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Assessment of Construct of the Parent/Teacher Disruptive Behaviour Disorder (DBD) Rating Scale –Sinhala by Principal Component Factor Analysis (PCA)

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ABSTRACT

Background: DBD cause disadvantageous outcomes for adolescents in terms of educational achievement, peer and social relations, and family relations, which hamper their potential to go on a productive life. Objectives: To translate the Parent/ Teacher Disruptive Behaviour Disorder (P/T DBD) Rating Scale (Pelham et al, 1992) to the Sinhalese language and to assess the construct validity of the translated version among adolescents aged 11 to 17 years. **Method:** The Translation / back translation method was used to translate the English DBD Rating Scale into Sinhalese. This scale is a multi-dimensional scale covering Diagnostic and Statistical Manual for Mental Disorders (DSM) 4th version criteria for the diagnosis of attention deficit hyperactivity disorder (ADHD), Oppositional Defiant Disorder (ODD) and Conduct Disorder (CD). Primary caregivers of adolescents aged 11 to 17 living in the medical officer of health area of Hambantota were introduced to the P/T DBD Rating Scale –Sinhala. Factor analysis was carried out using SPSS version 20.0. **Results/ conclusions:** Four-factor extractions accounted for 36.8% of the variance, whereas 12-factor extractions explained 64% of the variance in the data set. Maximum variance was explained by Factor 1 consisted of all the items in ADHD- ADHD-Hyperactivity and ODD scales. All the items in the ADHD- Inattention sub-scale were loaded into Factor 2, which accounted for 6.4% of the variance of the total sample. Items in the CD subscale were loaded into Factors 3 and 4, which altogether accounted for 9.9% variance of the total data set.

Keywords: *Disruptive behavior, ADHD, ODD, CD*

INTRODUCTION

Disruptive Behavior Disorders (DBD) is characterized as “persistent failure to control behavior appropriately within socially defined rules”. According to Goodman et al, DBD is often persistent and costly to manage and does not carry a good prognosis in most situations. (1).
Many researchers have identified academic underachievement (2), peer relationship problems (3) (4) (5) (6) and aggression as adverse implications of DBD among children & adolescents. Furthermore, research indicates that

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CD symptoms are the most reliable indicator of future antisocial behavior (7). Therefore, many researches have highlighted the fact that early identification and management is much important to prevent these adverse outcomes (8).
Most cases of DBD are socially determined and the management is based on behavior management at school or community level by local mental health professionals together with other agencies such as social services education department and voluntary agencies. Only a minority of cases need referral to specialized mental care (1). This emphasizes the need for identification of adolescents at risk of DBD in the community setting through appropriate screening methods.

METHODOLOGY

The definition given by the 'American Psychiatric Association' (APA) under the 'Diagnostic and Statistical Manual' of Mental Disorders Forth edition (DSM-IV) (9) was decided to take as the working definition for this component of the research after an extensive literature search and obtaining the consensus of an expert panel. Accordingly, DBD was considered as a spectrum of behavioral disorders inclusive of 'attention deficit hyperactivity disorder' (ADHD), 'Oppositional Defiant Disorder' (ODD) and 'Conduct Disorder' (CD).

This definition had been used by many researchers in the USA, Europe and South East Asia in their research in DBD and behavioral disorders (10) (11) (12). In this definition ADHD, ODD and CD is considered as subtypes of DBD.

The operational definition for each entity of DBD were laid down as described by the DSM-IV is illustrated in Figure 1.

Selection of a suitable study instrument

An extensive literature search was carried out by the PI (Principal Investigator) and 3 generic tools (13) (14) (15) and 4 specific tools (16) (17) (18) (19) were identified. Out of seven tools the expert panel consented to use P/T DBD Rating Scale-Pelham for this study due to the fact that it is developed as an interviewer administered tool, contains 45 items representing DSM IV criteria for the diagnosis of all three sub-types of DBD and is developed to be used for both teacher and parent respondents. The DSM IV and 'International Classification of Diseases' – 10 (ICD-10, WHO) both describe, symptoms of DBD especially ADHD need to be present at home and other settings. Furthermore, the interpretation of the scale is based on the scoring of items representing each sub-type of DBD separately (16). It had been translated and validated for use in an Asian country (10).

Standard method of translation back translation system was used to adopt the tool into Sinhala language.

Assessment of Construct of the P/T DBD Rating Scale –Sinhala

As the P/T DBD Rating Scale –Sinhala is a multi-dimensional instrument investigator applied factor analysis to assess its construct in terms of a smaller number of underlying factors.

