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Validation of the Arabic ADHD rating Scale-5 for adolescents in Saudi Arabia using structural equation modeling

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There is an increasing number of studies in the literature on the prevalence of attention-deficit/hyperactivity disorder (ADHD), indicating its high prevalence. This study sought to investigate the reliability of the ADHD Rating Scale-5 (ADHD-RS-5) for adolescents in Saudi Arabia as a valid screening tool for this age group. Furthermore, it aimed to calculate the cutoff score for screening for ADHD in the Saudi environment to provide a reliable tool that helps specialists assessing for ADHD among adolescents.This study applied a descriptive approach to verify the reliability of the ADHD-RS-5 in the Saudi environment. The sample consisted of 477 parents and 1284 teachers of Saudi and non-Saudi adolescents (aged 13 to below 20 years) residing in Riyadh, Makkah, and the Eastern Province. Both forms of the ADHD-RS-5 (home and school) were applied to the sample under supervision of the Saudi ADHD Society. Data were analyzed using IBM SPSS Statistics (version 26), JASP (version 0.18.3.0), and MedCalc statistical software (version 22.030).Confirmatory factor analysis results revealed acceptable goodness-of-fit indicators for the home and school forms of the ADHD-RS-5. Pearson's correlation coefficients for both forms were found to be positive and statistically significant ($p > 0.001$); the coefficient values ranged between 0.669 and 0.921 for the home form and between 0.795 and 0.954 for the school form. In addition, Cronbach's α coefficient values for inattention, hyperactivity, impairment, and the scale's total score for the home form were 0.919, 0.913, 0.952, and 0.952, respectively, while for the school form were 0.955, 0.944, 0.969, and 0.981, respectively. Cronbach's α coefficient values were close to the values of the McDonald's ω for the home form (0.920, 0.914, 0.953, and 0.965, respectively) and for the school form (0.955, 0.939, 0.968, and 0.977, respectively). These results indicate that the ADHD-RS-5, both home and school forms, and its subscales have good Cronbach's α and McDonald's ω coefficients. The findings also showed that the prevalence of ADHD among adolescents in Saudi Arabia was 5.03% based on the home form and 5.92% based on the school form. The cutoff value to screen for ADHD in adolescents in the Saudi environment for the home form was > 30, with a sensitivity of 91.67% (95% confidence level [CL] = 73–99), a specificity of 86.98% (95% CL = 83.5–89.9), and 81.29% accuracy. However, the cutoff score in the school form was > 28, with a sensitivity of 94.74% (CL = 81.1–98.5), a specificity of 89.65% (CL = 87.8–91.3), and 86.46% accuracy. The current findings suggest that the Arabic version of the ADHD-RS-5-AR has strong psychometric properties, with good indicators of internal consistency and reliability. This study provides valuable information for the national ADHD survey planned to be carried out in 2024–2025. It will also support the preventive efforts in Saudi Arabia and Saudi Vision 2030 in achieving its goals related to the quality of life and well-being of community members of all ages as well as the goals of sustainable development.

Keywords ADHD, Reliability, Validity, ADHD-RS-5-AR, Assessment, Inattention, Hyperactivity, Impulsivity, Adolescents, Saudi Arabia

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Adolescence is the most critical developmental stage individuals go through in life, during which they undergo comprehensive development in all aspects, transitioning from the stage of childhood to youth and adulthood. Adolescence, in general, is an age crisis because many factors in adolescents' personal and social development expose them to developmental problems and mental disorders, including attention-deficit/hyperactivity disorder (ADHD). Due to the increasing prevalence of adolescent mental problems, governments, societies, and mental health officials have given much attention to studying and treating these problems[1–4].

Attention-deficit/hyperactivity disorder is one of the behavioral disorders that appear in childhood and continue into adolescence and adulthood. It includes several attention deficit, impulsivity, and hyperactivity symptoms that affect the individual's normal development, especially those in the adolescent stage. Comprising apparent impairment in functioning in one or more aspects of daily life (work, school, home) and feelings of instability, hesitation, doubt, restlessness, and impulsivity, the adverse effects of ADHD extend to the individual's family, school, peers, and surrounding community[4–6]. Nikander[7] pointed out that the most common characteristic of adolescents with ADHD is poor concentration and attention, as they are more easily distracted, have a short attention span, cannot retain attention or focus during time-consuming tasks, and they ignore teacher instructions. Furthermore, as Al-Desouki[8] indicated, ADHD begins early, with symptoms appearing before the age of seven, and it affects approximately 3–5% of schoolchildren at enrollment, with a ratio of 5:1 between boys and girls. Also, the disorder tends to be chronic, as more than 50% of children who have the disorder continue to exhibit evidence of severe pathological symptoms through adolescence and adulthood, and a high percentage of students, up to 40%, face difficulties in the learning process and in gaining experience as a result of their inability to focus and pay attention. Alexander and his associates[9] found that ADHD is one of the most common disorders among children and adolescents.

Studies examining the prevalence of ADHD in Arab countries have reported varying rates. A meta-analysis, for instance, found the prevalence among school-aged children to be between 5.1% and 14.9% across Saudi Arabia, Egypt, Palestine, Oman, Qatar, and the United Arab Emirates[10]. Another systematic review, analyzing 26 articles, showed a broader range of 1.3–34.5% across a wider group of Arab nations, including Saudi Arabia, Lebanon, Jordan, and others[11]. While these reviews provide a general overview, the data specific to Saudi Arabia within them are sparse. This disparity may be attributed to the diagnostic criteria used and the populations sampled. Furthermore, demographic factors may cause situational variation in an adolescent's conduct or in how, for instance, parents may interpret and grade their adolescent's behavior[12]. The limited rating scales for ADHD available in Saudi Arabia are just translations of other rating scales, and their validity and reliability metrics have yet to be thoroughly investigated. Therefore, for accurate screening of ADHD, we need to begin using valid and trustworthy psychological rating scales.

Reported prevalence rates for ADHD show global variation, and they are significantly influenced by cultural and linguistic contexts. These factors can shape how symptoms are expressed, perceived, and reported, thereby impacting prevalence rates alongside methodological aspects such as the diagnostic criteria utilized (e.g., the DSM-5 and the International Classification of Diseases [ICD]), the characteristics of the assessed sample (e.g., home and school), and the perspectives of different informants (e.g., parent, teacher)[13]. Recognizing the profound impact of culture and language on ADHD manifestation necessitates the development and validation of assessment tools that are sensitive to these nuances[14]. Consequently, establishing the validity and reliability of ADHD screening instruments within specific cultural and linguistic groups, such as Arabic-speaking adolescents in Saudi Arabia, is crucial to ensure accurate and meaningful assessments.

Diagnosing ADHD in adolescents typically involves a comprehensive psychiatric evaluation, including a detailed assessment of symptoms and behavioral patterns aligned with DSM-5 criteria, alongside an evaluation of functional impairment and the exclusion of other potential contributing psychiatric conditions. To facilitate this multi-stage process, particularly in large-scale studies or initial clinical encounters within the Saudi Arabian context, brief yet reliable screening tools are essential for efficient identification of individuals who may require

more in-depth assessment. Thus, the availability of robust screening instruments is a critical precursor to the implementation of more extensive diagnostic procedures for ADHD in adolescents.

