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An Arabic version of Barkley Deficits in Executive Functioning Scale - Children and Adolescents (BDEFS-CA): translation and validation study

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Abstract

Background While executive dysfunctions are present abundantly in children with psychiatric and developmental disorders, unfortunately, it is significantly underdiagnosed in Arab countries due to the lack of Arabic executive functions diagnostic scales. To our knowledge, there is no available Arabic rating scale for assessing executive functions in children and adolescents till this moment except for BRIEF-2 which excluded anyone with a mental, learning, developmental, or medical disorder constituting unfortunately 25% of the general population. Our paper describes the translation and validation of an Arabic version of the Barkley Deficits in Executive Functioning Scale - Children and Adolescents (BDEFS-CA) (long form). The translation was done using the forward-backward method and the study population for validation included 60 parents of children of age 6–13 years.

Results Reliability of the scale domains was evident in Arabic showing high internal consistency (Cronbach's alpha from 0.93 to 0.97 scores over the five domains). These values were close to the original English version which is 0.95 to 0.97.

Conclusion The reliability of the Arabic version of BDEFS-CA was adequate making it a valuable instrument for executive function assessment in Arabic children and adolescents.

Keywords Executive functions, ADHD, Learning disability, BDEFS-CA Arabic

Background

Executive functions are a multidimensional cognitive skill mediated by multiple brain regions specially in the prefrontal cortex [1].

Pribram was one of the first to adopt the word “executive.” Since then, at least 30 or more constructions have been grouped together under the general label “EF,” making it challenging to operationally define it.

Recently in 2013, Naglieri used a significant nationwide study of children to inform analysis of the behavioral components of executive function. He argued that executive functioning is the effectiveness with which people approach learning and how well challenges can be solved throughout nine fields (working memory, planning, self-monitoring, organization, initiation, attention flexibility, emotion management, and inhibitory control) [2].

While executive dysfunctions are present abundantly in children with psychiatric and developmental disorders, unfortunately, it is significantly underdiagnosed in Arab countries due to the lack of Arabic executive functions diagnostic scales. Although the Arabic language is one of the most commonly used languages worldwide, to our knowledge, there is no available Arabic rating scale for

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assessing EF in children and adolescents till this moment except for BRIEF-2 which excluded anyone with a mental, learning, developmental, or medical disorder constituting unfortunately 25% of the general population.

Assessment of EF is difficult. Since most tasks require a combination of different EF including cognitive flexibility and working memory, attempts to isolate EF components in performing specific tasks are very hard [3]. Moreover, results from different tasks aimed at measuring the same skill were inconsistent. Repeated application of the same task does not show the same performance, as EF is often applied in new situations and tasks may only be new when first managed [4].

Performance-based tests

These are designed to measure specific domains of EF, and they are administered under specifically structured settings. Their ecological validity is questionable due to the gap between the requested performance in the structured test environment and the daily life demands [5].

Recent metanalysis shows that there are currently around 164 different lab-based tests used to measure different executive functions [6]. Most of them can rarely measure EF purely as they are mostly combined with different non-EF cognitive domains [7].

Using those lab-based tests can only evaluate EF at lower levels called cold cognition with only 10% related to real-life performance [8], while on the other hand, EF rating scales have much higher sensitivity and validity.

The rating scales

The other assessment approaches evaluate the executive functions in natural contexts by integrating data from different sources as parents and teachers about the daily life of the child so that they can capture a broader range of behaviors over different durations and contexts [5].

Executive function rating scales which are supported with high evidence are the Executive Function Index that can be used in adults only, BDEFS-CA, Dysexecutive Questionnaire, and the Behavior Rating Inventory of Executive Function (BRIEF) that can be used in both adults, children, and adolescents, while the Delis Rating of Executive Function, Childhood Executive Functioning Inventory, and the Behavior Assessment System for Children (BASC) are only used in children [9].

The BDEFS-CA long form contains 70 questions developed by Professor Barkley and was mainly based on an executive functions theory and its five main domains. It is designed to evaluate the major components of the higher strategic level of executive functioning that is more closely affecting daily life activities of children ages 6–17 as reported by their parents and taking 20 to 30 min to apply.

The long form of the BDEFS-CA is scored by summing the scores of the five main domains including the time management EF, problem-solving EF, response inhibition EF, self-motivation EF, and emotion regulation EF. Items are answered on a 4-point scale ranging from 1 (never or rarely) to 4 (very often). Items in each subscale are then summed to get the raw score for that subscale. The five subscale scores are combined to create a total EF score [10].

The results can be interpreted using different approaches here in this study; we used the percentile scores according to sex group and age group with charts included in the manual.

The reliability of BDEFS-CA includes high internal consistency from 0.95 to 0.97 scores over the five domains and test-retest reliability from 0.73 to 0.82 over a 3–5-week interval, and the validity of the scale domains was significant in multiple analyses with other rating scales of EF [11].