Factor analysis has been used in research to explore many aspects of questionnaire development.

1 To construct questionnaires to measure an underlying variable (20)
2 To investigate the factor structure in psychological tests i.e. to know "what factors account for the variance in a measure" (20)
3 To verify validation by conducting a factorization of the test using the most recognized marker variable (21)
4 To confirm multidimensionality of the scale by examining the factor structure (22)
5 To evaluate if the items in a multidimensional scale are correctly allocated to their respective subscales, based on their factor loadings (23)

The Sinhala version of the P/T DBD Rating Scale underwent exploratory factor analysis using orthogonal varimax rotation to evaluate if the items in the multidimensional scale are correctly categorized into their respective subscales that represent various subtypes of DBD, based on their factor loadings, factorial validity, alpha reliability, correlations, and item-total correlations.

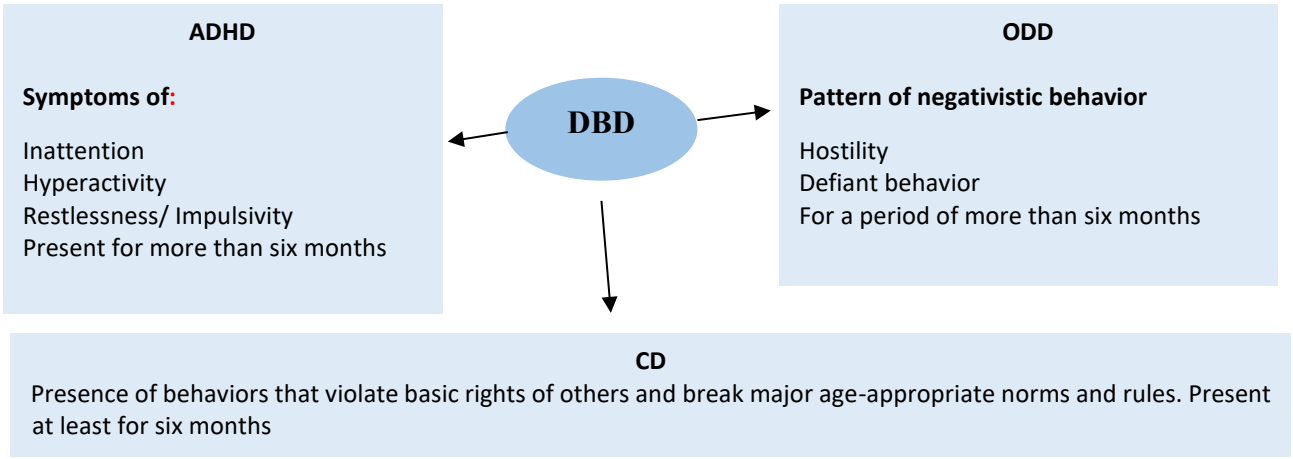

Figure 3: Operationalization of sub types of DBD

Data collection for factor analysis was carried out in Hambantota medical officer of health (MOH) area, Hambantota district.

Sample size for factor analysis

Many researchers in Sri Lanka and overseas had been used subject to variable ratio of 5 to calculate the sample size for studies on factor analysis (24) (25). Accordingly, a sample of 225 primary care giver (PCG) of adolescents aged 11 to 17 years was recruited for this component of study.

Selection and recruitment of the study sample

All the adolescents aged 11 to 17 living in MOH area Hambantota were listed out with the help of the PHMs and out of the list a randomly selected 225 adolescents were enrolled for this component by using random number tables. PCG of the selected adolescent was the informant to introduce the P/T DBD Rating Scale –Sinhala.

Definition and selection of PCG

PCG was identified as "the person who was most responsible for the day-to-day responsibilities of providing care to the adolescent" (25).

Collection of data for the factor analysis

P/T DBD Rating Scale –Sinhala was administered to the selected adolescents as an interviewer administer instrument by the principal investigator after taking the written consent.

Data analysis

Factor analysis was carried out using SPSS version 20.0.

RESULTS

The item analysis also carried out on the same sample. The following aspects of the P/T DBD Rating Scale –Sinhala were analyzed for the 4 subscales separately.