While various validated screening tools are available, the majority are aligned with the diagnostic criteria outlined in the DSM-5. Notably, the DSM-5 introduced revisions, including a reduction in the required number of symptoms (from six to five) and an extension of the age-of-onset criterion (from seven to twelve years). The ADHD Rating Scale-5 for Adolescents (ADHD-RS-5) stands out as a tool specifically designed to assess ADHD symptoms in adolescents based on these updated DSM-5 criteria. Unlike some broader scales, the ADHD-RS-5 concentrates solely on evaluating ADHD and has demonstrated its utility in both clinical and general population samples. It measures the frequency and intensity of ADHD symptoms and associated impairments through parent and teacher reports, utilizing a 4-point Likert scale with symptom descriptions adapted from the DSM-5[15]. Thus, raters assess the adolescent's behavior over the preceding six months as consistent with DSM-5 guidelines.

To contextualize this research, it is important to consider the current landscape of ADHD assessment tools available in the Arabic language and within Saudi Arabia specifically. Several rating scales have been adapted into Arabic to gather reports from parents and teachers regarding the frequency or severity of ADHD symptoms in both children and adolescents. These include the Conners' Teacher and Parent Rating Scales, the Swanson, Nolan, and Pelham Teacher and Parent Rating Scale (SNAP), and earlier versions of the ADHD Rating Scale[11]. These narrower-band scales have generally demonstrated acceptable to strong levels of reliability and validity for the purposes of screening and monitoring treatment outcomes[16].

Within Saudi Arabia, one of the more commonly utilized assessment tools for children has been the Vanderbilt ADHD Diagnostic Rating Scales, developed by the American Academy of Pediatrics (AAP). This comprehensive instrument provides forms for both parents (VADPRS) and teachers (VADTRS) to screen for ADHD symptoms across various settings[17]. More recently, the ADHD-RS-5 underwent validation in the Sudanese context for children and adolescents, demonstrating adequate reliability and validity for screening and treatment evaluation[18]. This highlights the growing interest in utilizing DSM-5–aligned tools in the region.

However, many of the currently available Arabic ADHD rating scales in Saudi Arabia and other Arabic-speaking countries were originally developed based on the criteria outlined in the DSM-IV. This presents at least two key limitations[19]. First, the DSM-5 introduced updated wording for ADHD symptoms specifically for evaluating adolescents, a nuance often lacking in scales primarily designed for children but subsequently used for older age groups. Second, the normative data associated with previously published Arabic ADHD rating scales, often collected over a decade ago based on DSM-IV criteria, may no longer be representative of current adolescent populations. Therefore, the development and validation of the Arabic version of the ADHD-RS-5 (ADHD-RS-5-AR), which incorporates DSM-5 symptom wording relevant to adolescents and aims to establish current normative data, is a crucial step towards providing developmentally appropriate and up-to-date assessment tools for this population in Saudi Arabia.

Considering the potential impact of cultural and linguistic factors on the presentation and reporting of ADHD symptoms in adolescents within Saudi Arabia, it is essential to validate assessment tools for this specific context. Therefore, this study aims to establish the reliability and validity (psychometric properties) of the Arabic adaptation of the ADHD-RS-5-AR. This validation is a crucial step towards ensuring accurate identification of ADHD in Saudi Arabian adolescents, which is necessary for the implementation of effective intervention strategies for this population.

Objectives

There is an increasing body of literature from around the world, including Saudi Arabia, reporting high prevalence rates for ADHD in adolescents. We noted that there is a significant scarcity of studies on codifying the ADHD-RS-5-AR for the Saudi environment and identifying its cutoff score for screening for ADHD among adolescents.

Because scales are among the tools for assessment and case studies to plan treatments and ensure their effectiveness in reducing ADHD symptoms and their adverse effects, preparing scales with good psychometric properties is necessary to help specialists screen and manage adolescents with ADHD. Therefore, this study attempted to validate the ADHD-RS-5-AR in the Saudi environment and identify the cutoff score for screening ADHD among adolescents.

Methods and participants

This preliminary cross-sectional study was drawn for a large national investigation project that aimed to understand the prevalence of ADHD among the Saudi population by applying a descriptive method. It was conducted on a general population sample of adolescents' parents and teachers in Saudi Arabia. Teams of assistants were recruited after being trained to apply the ADHD-RS-5-AR to collect data from the target sample for the study after they were informed that the inclusion criterion for participation was having an adolescent aged 3 to below 20 years at the time of the conduct of this study. Excluded from this study were adolescents with a prior diagnosis of a neurological or psychiatric disorder other than ADHD, and cases where data from both a parent and a teacher for the same adolescent were not available. The chosen age range encompasses adolescents typically in middle school (approximately 13 to 15 years old) and high school (approximately 16 to below 20 years old) in the Saudi Arabian education system. The data collection process was performed during the predefined period, between 23 January and 2 February, 2023.

The ADHD-RS-5-AR was applied to a sample of parents and teachers ($N = 1803$) during the study period in various settings, including schools and public places (Table 1). Of the 1803 participants, 42 cases were excluded for several reasons, including missing information from their ADHD-RS-5-AR forms, unwillingness to share data, and time stress, as well as meeting the aforementioned exclusion criteria.

Demographic characteristic	No. (%)
Gender	
Male	976 (55.42%)
Female	785 (44.58%)
Region	
Riyadh	982 (55.76%)
Makkah	519 (29.47%
Eastern Province	260 (14.77%)
Nationality	
Saudi	1543 (87.62%)
Non-Saudi	218 (12.38%)
Age of child (years)	
13–14	737 (41.85%)
15–16	467 (26.52%)
17–18	337 (19.14%)
19- <20	220 (12.49%)

Table 1. Demographic characteristics of participating parents and teachers.

Thus, the final sample consisted of two groups: parents ($N=477$) and teachers ($N=1284$) of adolescents spanning grades 7 to 12. The sample included Saudi ($n=1543$) and non-Saudi participants ($n=218$) living in Saudi Arabia (Riyadh, $n=982$; Makkah, $n=519$; and the Eastern province, $n=260$). All participants gave their informed consent before participating.

The ADHD-RS-5, developed by DuPaul et al.[20], was translated into Arabic and validated by the Saudi ADHD Society (https://adhd.org.sa/en/) and approved by the publisher. The scale has two forms: the home form and the school form; each consisting of two subscales: inattention and hyperactivity-impulsivity. Each subscale includes nine items. Parents and teachers respond to each item on a four-point Likert scale ranging from "Never or rarely" (0 points) to "Very often" (3 points). The rating scale also contains 12 items (6 per subscale) on relationships with family/teachers and peer, homework functioning, and self-esteem. Each of the 12 items is rated on a four-point Likert scale ranging from "No problem" (0) to "Severe problem" (3 points). According to the total score of the ADHD-RS-5 filled out by parents or teachers, we can screen for ADHD in adolescents.

Statistical analysis

Before analyzing the data collected from participants, we examined for completeness and whether there were any missing values; after that, statistical analysis was performed for both forms of the scale. Pearson correlation coefficients were computed to check the validity of the Arabic ADHD-RS-5-AR scales. Also, Cronbach's α and McDonald's ω coefficients were used to investigate the scale's reliability. Next, confirmatory factor analysis (CFA) was applied to verify the constructive validity of the ADHD-RS-5-AR with its two factors (attention deficit and hyperactivity-impulsivity) as well as the structural validity of the impairment items (positive hyperactivity, positive attention deficit, and impairment in functioning). The impairment in functioning factor consists of 6 subfactors: self-esteem, behavioral functioning, academic functioning, home functioning, peer relationships, and relationship with family/teacher. According to Byrne & Russon[21], the measurement model structural equation modeling is used to examine how well it reproduces the variance-covariance structure in the data. Hence, we use it to examine whether the models fit well or not. The root mean square error of approximation (RMSEA) measures a properly fitted model, and values from 0.05 to less than 0.08 are acceptable. The goodness-of-fit index (GFI) measures the fit between the proposed model and the observed covariance matrix. The GFI should range between 0 and 1, values of 0.90 or greater are generally accepted. Also, the mean, standard deviation, and percentile were used to calculate norms for the ADHD-RS-5-AR. Data were analyzed using the IBM SPSS Statistics (version 26), JASP (version 0.18.3.0), and MedCalc statistical software (version 22.030).