The selection of the assessment tool for EF should depend on the levels of EF targeted by the assessment. If the target is the lowest basic EF, then lab-based tests are preferred while if it is the higher complex long-term EF to be targeted then the rating scales as BDEFS-CA are preferable (Naglieri & Goldstein, 2014).

Aim of the present study

The aim of the present study is to develop an Arabic version of the Barkley Deficits in Executive Functioning Scale - Children and Adolescents (BDEFS-CA) and evaluate its validity and reliability.

Procedure

- Original author approval was taken from Professor Russel Barkley for the translation and use of BDEFS-CA in this research.
- The Ethical Committee of Alexandria University approved the study.

Translation

The initial forward translation from the English language to the Arabic language was made by two independent translators followed by Backward translation as the scale was independently back-translated to ensure the accuracy of the translation by another two independent translators.

The original and the backward-translated versions of BDEFS-CA were compared to confirm that the original meaning was constant with no change. This process showed a near identical similarity

between the original English version and the translated English one with few insignificant differences not affecting the meanings and so no changes were done.

Pilot testing for validation and reliability

Participants

This Egyptian study population for the Arabic version of BDEFS-CA included 60 participants (parents of children of age 6–13 years and of both genders). Their first language was Arabic, they were all drug-naive, and they all gave an informed consent.

The participants were classified into four different groups based on their diagnoses in order to test the discriminant validity between normal children and those with developmental disorders such as ADHD and SLD, each contained 15 participants; the first group included attention deficit and hyperactivity disorder (ADHD) only, the second group included the specific learning disorder (SLD) only, and the third group included the combined ADHD and SLD while the fourth was the control group of matching gender, age, and education.

- The participants were recruited from the child and adolescent clinic at Alexandria University Hospital.
- Informed consent and assents were taken from all the participants, followed by a structured psychiatric interview, Stanford Binet Scale, to ensure the average IQ and exclude intellectually disabled children.

All of the 60 participants completed the Arabic *BDEFS-CA* long form and after an average of 4 weeks, each of them completed a second Arabic *BDEFS-CA* long form.

Statistical analysis of the data

The Cronbach's alpha coefficient was used for evaluating the internal consistency.

The intra-class correlation coefficient (SPSS version 17, SPSS Inc.) was used to measure the test-retest reliability.

Results

Reliability for Barkley Scale for Executive Functions

Cronbach's alpha	No. of items	
0.955	13	القدرة على ادارة الوقت
0.939	14	القدرة على التنظيم الذاتى و حل المشاكل
0.952	13	القدرة على التحكم بالنفس
0.947	14	القدرة على تحقيق الذات
0.973	16	الثبات الانفعالى
0.978	70	Overall

Interrater reliability

Consistency of the Arabic BDEFSCA rating between different evaluators was measured by studying the discrepancies between mothers' ratings and fathers' ratings for their child EF. There was a significant agreement between the 2 groups with few discrepancies as evidenced by a correlation coefficient of 0.9. and Kappa coefficient 0.6.

Discriminant validity

The results of executive dysfunction of the first three groups were compared with the fourth control group of normal children. Multivariate analysis showed that there was a significant difference between the performance of clinical and normal groups in the subscales and the total EF score of BDEFS-CA. All the differences were at the $p < 0.001$ level (Table 1).

Discussion

Reliability of the scale domains is evident in Arabic showing high internal consistency (Cronbach's alpha from 0.93 to 0.97 scores over the five domains). These values are close to the English version mentioned earlier from 0.95 to 0.97 [11].

The test-retest reliability assessment was measured using the intra-correlation coefficient, showing a high reliability of the scale over a 4-week interval.

Furthermore, the Arabic BDEFS-CA showed higher internal consistency, reliability, and stability than the Psychometric Properties of the Arabic BRIEF-2 which had internal consistency in the range of (α 's = 0.76–0.97) (Alsaedi & Carrington, [12]).

Table 1 Comparison between the different studied groups according to different scores

	Combined (n=15)	Learning (n=15)	ADHD (n=15)	Control (n=15)	F	P
Score time management	42.93 [#] ± 6.36	42.20 [#] ± 8.66	41.0 [#] ± 6.95	22.67 ± 5.41	29.374*	<0.001*
Score problem solving	37.07 [#] ± 4.62	40.60 [#] ± 5.57	35.80 [#] ± 7.46	18.60 ± 2.95	49.652*	<0.001*
Score SEL restraint	44.73 [#] ± 4.30	25.73 ± 6.81	43.20 [#] ± 2.43	21.60 ± 5.67	82.026*	<0.001*
Score self-motivation	39.27 [#] ± 9.95	32.87 [#] ± 11.13	37.67 [#] ± 8.55	19.87 ± 3.40	15.106*	<0.001*
Score emotion regulation	51.40 [#] ± 10.70	42.07 [#] ± 13.45	54.80 [#] ± 7.88	24.80 ± 5.63	27.840*	<0.001*

F: F for One way ANOVA test, Pairwise comparison bet. each 2 groups was done using Post Hoc Test (Tukey)

p: P value for comparing between the different studied groups

*: Statistically significant at $p \leq 0.05$

#:Sig. with Control

Implications for practice

Comprehensive executive function assessment should be done for children presented with relevant cognitive, emotional, or behavioral problems using a valid rating scale for EF besides the lab-based tests for capturing the whole degree of executive dysfunction correctly.

