred to a Child Psychiatry Clinic who met an operational definition of ADHD and an inclusion criterion (N=100) and the final group was a group of children from a Child Psychiatry Clinic population (Anxiety disorder, N=128). So, the validation samples consist of about 356 Nepalese school aged children, 100 ADHD cases and 128 anxiety cases who were presented in OPD matching the age with GP. These samples were individually administered the purposed ADHD rating scale.

Clinical assessment of ADHD positive cases (who already met the DSM-5 criteria) was done based on the application K-SADS-PL and CASI-5. The response inhibition (executive function) test was done by using Stroop test. The proposed ADHD rating scale was also given to parent with the CASI-5. Informed consent was taken. Confidentiality was properly maintained. As under 18 years children were involved in this research, assent was taken. All assessments were conducted by qualified mental health professionals (1 psychiatrist and 1 clinical psychologist). At the end of this evaluation, cases were further discussed by the service team in order to establish the diagnosis. For security purpose, a code was assigned i.e. clinician code like 101, 102, 103

and detailed information of assigned code was locked in principal researcher's locked archive. Daily editing has been done after collecting data to maintain accuracy and completeness. Collected data has been coded and analysis has been done in Statistical Package for the Social Sciences (SPSS). Interpretations of the findings are being made on graphical or tabulated form. Verbatim analysis was done with many discussions with expert team. Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) was done to identify general ideas about whether factor analysis is useful for the collected data in this study or not. Bartlett's test of Sphericity was done to measure strength of relationship across the items (variables). Thereafter, Principle Axis Factoring (PFA), Varimax criterion of rotation was used to obtain number of factors. Factor analysis was done. The alpha internal consistency was estimated for all factors. As Cronbach's Alpha is the most common measure of internal consistency ("reliability"), it was calculated to check reliability of the scale. Test -Retest was done with ADHD Children presented at OPD in two set up. Constructs (convergent validity) and divergent (discriminant validity) were achieved by using Confirmatory Factor Analysis (CFA). Cut off score for specificity and sensitivity was calculated by ROC Curve Analysis.

## RESULTS

KMO was 0.882 indicated adequate sample size to perform Factor Analysis. Bartlett's test of Sphericity was less than 0.05 of the significance levels indicated that a factor analysis is useful with the current data. So, Principle Axis Factoring (PFA), Varimax criterion of rotation was used to obtain number of factors. Based on the Eigen value 1 or more three factors (Inattention, Impulsivity and Hyperactivity) were identified. The alpha internal consistency was estimated for these three factors where Cronbach Alpha of each item is  $\geq 0.91$  indicate that all constructs are better consistent or reliable (Table-1).

Table 1. Reliability Test using Cronbach alpha.

Constructs (factors)	AVE	CR	Cronbach Alpha	No. of items
Inattention (Factor 1)	0.6722	0.9483	0.946	9
Impulsivity (Factor 2)	0.6187	0.9351	0.921	9
Hyperactivity (Factor 3)	0.8633	0.9262	0.922	2

The convergent validity and discriminant or divergent validity of the proposed ADHD Scale were calculated where all the three factors had strong level of convergent validity according to AVE and CR (AVE must greater than

0.5.). Similarly, regarding discriminate validity, the Square root of correlation between pairwise construct is less than their respective AVE. Square of correlation between Inattention(Factor1) and Impulsivity (Factor2) (0.1616) is less than AVE (0.6722) of Factor 1 and AVE (0.6187) of Factor 2. This implies that two factors are different from each other. Hence a few items in each factor discriminate these two factors, Factor1 and Factor 2. Whereas square of correlation between Inattention Factor and Hyperactivity (Factor 3) (0.0529) is less than AVE (0.6722) of Factor 1 and AVE (0.8633) of Factor 3. This implies that two factors are different from each other. A few items in each factor discriminate these two factors, Factor 1 and Factor 3. Moreover, Square of correlation between Factor 2 and Factor3 (0.5643) is marginally less than or equal to AVE (0.6187) of Factor 2 but much less than AVE (0.8633) of Factor 3. This implies that two factors are marginally different from each

other. Hence, a few items in each factor discriminate these two factors, Factor 2 and Factor 3 (Table 2). Now it can be inferred that all the factors (Factor 1, Factor 2, and Factor 3) satisfies reliability and validity criteria. Therefore, the three different scales (Inattention, Impulsivity and Hyperactivity) are said to be constructed for ADHD successfully. In addition to estimating internal consistency, corrected item-total correlation for all three factors were calculated which showed positive correlation of more than 0.60 indicating that each item or question was answered correctly on the average. The cut off score 38.5(Total score) give 97.0% sensitivity and 96.6% specificity as optimum probability. So, 38.5 is considered as the best cut-off point as Total score criteria (Table 3). With this cut of (i.e.38.5) point there is a 3.0% chance of ADHD being misclassified as Normal (Non-ADHD) and 3.7% chance of Normal (Non-ADHD) being classified as ADHD.

Table 2. Validity Test.

Constructs	Correlation	Constructs	Estimate or correlation	square of correlation	AVE1	AVE2
Factor1	<-->	Factor2	0.414	0.1616	0.6722	0.6187
Factor1	<-->	Factor3	0.230	0.0529	0.6722	0.8633
Factor2	<-->	Factor3	0.751	0.5640	0.6187	0.8633

Table 3. Age Norms (Cut off)

Age-group	Factor 1	Factor 2	Factor 3	Total Score for all age group
5-6	15.5	14	3.5	
7-9	17.5	13.5	3.5	38.5
10-12	17.5	12.5	2.5	

## DISCUSSION

The ADHD diagnostic scale is being constructed with good reliability because of the careful selection of methodology. The design of this study was both quantitative and qualitative (i.e. case study of some cases). Quantitative method was used to examine the relationship between variables which represents relationship mathematically through statistical analysis. Qualitative method was basically used to examine, understand and describe a phenomenon. Case study of few cases were done to examine, understand and describe the phenomenon in detail. Many researchers have highlighted that mixed methods designs are better and systematic to conduct complex research.<sup>13</sup> Many psychological researches have been using mixed method designs to increase the strength of psychological research. The prevalence rate for mixed methods research in pure disciplines like psychology, sociology is 6%.<sup>14</sup>

Quantitatively oriented studies are often conducted in larger samples, are predominantly group-oriented (with single-subject studies being the exceptions, because they use small samples and are individual-oriented), and address (direction/magnitude of) relationships between specific sets of constructs, rather than conducting “process analysis”.<sup>15</sup> Brady, Collier and Seawright (BCS) have argued that “causal process observations” can be adjoined to “data set observations.” This implies that qualitative methods can be used to add information to quantitative data set.<sup>16</sup>

Regarding limitation of current study, purposive sampling with clinical participants was done due to limited time of the researcher is a limitation. The researcher is unable to collect data from school teacher of every child like their parent and unable to analyze the verbatim quantitatively due to researcher’s limited time as well as resources were the major limitation of this study. Mixing of data collected during last pretesting or third

pilot study and the final survey data from GP during analysis was another limitation of this study.

## CONCLUSIONS

By using systematic process, a valid and reliable ADHD rating scale is being developed for the first time in Nepalese context and language. Considering the obtained preliminary values in the psychometric indexes, the consensus among specialists on the basis of test content validity as well as considering the calculation methods of the cutoff point, we can safely use this scale in the clinical situations, epidemiological studies, and other researches.

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