Results

Confirmatory factor analysis of the ADHD-RS-5

According to the theoretical literature on the ADHD-RS-5, a model of two factors was tested using CFA by the maximum likelihood method conducted by JASP (version 0.18.3.0) for the home and school forms. The results are presented in Table 2; Figs. 1 and 2.

The results of CFA, shown in Table 2; Figs. 1 and 2, indicate that the proposed measurement model for the home and school forms of the ADHD-RS-5-AR had acceptable goodness-of-fit indicators, as the chi square for the home form was 448.755 (degree of freedom [df] = 133, $p<0.001$), and for the school form was 1769.013 (df = 133, $p<0.001$). These results show that the two-factor model for inattention and hyperactivity (for both forms) matched the data collected from the adolescents' parents and teachers.

The findings in Figs 1 and 2 of the CFA present further evidence of the constructive validity of the scale's two forms. Factor loading coefficients for the home form were all acceptable (0.71–0.81, 0.66–0.81 for inattention and hyperactivity/impulsivity, respectively) (Fig 1), and for the school form were 0.76–0.89 and 0.68–0.88, respectively (Fig 2).

Index	Value	
	Home form	School form
Comparative Fit Index (CFI)	0.940	0.942
Tucker-Lewis Index (TLI)	0.930	0.924
Bentler-Bonett Normed Fit Index (NFI)	0.915	0.933
Parsimony Normed Fit Index (PNFI)	0.796	0.756
Bollen's Relative Fit Index (RFI)	0.903	0.938
Bollen's Incremental Fit Index (IFI)	0.939	0.940
Root mean square error of approximation (RMSEA)	0.07	0.046
Goodness of fit index (GFI)	0.918	0.901

Table 2. Fit indices for the ADHD-RS-5-AR (inattention and hyperactivity) home and school forms.

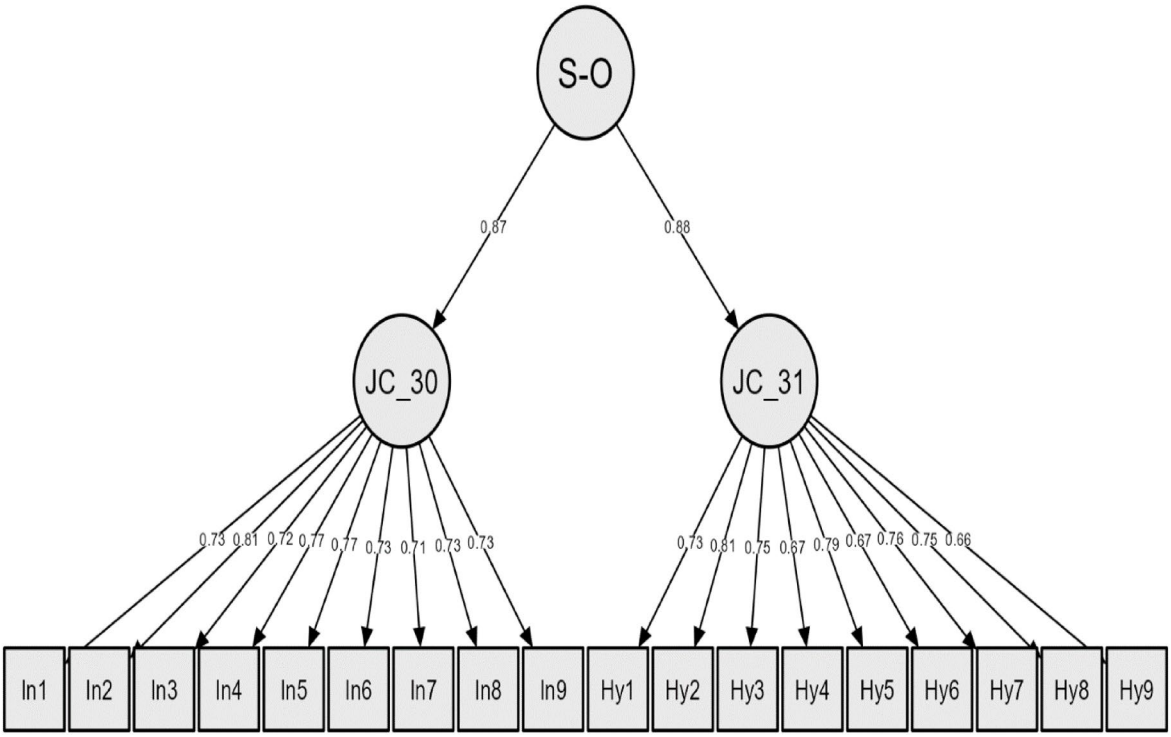

Fig. 1. Results of confirmatory analysis for the ADHD-RS-5-AR home form(S-O: ADHD Rating Scale, JC_30: Inattention, JC_31: Hyperactivity).

Also consistent with the theoretical literature on the ADHD-RS-5, a model of the six factors (family/teacher relationships, peer relationships, home functioning, academic functioning, behavioral functioning, and self-esteem) of impairment diagnosis containing 12 items was investigated for each form (home and school) by CFA with the maximum likelihood method (Table 3; Fig. 3 and 4).

The results presented in Table 3; Figs. 3 and 4 show that the proposed measurement model for the12 items of impairment had acceptable goodness-of-fit indices for both the home and school forms (chi square = 1625.493, df = 48, $p < 0.001$ for the home form; chi square = 493.758, df = 48, $p < 0.001$ for the school form). These findings indicate that the six-factor model of the 12 impairment items matched with the data collected from the adolescents' parents and teachers. Also, factor loading coefficients were acceptable; factor loadings for the home form were 0.89, 0.94, 0.89, 0.88, 0.95, and 0.97, however, for the school form were 0.82, 0.92, 0.95, 0.94, 0.89, and 0.86 for the six factors (teacher relationships, peer relationships, home functioning, academic functioning, behavioral functioning, and self-esteem) respectively.

Validity of the Arabic ADHD-RS-5-AR

The validity of each ADHD-RS-5-AR form was verified by calculating Pearson's correlation coefficient for each. The results are shown in Table 4; Figs. 5 and 6.