Conclusions

Barkley Deficits in Executive Functioning Scale - Children and Adolescents (BDEFS-CA) is recommended as a feasible rating scale with tested reliability in the Arabic language for testing executive functions overcoming the previously mentioned limitations of lab-based tests of EF besides it outperforms the other EF rating scales as the Dysexecutive Questionnaire for Children (DEX) and Childhood Executive Functioning Inventory (CHEXI) scales do not have population norms for clinical use while although the BRIEF scale has population norms, but they excluded anyone with a mental, learning, developmental, or medical disorder and that is 25% of the general population.

Abbreviations

ADHD	Attention deficit hyperactivity disorder
BASC	Behavior Assessment System for Children
BDEFS-CA	Barkley Deficits in Executive Functions Scale - Child and Adolescent
BRIEF	Behavior Rating Inventory of Executive Functioning
CHEXI	Child Executive Function Inventory
DEX	Dysexecutive Questionnaire
EF	Executive functions
IQ	Intelligence quotient
LD	Learning disabilities
SLD	Specific learning disabilities

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Authors' contributions

All three authors contributed to the conceptualization of the study, translation of the scale, and recruitment of the participants. Additionally, A. M. was responsible for the scale administration and statistical analysis of the data besides writing the main manuscript while S.A and H.E were responsible for reviewing the manuscript. The author(s) read and approved the final manuscript.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Declarations

Ethics approval and consent to participate

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Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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References

- Turnbull O (2002) The executive brain: frontal lobes and the civilized mind. *Neuropsychanalysis* 4(2):206–208. <https://doi.org/10.1080/15294145.2002.10773402>
- Fenwick M, McCrimmon AW (2015) Test review: comprehensive executive function inventory by J. A. Naglieri and S. Goldstein. *Can J Sch Psychol* 30(1):64–69. <https://doi.org/10.1177/0829573514546318>
- Miyake A, Friedman NP, Emerson MJ, Witzki AH, Howerter A, Wager TD (2000) The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: a latent variable analysis. *Cog Psychol* 41(1):49–100. <https://doi.org/10.1006/cogp.1999.0734>
- Serpell ZN, Esposito AG (2016) Development of executive functions. *Policy Insights From the. Behav and Brain Sci* 3(2):203–210. <https://doi.org/10.1177/2372732216654718>
- Miranda A, Colomer C, Mercader J, Fernández MI, Presentación MJ (2015) Performance-based tests versus behavioral ratings in the assessment of executive functioning in preschoolers: associations with ADHD symptoms and reading achievement. *Frontiers in Psychology* 6:545. <https://doi.org/10.3389/fpsyg.2015.00545>
- Weyandt LL, Willis WG, Swentosky A, Wilson K, Janusis GM, Chung HJ, Turcotte K, Marshall S (2013) A review of the use of executive function tasks in externalizing and internalizing disorders. In: Goldstein S, Naglieri JA (eds) *Handbook of executive functioning*. Springer, New York, NY, pp 69–87. https://doi.org/10.1007/978-1-4614-8106-5_5
- Castellanos FX, Sonuga-Barke EJ, Milham MP, Tannock R (2006, March) Characterizing cognition in ADHD: beyond executive dysfunction. *Trends in Cogn Sci* 10(3):117–123. <https://doi.org/10.1016/j.tics.2006.01.011>
- Bental B, Tirosh E (2007, May) The relationship between attention, executive functions and reading domain abilities in attention deficit hyperactivity disorder and reading disorder: a comparative study. *J Child Psychol and Psychiat* 48(5):455–463. <https://doi.org/10.1111/j.1469-7610.2006.01710.x>
- Duggan EC (2014) Assessing the behavioral aspects of executive functioning across the lifespan: review of rating scales and psychometric derivation of a screener for young adults
- Naglieri JA, Goldstein S (2014) Assessment of executive function using rating scales: psychometric considerations. In: Goldstein S, Naglieri JA (eds) *Handbook of executive functioning*. Springer Science, New York, NY, pp 159–170. https://doi.org/10.1007/978-1-4614-8106-5_10
- Mashhadi A, Maleki ZH, Hasani J, Rasoolzadeh Tabatabaei SK (2020) Psychometric properties of Persian version of the Barkley Deficits in Executive Functioning Scale—Children and Adolescents. *Applied Neuropsychol Child* 10(4):369–376. <https://doi.org/10.1080/21622965.2020.1726352>
- Alsaedi RH, Carrington S, Watters JJ (2020) Behavioral and neuropsychological evaluation of executive functions in children with autism spectrum disorder in the Gulf Region. *Brain Sci* 10(2):120. <https://doi.org/10.3390/brainsci10020120>

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