1. Inter-item correlation
2. Cronbach's alpha
3. Item total correlation within the sub type scales

Inter item correlation

Inter item correlation measures the homogeneity of a composite scale. It means that if all items in a composite scale or a sub-scale measure the same attribute, the summation of items make a sense. However, when the items assess different attributes, it is not logical to add up those items to form single total score. As described, the P/T DBD Rating Scale also have sub-scales according to the sub-types of DBD and the composite value for each scale determine the presence of the specific sub-type of DBD. Therefore, it is desirable to explore the inter item correlation in each –subscale of the instrument namely,

1. ADHD- Inattentive type
2. ADHD- Hyperactivity /impulsive type
3. ODD
4. CD

According to modern thinking each item in the subscale should be moderately correlated (0.20 - 0.80) to each other and each should correlate with the total score of the subscale (23). The inter-item correlations for each subscale were assessed separately and were found to be between 0.2 and 0.8 in majority of the cases. Three of the subscales had mean inter-item correlations above 0.4. However, in Cd subscale it was 0.166, reflecting a low correlation between the items.

Cronbach's alpha

This also a method of appraising internal consistency of a scale in which alpha correlation calculates by elimination one item at a time. This allows identifying items which contribute for less reliability of the scale (23).

The summary of mean inter-item correlations and Cronbach's alpha for the 4 subtypes of the final P/T DBD Rating Scale –Sinhala is given in Table 1.

Table 1: The mean inter-item correlations and Cronbach's alpha for the 4 sub-types of the final P/T DBD Rating Scale –Sinhala

Scale	No. of items	Mean inter-item correlations	Cronbach's alpha
ADHD-	9	0.593	0.84
ADHD-	9	0.471	0.76
ODD	8	0.40	0.74
CD	15	0.166	0.64
Total scale	45	0.157	0.90

All subscales except CD subscale showed average inter-item correlations in the moderate range and good internal consistency. Text books and experts suggest that an accepted value for Cronbach's alpha is between 0.7 and 0.9 (23). Except CD sub scale other 3 subscales showed an acceptable Cronbach's alpha. According to the item total statistics deleting items was not appearing to increase the Cronbach's of the CD sub scale. The number of items (more than 14) is also adequate to have a reasonable internal consistency (23).

Both inter item correlation and Cronbach's alpha were low in CD subscale reflects the poor homogeneity. This reflects that all items in the scale do not measure the same attribute. Theoretically sub scale CD measures 4 kinds of attributes related to CD (ICD-10, DSM-IV). Those are,

1. Aggression to people and animal- 7 items
2. Destruction of property- 2 items
3. Deceitfulness of theft- 3 items
4. Serious violation of rules- 3items

Hence the items in the CD subscale do not measure a single variable of DBD and therefore it is a heterogeneous sub-scale. According to Abrahamson, if the items of the scale are heterogeneous that can under-estimate the reliability.

Factor Analysis

Factor analysis (FA) of the P/T DBD Rating Scale – Sinhala was carried out to explore the factor structure of the scale and thereby to assess the construct validity. It also was helpful to assess whether the items in a multidimensional scale are collectively uploaded to the respective subscales, by means of their factor loadings (23).

A Principal Component Analysis (PCA) with varimax rotation was conducted on 42 items of P/T DBD Rating Scale –Sinhala excluding 3 items which were not accounting for the diagnosis of DBD.

Appropriateness of factor analysis

The following two tests were used to determine the appropriateness of factor analysis.

1. Kaiser-Meyer-Olkin (KMO) test
2. Bartlett's Test of Sphericity

KMO test measures the adequacy of the sample and Bartlett's Test of Sphericity test the null hypothesis that the original correlation matrix is an identity matrix. Table 2 illustrates the results of adequacy statistics for factor analysis.

According to Kaiser (26) KMO value closer to 1 is ideal and in this research the KMO value was 0.797 which is considered as average. Hence, the factor analysis is plausible. Furthermore, the significance

of the Bartlett's test (p=<0.001) showed the correlation matrix is significantly different from identity matrix and confirm that the data set is suitable factor analysis. (Table 2).

Table 2: Results of Adequacy Statistics for FA

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.797
Bartlett's Test of Sphericity	Approx. Chi-Square	3691.559
	Df	820
	Sig.	.000

Principal Component Analysis (PCA)

PCA was performed to explore the factor structure of the instrument. The analysis extracted 12 factors based on the following criteria (Table 3.).

1. The root criterion of selecting the factors with "eigenvalues" >1
2. The "Scree test" used to examine a plot of eigenvalues. The factors with eigenvalues by the elbow (in the sharp decent part) of the plot are retained.

Those 12 factors explained the 64% of the total variance (Table 3.). According to Kline (21), the eigenvalues of all the components in the matrix must be zero or positive. In the present study all the eigenvalues were positive thus confirming the suitability to be factored.