The findings shown in Table 4; Figs. 5 and 6 reveal that the correlation coefficients between the ADHD-RS-5-AR factors and the total score for the home and school forms were positive and statistically significant ($p > 0.001$). The values of the coefficients ranged between 0.669 and 0.921 for the home form and between 0.795

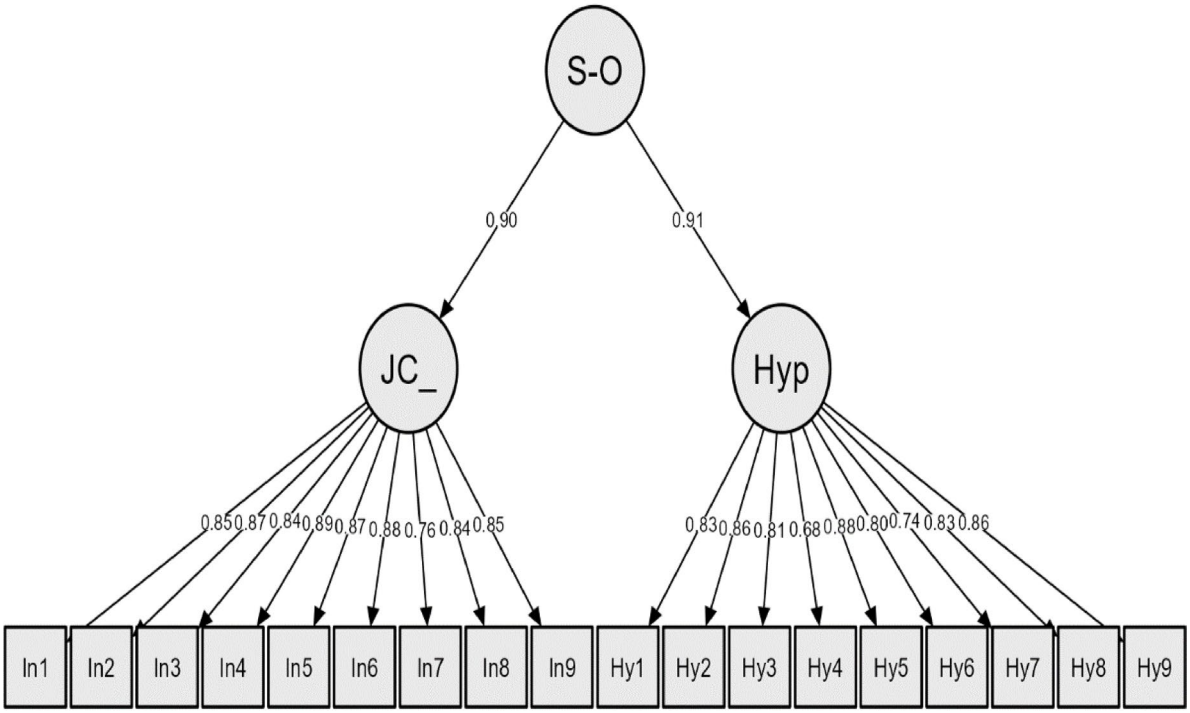

Fig. 2. Results of confirmatory analysis for the ADHD-RS-5-AR school form(S-O: ADHD Rating Scale, JC_: Inattention, Hyp: Hyperactivity).

Index	Value	
	Home form	School form
CFI	0.913	0.917
TLI	0.900	0.903
NFI	0.904	0.914
PNFI	0.658	0.665
RFI	0.900	0.882
IFI	0.913	0.917
RMSEA	0.061	0.07
GFI	0.902	0.910

Table 3. Fit indices for the 12 items of impairment for the home and school forms. Abbreviations: CFI, comparative fit index; TLI, Tucker-Lewis index; NFI, normed fit index; PNFI, Parsimony normed fit index; RFI, relative fit index; IFI, incremental fit index; RMSEA, root mean square error of approximation; GFI, goodness-of-fit index.

and 0.954 for the school form. These results indicate that the ADHD-RS-5-AR has good validity indicators for both the home and school forms.

Reliability analysis of the ADHD-RS-5-AR

The reliability of the ADHD-RS-5-AR was investigated by calculating Cronbach's α coefficients and McDonald's ω for both forms. The results are shown in Table 5.

The results presented in Table 5 demonstrate that the scale and its factors had good reliability coefficients for both the home and school forms. The Cronbach's α coefficient values for inattention, hyperactivity, impairment, and the scale's total score for the home form were 0.919, 0.913, 0.952, and 0.952, respectively, while for the school form they were 0.955, 0.944, 0.969, and 0.981, respectively. Cronbach's α coefficient values were close to the McDonald's ω values for the home form (0.920, 0.914, 0.953, and 0.965, respectively) and the school form (0.955, 0.939, 0.968, and 0.977, respectively). These results indicate that the ADHD-RS-5-AR and its subscales (for both the home and school forms) had good Cronbach's α and McDonald's ω coefficients.

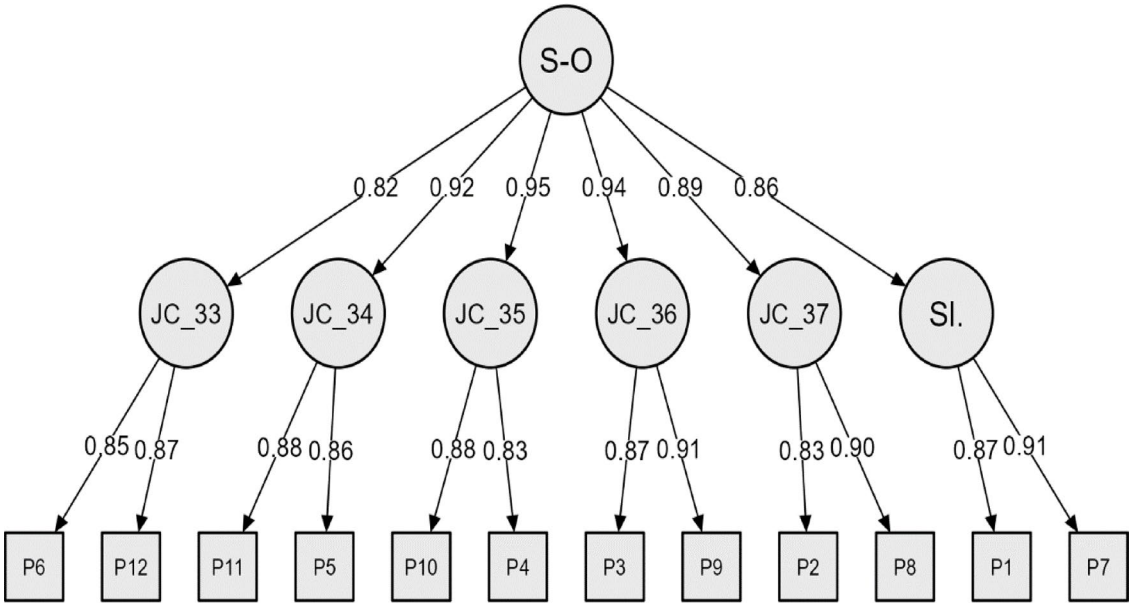

Fig. 3. Results of confirmatory analysis for the 12 items of impairment in the home form (S-O: Impairment, JC_33: family relation, JC-34: Peer relation, JC_35: Home function, JC_36: Academic function, JC_37: Behavior function, SI: Self-esteem).

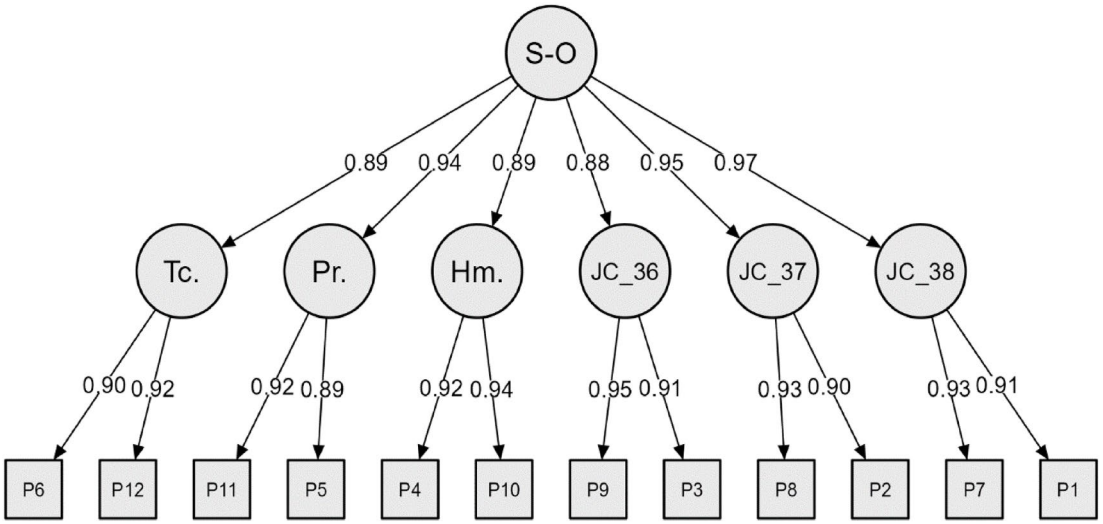

Fig. 4. Results of confirmatory analysis for the 12 items of impairment in the teachers' sample (S-O: Impairment, JC_33: family relation, JC-34: Peer relation, JC_35: Home function, JC_36: Academic function, JC_37: Behavior function, SI: Self-esteem).

	Ina		Hy		Imp		ADHD	
Variable	Home form	School form	Home form	School form	Home form	School form	Home form	School form
In	-	-						
Hy	0.708***	0.759***	-	-				
Imp	0.783***	0.881***	0.669***	0.789***	-	-	-	-
ADHD	0.921***	0.954***	0.871***	0.907***	0.871***	0.954***	-	-

Table 4. Pearson's correlation for the ADHD-RS-5-AR home and school forms. Abbreviations: Ina, inattention; Hy, hyperactivity; Imp, impulsivity; ADHD, attention-deficit/hyperactivity disorder. ***$p > 0.001$.

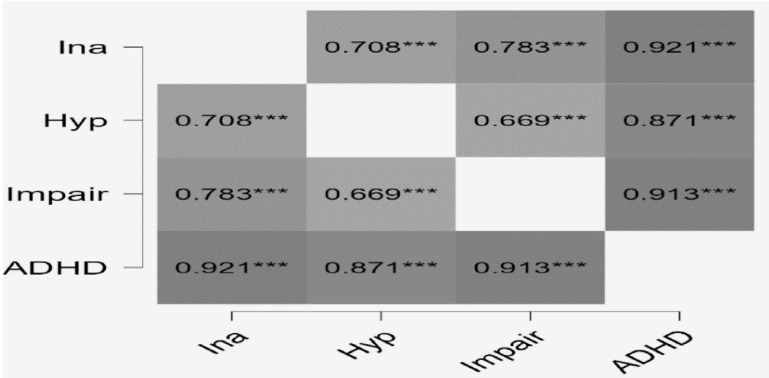

Fig. 5. Pearson's *r* heatmap for the ADHD-RS-5-AR home form.

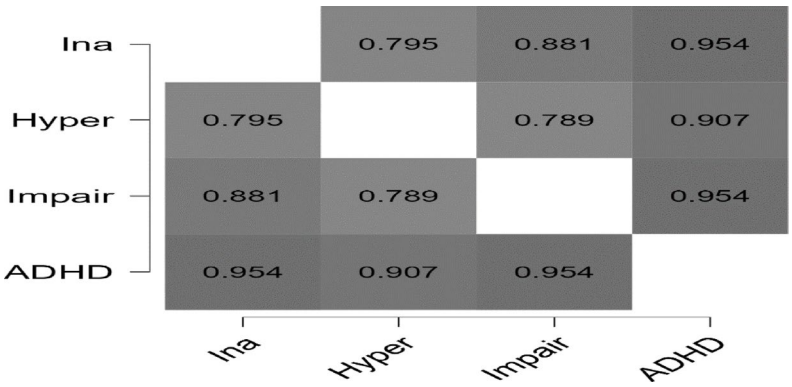

Fig. 6. Pearson's *r* heatmap for the ADHD-RS-5 school form.

Variable	McDonald's ω		Cronbach's α	
	Home form	School form	Home form	School form
Inattention	0.920	0.955	0.919	0.955
Hyperactivity and impulsivity	0.914	0.939	0.913	0.944
Impairment	0.953	0.968	0.952	0.969
ADHD	0.965	0.977	0.952	0.981

Table 5. Cronbach's α and mcdonald's ω coefficients for the ADHD-RS-5-AR home and school forms.

ADHD-RS-5-AR norms

Table 6 shows the standard data for the ADHD-RS-5-AR for screening for ADHD in adolescents in Saudi Arabia with inattention and hyperactivity-impulsivity and the total scores for both males and females in different age groups at four cutoff points: the 80th, 90th, 93rd, and 98th percentiles. According to DuPaul and his associates[22], cutoff points can be used for risk screening (80th and 90th percentiles) and identification purposes (93rd and 98th percentiles).

The results presented in Table 6 show that children 13 to 14 years old scored higher on the ADHD-RS-5-AR than those in the other age groups, both males and females. They also demonstrate that females scored higher than males and that ADHD decreased with age.

Cutoff scores for the ADHD-RS-5-AR in a population of adolescents in Saudi Arabia

A receiver operating characteristic (ROC) curve analysis was performed to calculate the cutoff value for screening for ADHD in adolescents. The results are shown in Table 7; Fig. 7.

The results presented in Table 7 indicate that the area under the ROC curve (AUC) value was excellent for the home form (AUC = 0.908, 95% CI = 0.878–0.932, $p < 0.0001$, accuracy = 81.29%) (Figs. 7), and the school form (AUC = 0.906, 95% CI = 0.888–0.921, $p < 0.0001$, accuracy = 86.46%) (Fig. 8).

The ROC curve analysis presented in Table 7; Fig. 7 showed that the cutoff value for assessing for ADHD in adolescents using the the ADHD-RS-5-AR home form in the Saudi environment was greater than 30

	Inattention Percentile							Hyperactivity-Impulsivity Percentile						Total Score Percentile					
Age	No.	*M*	*SD*	80th	90th	93rd	98th	*M*	*SD*	80th	90th	93rd	98th	*M*	*SD*	80th	90th	93rd	98th
Males																			
13–14	430	6.47	8.47	14.80	21.0	23.0	27.0	4.71	7.31	9.0	16.0	20.0	27.0	11.19	14.99	24.0	34.0	40.0	52.0
15–16	269	6.35	8.31	14.0	21.0	23	27	4.72	7.02	9.0	16.0	19.0	27.0	11.06	14.46	24.0	35.0	40.0	51.6
17–18	195	5.33	7.92	10.0	19.0	23.0	27.0	3.81	6.36	7.0	12.0	18.0	24.0	9.14	13.60	18.0	30.0	34.0	50.3
19-<20	134	5.82	8.37	12.0	21.0	24.1	27.0	4.41	7.04	11.0	17.0	18.5	24.9	10.23	14.57	23.0	34.5	38.0	51.2
Females																			
13–14	307	8.36	8.72	17.0	23.0	25.0	27.0	7.0	8.04	15.0	20.2	23.0	27.0	15.36	15.62	29.0	39.0	46.0	53.0
15–16	198	6.96	7.85	12.0	20.0	23.1	27.0	6.23	7.78	12.0	19.0	21.1	27.0	13.19	14.60	26.0	33.0	42.0	54.0
17–18	142	7.85	8.84	16.4	24.4	27.0	27.0	6.10	7.56	11.0	19.0	22.9	27.0	13.95	15.42	28.0	40.0	45.0	52.3
19-<20	86	7.17	7.79	14.6	19.6	21.0	27.0	6.28	7.86	13.0	20.6	22.9	27.0	13.45	14.17	25.0	38.0	38.9	51.0

Table 6. Norms of the ADHD-RS-5-AR for screening and identification according to age group variables. ADHD-RS-5-AR = ADHD Rating Scale Fifth Edition.