These factors were rotated using "Varimax rotation with Kaiser Normalization". According to the Kline21 factor loading of .3 or larger is regarded as significant. Table 3.4 illustrates the factor loading (>0.3) of individual items of P/T DBD Rating Scale-Sinhala after varimax rotation. The item list was rearranged for better understanding after rotation.

In the total sample maximum variance explained by the factor 1 was 20.5%. The factor 1 consisted of all items of ADHD- Inattention scale. Factor 2 and 3 accounted for 11.5% of total variance, were loaded with both ADHD- Hyperactivity and ODD items except one item from CD scale. Extracted factors of 4, 6,7,9,11,12 was accounted for the 21% of variance was loaded with items of CD subscale. None of the other three factors extracted in the analysis contained more than 3 items from one sub-scale.

Prior knowledge in clinical literature on conceptualization of DBD and formers studies carried out by Loona et al on a sample of general population aged 9 to 13 years and Pelham et al on a clinical sample extracted 4 factors >than eigenvalue 1 (10) (16). Therefore, the PCA was run by limiting the factors to be extracted to 4 (Table 3).

Table 3 illustrates the factor loading of individual items considering the accepted salient loading as 0.3 after PCA with Varimax rotation limiting to 4 factor extractions. The item list was rearranged for better understanding after rotation. The factors in this four-factor model can be named as,

Factor 1- Hyperactivity/ Impulsivity and ODD
Factor 2- Inattention
Factor 3- CD- moderate violation of rules
Factor 4- CD- severe violation of rules

Four factor extractions accounted for 36.8% of the variance whereas 12 factor extractions explained 64% of the variance in the data set. All the items in ADHD- Hyperactivity and ODD scale was loaded into Factor 1 with maximum variance.

All the items in the ADHD- Inattention sub-scale were loaded in to Factor 2 representing 6.4% of variance of the total sample.

Items in the CD subscale were loaded in to Factor 3 and 4 which altogether accounted for 9.9% variance of the total data set.

One item from the ADHD- Hyperactivity sub-scale and 4 items from the CD sub-scale did not have shown significant loading in the analysis.

Interpretation

However, it was visible that items attributing to ADHD Hyperactivity/ Impulsivity and ODD were loaded to a single factor. Text books and experts in the field of clinical psychiatry described the fact that symptoms of ODD and ADHD Hyperactivity disorders co-morbid and co-exist (1).

Table 3: Factor Structure of P/T DBD rating Scale- Sinhala Limited to 4 factors extraction

	1	2	3	4
Talks excessively	.625			
Runs about or climbs inappropriately	.616			
Intrudes on others	.600			
Difficulty awaiting turn	.534			
Fidgets with hands & feet	**.534**	.350		
Acts as if "driven by a motor"	**.414**	.427		
Blurts out answers	.405	.314		
Leaves seat in classroom	.345			
Difficulty in engaging leisure activity quietly				
Argues with adults	.646		.354	
Losses temper	.611			
Angry & resentful	.546			
Deliberately annoy people	.392			
Touchy & easily annoyed by others	.479			
Defies or refuses to comply with rules	.471			
Spiteful or vindictive	.471			
Blame other for his/her mistakes or misbehaviors	.465			
Difficulty sustaining attention in tasks	.339	**.436**		
Forgetful in daily activities		**.770**		
Does not follow through on instructions		**.742**		
Difficulty in organizing tasks or activities		**.740**		
Fails to give close attention		**.721**		
Avoid tasks that require sustained mental efforts		**.709**		
Does not seem to listen when spoken directly		**.563**		
Losses things necessary for tasks & activities		**.518**		
Distracted by external stimuli		**.436**		
Bullies, threatens, or intimidates others			.680	
Has stolen items without confronting the victim			.666	
Physically cruel to people			.602	
Stays out at night despite parental prohibitions			**.581**	
Initiates physical fights with other than household	.488		**.316**	
Lies to obtain goods or favors	.437	.378	**.463**	
Deliberately destroyed others property (not setting fire)				
Broken in to someone else's home or car				.766
Has stolen while confronting a victim				.486
Absentee from school	.357			**.459**
Used a weapon				.419
Physically cruel to animals				.313
Deliberately engaged in fire setting				
Run away from home				
Forced someone into sexual activity				
Eigenvalues before rotation	20.5	6.4	5.3	4.6
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 6 iterations.				