ADHD	Cutoff Value	Sensitivity	Specificity	Accuracy	AUC
Home form	> 30	91.67%	86.98%	81.29%	0.908
School form	> 28	94.74%	89.65%	86.46%	0.906

Table 7. ADHD-RS-5-AR cutoff value screening accuracy in a general population sample of adolescents in Saudi Arabia. Abbreviations: AUC, area under the curve.

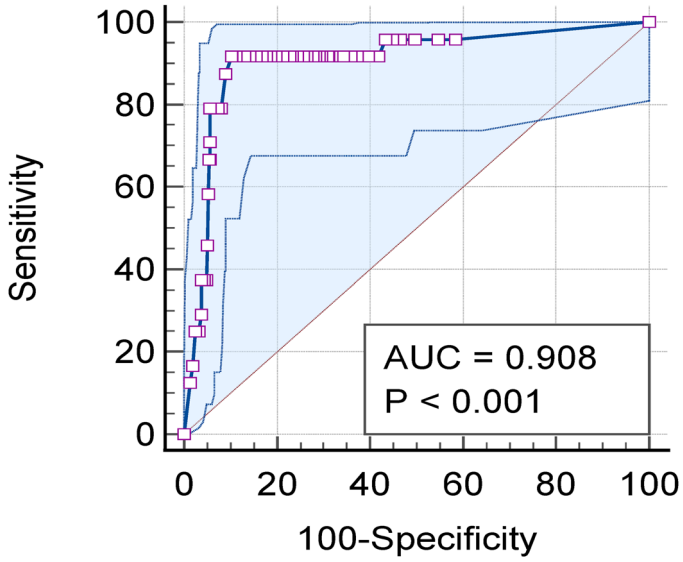

Fig. 7. ROC Curve for the ADHD-RS-5-AR home form. Prepared using MedCalc software.

(ADHD-RS-5-AR > 30), with a sensitivity of 91.67% (95% CL = 73–99), specificity of 86.98% (95% CL = 83.5–89.9), positive predictive value of 27.2% (95% CL = 22.2–32.7), and a negative predictive value of 99.5% (95% CL = 98.1–99.9). However, for the school form, the cutoff score was greater than 28 (ADHD-RS-5-AR > 28), with sensitivity of 94.74% (95% CL = 81.1–98.5), specificity of 89.65% (95% CL = 87.8–91.3), positive predictive value of 36.5% (95% CL = 32.6–40.7), and negative predictive value of 99.6% (95% CL = 99.1–99.9). Furthermore, the ROC analysis revealed that the prevalence rate for ADHD in adolescents in Saudi Arabia was 5.03% for the home form and 5.92% for the school form.

Discussion

The primary goal of this research was to validate the Arabic version of the ADHD-RS-5-AR for use with adolescents in Saudi Arabia. This involved confirming its factor structure, examining its measurement invariance

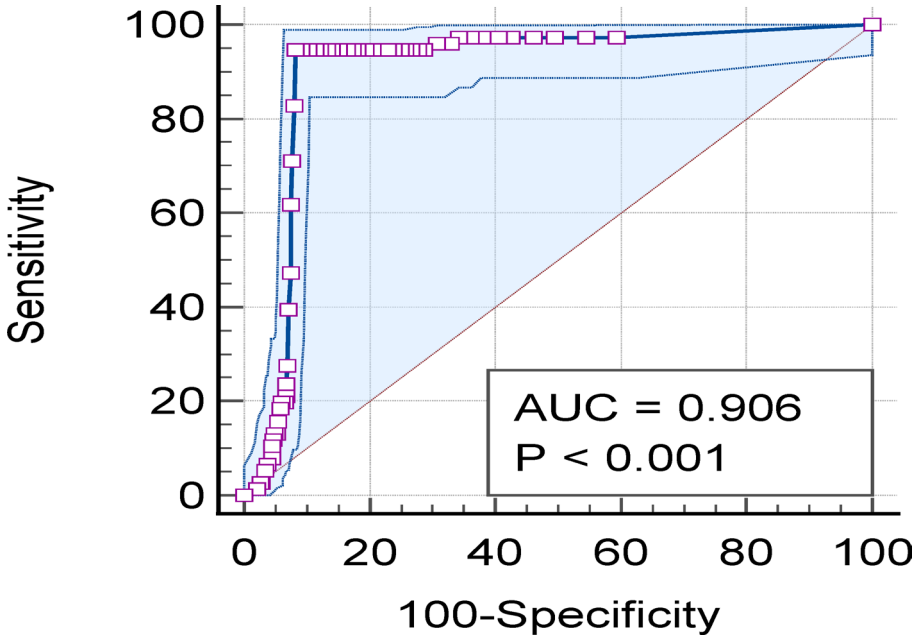

Fig. 8. ROC Curve for the ADHD-RS-5-AR school form. Prepared using MedCalc software.

between the home and school versions, and demonstrating the reliability and validity of its scores to establish it as a sound screening instrument in this cultural and linguistic context.

The acceptable factor loadings observed in the CFA results for both the home and school forms of the Arabic ADHD-RS-5-AR provide initial support for its constructive validity within the Saudi Arabian adolescent population. These findings suggest that the underlying structure of ADHD, characterized by the distinct but related dimensions of inattention and hyperactivity/impulsivity as outlined in the DSM-5, is likely being captured by the Arabic version of the scale as perceived by both parents and teachers. This alignment with the established theoretical framework of ADHD is a crucial first step in validating the instrument for this cultural and linguistic group. Furthermore, the adequate fit of the proposed six-factor model of impairment, as indicated by the goodness-of-fit indices for both reporter groups, suggests that the Arabic ADHD-RS-5-AR is sensitive to the multifaceted ways in which ADHD can impact adolescents' daily functioning across various domains such as relationships, academics, and behavior. This ability to assess not only core symptoms but also associated impairments strengthens the potential utility of the scale as a comprehensive screening tool in the Saudi context.

The significant positive correlations observed between the subscales and the total score of the Arabic ADHD-RS-5-AR for both parent and teacher reports suggest a strong internal consistency within the scale. This indicates that the items designed to measure inattention and hyperactivity/impulsivity are indeed tapping into a related underlying construct of ADHD as perceived by these key informants in the adolescents' lives. Furthermore, the high reliability coefficients (Cronbach's alpha and McDonald's omega) for both the overall scale and its subscales, across both home and school versions, underscore the stability and dependability of the Arabic ADHD-RS-5-AR in measuring ADHD symptoms in Saudi adolescents. This robust internal reliability is a critical prerequisite for a screening tool, suggesting that the scale provides consistent measures regardless of whether the information comes from parents or teachers. Such consistency enhances the confidence in using the Arabic ADHD-RS-5-AR to identify potential cases for further evaluation, as it demonstrates a stable measurement of the core ADHD symptom dimensions from different perspectives.

The constructive validity and reliability results obtained in the current study are consistent with a body of international research[23–26] that has generally supported the sound psychometric properties of the ADHD Rating Scale among adolescent populations across various cultural contexts. Building upon this broader evidence, our findings specifically align with studies conducted within the Arabic-speaking region. For instance, the current results corroborate the work of Alhossein et al.[9] in their evaluation of the ADHD-RS-5 in the Sudanese environment for children and adolescents. These convergences with research conducted both internationally and within the Arabic region, particularly, strengthen the evidence for the cross-cultural applicability and robustness of the ADHD-RS-5 as a reliable and valid tool for assessing ADHD symptoms in adolescents.

The current study, the standard data for the ADHD-RS-5-AR norms according to age group matched the diagnostic criteria contained in the DSM-5 and the ICD-10 for ADHD, indicating the possibility of diagnosing adolescents by the presence of inattention and hyperactivity-impulsivity. Furthermore, this study examined normative data collected using the ADHD-RS-5-AR in a large community sample of adolescents. The total scores and subscale scores were higher for females than for males. According to age group, scores for adolescents aged 13 to 14 years were higher than for all other age groups for both genders. There was also a decrease in the ADHD-RS-5-AR score with age, and this was consistent with previous studies that reported a reduction in

ADHD symptoms with age. However, we would like to point out that these data were collected from the general population of adults and not from children or adolescent samples[27–32].

Also, the ADHD-RS-5-AR cutoff value to screen for ADHD in adolescents in the Saudi environment for the home form was greater than 30 and for the school form was greater than 28, both with high sensitivity and specificity values. These results agreed with Somma et al.[25], who found a general cutoff score of 31, and Olofsdotter et al.[33] who reported a cutoff score of 30. Pereira et al.[34] reported a cutoff score of 24 when assessing for ADHD in Spanish adolescents. These differences result from the different measurement tools used and samples tested, whether general population or clinical samples.

We point out here that the cutoff score we report in the present study for screening ADHD among adolescents in the Saudi context was the outcome of a general population sample and not a clinical sample. Therefore, it is not a definitive score that can be generalized to all Gulf Cooperation Council (GCC) or Arab countries, because the symptoms of ADHD vary depending on culture, nutrition, medications, etc. Thus, identifying a definitive cutoff score would require future cross-cultural studies and the comparison of cutoff scores between general and clinical samples.

Furthermore, the prevalence rate for ADHD in general adolescents in Saudi Arabia was 5.03% based on the home form and 5.92% using the school form, which fall within the range indicated by Eaton et al.[35] (2.6–95.5%). These rates are, however, lower than those reported by Olofsdotter et al.[33] (33% among adolescents in Italy) because their sample consisted of both individuals in the general population and clinical cases of ADHD. Leitner[36] found that the rate of ADHD in clinical samples ranges from 37 to 85%, and Lai et al.[37] reported that the rate was higher in clinical samples (34%) compared with community samples (22%).

From these findings, we emphasize the critical role of early identification of ADHD in adolescents in Saudi Arabia. Timely and accurate screening, facilitated by validated tools like the Arabic ADHD-RS-5-AR, will enable prompt and effective treatment for those affected[10]. This early intervention can significantly improve cognitive, behavioral, academic, and social functioning, potentially mitigating the long-term adverse effects of the disorder on individuals, their families, and society[38]. Conversely, delayed intervention is often associated with reduced treatment effectiveness and an increased likelihood of secondary problems and burdens on families and communities[39].

Conclusion

The current cross-sectional descriptive study investigated the psychometric properties of the ADHD-RS-5-AR for assessing ADHD by parents and teachers of a general population sample of adolescents aged 13 to under 20 years attending middle-to-high school in Saudi Arabia from many regions, selected according to the study criteria. The results found that the ADHD-RS-5-AR is a valid tool for screening ADHD among adolescents in the Saudi environment and that it showed good constructive validity and reliability indicators. The results also revealed that the cutoff score for the ADHD-RS-5-AR home form was over 30 points and for the school form was over 28 points. These results emphasize the importance of applying the ADHD-RS-5-AR for early identification of potential cases of ADHD in adolescents in Saudi Arabia and the provision of proper intervention and management.

Study strengths and limitations

The current study included a large sample of parents and teachers from the largest populated regions in the country: Riyadh, Makkah, and the Eastern Province. This ensures that the study sample is representative of the studied population and confirms the possibility of generalizing the results. However, the study has several limitations, including the descriptive design followed. This investigation did not aim to study factors mediating or affecting the spread of ADHD. It was also not an experimental study examining the impact of an intervention on parents, teachers, or adolescents with ADHD. Furthermore, this quantitative study relied on data collected from parents and teachers using a questionnaire rather than in-depth interviews or observation. Accordingly, we hope that researchers interested in this area will use the ADHD-RS-5-AR to study factors affecting or predicting ADHD and conduct interventional studies for parents and teachers dealing with the disorder. Also, we need future cross-cultural studies and studies to compare a general with a clinical cutoff score to identify a definitive cutoff value for the assessment of ADHD among adolescents in all GCC or Arab countries. Furthermore, we recommend conducting a longitudinal study of ADHD to investigate the norms and cutoff scores for screening for ADHD across the lifespan.

Finally, future research should further investigate the validity of the Arabic ADHD-RS-5-AR within the Saudi population across various settings, including the clinical setting. The present study focused primarily on reliability and initial psychometric properties, and, thus, did not employ diverse research designs such as qualitative or mixed methods, nor did it compare the scale's results with other diagnostic tools such as clinical judgment (i.e., DSM-5–based interviews) and observation for assessing ADHD in adolescents. Therefore, establishing the comprehensive validity of the Arabic ADHD-RS-5-AR within the Saudi context remains a crucial area for future investigation, involving comparisons with these diverse assessment approaches.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request and with permission of Saudi ADHD Society.