One of the purposes of doing factor analysis was to compere the similarities of factorial loading of new scale with the original. The factor analysis on the original version of Pelham P/T rating scale had been carried out one a sample aged 5 to 19 years attending to special education classes due to behavioural disorders and learning disabilities without mental retardation using the same factor analysis methodology as the present study: PCA with Varimax rotation. Major limitation of the said study in order to compare with the finding of the present study is that in Pelham's study PCA had

been carried out for selected items only due to non-response to some items16.

DISCUSSION

Selection translation and validation of P/T DBD Rating Scale

The selection of the instrument was based on the conceptual definition of the DBD. There were many controversies on this conceptual definition. The ICD-10 and the DSM-IV which are the two main diagnostic standards used internationally have differences in conceptualizing domains of DBD. However, the consensus of the panel of experts was to use DSM-IV in the conceptual definition and in the formulation of a working definition of DBD in this research. Based on that, the advice of the expert panel was to use the P/T DBD Rating Scale developed by Pelham. The P/T DBD Rating Scale by Pelham is a check list based on the diagnostic criteria of DBD.

Factor analysis

The study setting selected for factor analysis was a district in the same province with a similar socio-economic back ground to ensure the generalizability. The same age group was selected for study population.

According to Kline (1994) in exploratory factor analysis it is best to use a heterogeneous sample. The factor analysis of the original version of P/T DBD Rating Scale was carried out among a referral sample of adolescents which is more homogeneous (16). However, the factor structure was analyzed on the Urdu translation using a general sample (10). Therefore, with the guidance of technical supervisors and the experts' opinion a representative sample from the general population was drawn to perform PCA.

There was a controversy on the size of the sample for factor analysis. Some schools of thoughts suggested even 100 subjects were quite sufficient21. However, it was highlighted that the rule is that "more subjects the better". Many researchers have used the rule of five subjects per item as the sample size (26) (27) (28). The same criterion was used in the present study as well.

Literature describes several hypothetical constructs of DBD used by many researches. One such construct explored the five-factor model representing Inattention, Hyperactivity, Impulsivity, OOD and CD as components (29). The factor analysis of the original version of P/T DBD Rating Scale had reported a four-factor model representing Inattention, Hyperactivity/ Impulsivity, ODD and CD. In his model Impulsivity items were heavily loaded on ODD factor as well as hyperactivity factor suggesting impulsivity may be a common element in both hyperactivity and ODD (16). The Urdu version of P/T DBD Rating Scale (10) and the Italian version reported the similar four factor model (30).

The results of factor analysis in the present study obtained a 12-factor model at the initial step and when restricted to a four factor model items representing Hyperactivity/ Impulsivity and ODD were loaded highly in to one factor. In par with the original factor structure, items assessing inattention were loaded separately as a single factor.

The translated version of health measurement tools does not always show the similar factor structure of the original due to the differences in cultural setting and various other reasons. This had been demonstrated in the Sinhala translation of SDQ (31) and Sinhala translation of Edinburgh Post-Partum Depression Scale as well (32). actitioners to check the details of medicines.

CONCLUSION

The translated and valid P/T DBD Rating Scale-Sinhala is a valid and reliable instrument to identify DBD among adolescent aged 11 to 17 years. The instrument is compatible with the accepted construct of DBD and is a check list of International Criteria of DBD.

RECOMMENDATIONS

The P/T DBD Rating Scale- Sinhala recommended to be used to identify DBD among adolescents aged 11 to 17 years in community setting and clinical setting by MO/Mental Health, MOH and other community level stake holders with medical background, in other Districts of Sri Lanka.

Author declaration

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Department of Health, Southern province
Medical officer of Health Hambantota.

Authors' contributions:
Development of Methodology, Data Collection & Analysis: BCM; Planning and Designing the Research Protocol: PVDS; Methodological Expertise in Research Development: PF; Technical Expertise in Subject Area: RR; Coding, Manuscript Writing and Revision: BCM, PVDS, PF, RR; Writing – Original Draft and Evaluation of Revisions: BCM, PF

Conflicts of interest:
The authors declare that there is no financial or non-financial conflict of interest.
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Ethics statement:
Ethical clearance was obtained from the faculty of medicine; University of Ruhuna. Anonymity was maintained throughout the study. The participants were informed that they are free to withdraw from the study at any time and voluntary participation ensured. The confidentiality of information was assured by the PI and only to publish in scientific publications as summarized data. Informed consent was obtained prior to data collection.

Statement on data availability:
Data of this study is available with the principal investigator and can be handed over on request. .

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