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References

1. Jiang, M. M. et al. The effect of teacher discrimination behavior on adolescent suicidal ideation: a cross-sectional survey. *Psychol. Res. Behav. Manag.* **16**, 2667–2680 (2023).
2. Saura-Garre, P. et al. Assessment of hyperactivity-impulsivity and attention deficit in adolescents by self-report and its association with psychopathology and academic performance. *Front. Psychol.***13**, 989610. https://doi.org/10.3389/fpsyg.2022.989610 (2022).
3. Wang, T. et al. Prevalence of attention-deficit/hyperactivity disorder among children and adolescents in China: A systematic review and meta-analysis. *BMC Psychiatry***17**(1), 32. https://doi.org/10.1186/s12888-016-1187-9 (2017).
4. Zendarski, N., Sciberras, E., Mensah, F. & Hiscock, H. Early high school engagement in students with attention/deficit hyperactivity disorder. *Br. J. Educ. Psychol.* **87** (2), 127–145 (2017).
5. Birchwood, J. & Daley, D. Brief report: The impact of attention deficit hyperactivity disorder (ADHD) symptoms on academic performance in an adolescent community sample. *J. Adolesc.***35**(1), 225–231 (2012).
6. Mhalla, A. et al. ADHD in Tunisian adolescents: Prevalence and associated factors. *J. Atten. Disord.***22**(2), 154–162 (2018).
7. Nikander, D. Attention deficit hyperactivity disorder and mindfulness practice in children and adolescents: A comprehensive review of evidence-based research. *Doctoral Nurs. Pract. Program. Calif. State Univ.***15**, 5–28 (2015).
8. Al-Desouki, M. *Attention Deficit Hyperactivity Disorders (causes - diagnosis – prevention and treatment)* (Anglo-Egyptian Library, 2008).
9. Alexander, A., Angela, M. & Richard, D. Sex and age difference in attention-deficit / hyperactivity disorder symptoms and diagnoses: Implication for DSM-V and ICD – 11. *J. Am. Acad. Child Adolesc. Psychiatry.***49**(3), 28–27 (2010).
10. Farah, L. G. et al. ADHD in the Arab world: A review of epidemiologic studies. *J. Atten. Disord.***13**(3), 211–222 (2009).
11. Alkhateeb, J. M. & Alhadidi, M. S. ADHD research in Arab countries: A systematic review of literature. *J. Atten. Disord.***23**(13), 1531–1545 (2019).
12. Hassan, A. M., Al-Haidar, F., Al-Alim, F. & Al-Hag, O. A screening tool for attention deficit hyperactivity disorder in children in Saudi Arabia. *Ann. Saudi Med.***29**(4), 294–298 (2009).
13. Senol, V., Unalan, D., Akca, R. P. & Basturk, M. Prevalence of attention-deficit/hyperactivity and other disruptive behaviour disorder symptoms among primary school-age children in Kayseri, Turkey. *J. Int. Med. Res.***46**(1), 122–134 (2018).
14. Slobodin, O. & Masalha, R. Challenges in ADHD care for ethnic minority children: A review of the current literature. *Transcultural Psych.* **57** (3), 468–483 (2020).
15. Nasser, A. et al. Translating attention-deficit/hyperactivity disorder rating scale-5 and Weiss functional impairment rating scale-parent effectiveness scores into clinical global impressions clinical significance levels in four randomized clinical trials of SPN-812 (Viloxazine Extended-Release) in children and adolescents with attention-deficit/hyperactivity disorder. *J. Child. Adolesc. Psychopharmacol.* **31** (3), 214–226 (2021).
16. Pelham, W. E. Jr, Fabiano, G. A. & Massetti, G. M. Evidence-based assessment of attention deficit hyperactivity disorder in children and adolescents. *J. Clin. Child. Adolesc. Psychol.* **34** (3), 449–476 (2005).
17. Alqahtani, M. M. et al. Psychometric properties of the Arabic Vanderbilt children's ADHD diagnostic rating scale (VADRS-A) in a Saudi population sample. *Scandinavian J. Child. Adolesc. Psychiatry Psychol.* **12** (1), 72–83 (2024).
18. Alhossein, A. et al. Psychometric properties of ADHD rating scale-5 for children and adolescents in Sudan-school version. *Front. Psychol.***13**, 883578. https://doi.org/10.3389/fpsyg.2022.883578 (2022).
19. DuPaul, G. J. et al. Parent and teacher ratings of attention-deficit/hyperactivity disorder symptoms: Factor structure and normative data. *Psychol. Assess.***28**(2), 214 (2016).
20. DuPaul, G. J., Power, T. J., Anastopoulos, A. D. & Reid, R. *ADHD Rating Scale?? 5 for Children and Adolescents: Checklists, Norms, and Clinical Interpretation* (Guilford, 2016).
21. Byrne, R. W. & Russon, A. E. Learning by imitation. A hierarchical approach. *Behav. Brain Sci.***21**(5), 667–684 (1998).
22. DuPaul, G. J., Kern, L., Caskie, G. I. & Volpe, R. J. Early intervention for young children with attention deficit hyperactivity disorder: Prediction of academic and behavioral outcomes. *School Psychol. Rev.***44**(1), 3–20 (2015).
23. Adler, L. A. et al. Preliminary examination of the reliability and concurrent validity of the attention-deficit/hyperactivity disorder self-report scale v1.1 symptom checklist to rate symptoms of attention-deficit/hyperactivity disorder in adolescents. *J. Child. Adolesc. Psychopharmacol.* **22** (3), 238–244 (2012).
24. Kessler, R. C. et al. The world health organization adult ADHD self-report scale (ASRS): A short screening scale for use in the general population. *Psychol. Med.***35**(2), 245–256 (2005).
25. Somma, A., Borroni, S. & Fossati, A. Construct validity and diagnostic accuracy of the Italian translation of the 18-item World Health Organization adult ADHD self-report scale (ASRS-18) Italian translation in a sample of community-dwelling adolescents. *Psych. Res.***273**, 753–758 (2019).
26. Sonnby, K. et al. Validation of the world health organization adult ADHD Self-Report scale for adolescents. *Nordic J. Psych.* **69** (3), 216–223 (2015).
27. Alqahtani, M. M. The comorbidity of ADHD in the general population of Saudi Arabian school-age children. *J. Atten. Disord.***14**(1), 25–30 (2010).
28. Alqahtani, M. M. Attention-deficit hyperactive disorder in school-aged children in Saudi Arabia. *Eur. J. Pediatr.* **169** (9), 1117–1113 (2010).
29. Kooij, J. J. et al. Distinguishing comorbidity and successful management of adult ADHD. *J. Atten. Disord.* **16** (5 Suppl), 3S–19S (2012). (2012).
30. Mao, A. & Findling, R. Comorbidities in adult attention-deficit/hyperactivity disorder: A practical guide to diagnosis in primary care. *Postgrad. Med.***126**, 42–51. https://doi.org/10.3810/pgm.2014.09.2799 (2014).
31. Spencer, T. J., Biederman, J. & Mick, E. Attention-deficit/hyperactivity disorder: Diagnosis, lifespan, comorbidities, and neurobiology. *J. Ped. Psychol.***32**(6), 631–642 (2007).
32. Bedard, A. C. et al. The development of selective inhibitory control across the lifespan. *Develop Neuropsychol.* **21**, 93–111 (2022).
33. Olofsdotter, S., Fernández-Quintana, Á., Sonnby, K. & Vadlin, S. Clinical utility of new cut-off scores for the world health organization ADHD self-report scale among adolescents in psychiatric outpatient care. *Int. J. Clin. Health Psychol: IJCHP.* **23** (4), 100391. https://doi.org/10.1016/j.ijchp.2023.100391 (2023).
34. Pereira, A. et al. ADHD rating scale (ADHD-RS): validation in Spanish in adult population according to the DSM-5. *Span. J. Psychiatry Ment Health.* **17** (1), 46–50 (2024).
35. Eaton, C. et al. The prevalence of attention-deficit/hyperactivity disorder symptoms in children and adolescents with autism spectrum disorder without intellectual disability: A systematic review. *J. Atten. Disord.***27**(12), 1360–1376 (2023).
36. Leitner, Y. The co-occurrence of autism and attention deficit hyperactivity disorder in children - what do we know? *Front. Hum. Neurosci.* **8**, 268. https://doi.org/10.3389/fnhum.2014.00268 (2014).
37. Lai, M. C. et al. Prevalence of co-occurring mental health diagnoses in the autism population: A systematic review and meta-analysis. *Lancet Psychiat.***6**(10), 819–829 (2019).
38. Alqahtani, M. M. How do parents view psychological assessment and intervention for their children with ADHD in Saudi arabia?? *Asia Pac. J. Counselling Psychother.* **8** (1), 41–52 (2017).
39. Schoeman, R., Albertyn, R. & De Klerk, M. Adult attention-deficit hyperactivity disorder: why should we pay attention? *South. Afr. J. Psychiatry.* **23**, 1072. https://doi.org/10.4102/sajpsychiatry.v23i0.1072 (2017).

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Author contributions
MQ, NA and NA conceptualized and designed the work. All authors re-designed the work and designed methodology. NA, NA, JV and SA project administration, data acquisition, and curation. MQ, YA, WA, AA, EA, MB, AA and SA conducted literature review and re-conceptualized the work. BA, LA and MQ conducted formal analyses and interpretation of results. MQ, JV and BA drafted the manuscript. All authors redrafted the manuscript and revised and edited the draft. YA, NA share the results discussion AND revised and edited the draft. All authors read and approved the final manuscript.

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Declarations

Competing interests
The authors declare no competing interests.

Ethics approval
The Research Ethics Committee at the Saudi ADHD Society approved this study (Approval number: 23-06). All methods were carried out according to relevant guidelines and regulations, and informed consent was obtained from all participants.

Additional information
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