

Adaptation and Validation of Conners-3 Teacher and Parent Rating Scales on Lebanese Children

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Abstract: Conners-3 rating scale is primarily used in the assessment of ADHD and it has been found to be instrumental in variety of areas such as screening, assessment, and treatment monitoring. Most, if not all, rating scales are developed on western standards and available in different languages especially, English. For this reason, we adapted the Conners-3 teacher and parent rating scales since we are ethically responsible to have a rating scale that assess ADHD and takes into consideration the linguistic and cultural differences among the Lebanese population. Conners-3 aims to measure ADHD and most common comorbid problems in children and adolescents. The purpose of this study was to adapt and validate the Conners-3 teacher and parent rating scales to the Lebanese context. The International Test Commission (ITC) guidelines were used for translating the rating scales, and then they were reviewed by professionals, piloted, revised, and then administered. The sample consisted of students enrolled in grades 1 through 12 from nine schools. Their parents (455) and 108 teachers of (509) students filled the respective Conners-3 rating scales. The reliability and validity of the scales was investigated by examining the internal consistency and test-retest reliabilities, construct validity in terms of gender and age differences, discriminant validity between ADHD and non-ADHD groups, and Exploratory Factor Analysis. The reliability coefficients and discriminant validity were moderate to high. Age and gender differences were not well defined, and the obtained factor structure partially resembled that of the original Conners-3. Norms in terms of T scores and percentiles were reported. Results were discussed and limitations and recommendations for the future studies were proposed.

Keywords: Test Adaptation, Validation, ADHD, Conners-3 Teacher Scale, Conners-3 Parent Scale

1. Introduction

Attention Deficient Hyperactivity Disorder (ADHD) is one of the most common referrals to school psychologists [9]. According to Demaray and his colleague (2003), child psychologists are faced with problems in the selection of appropriate measures to assess at risk children specifically children with ADHD. Behaviour-rating scales have become an important component of the psychoeducational assessment of children and adolescents [2].

Conners-3 rating scale is primarily used in the assessment of ADHD and it has been found to be instrumental in variety of areas such as screening, assessment, and treatment monitoring. Conners-3 Rating Scale is the most recent scale for Conners, and it is a reviewed version of the Conners

Rating Scale-R. It aims to measure ADHD and most common comorbid problems in children and adolescents. For ages 6 to 18, two forms are available: a parent form (110 items) and a teacher form (115 items), while for ages 8 to 18, there is in addition a self-report form [7]. Most, if not all, of the rating scales have been developed on western standards and are available in several languages especially, English. However, these tools are not standardized for the assessment of children in non-western countries [18] and specifically in Lebanon. The lack of a standardized measure normed on Lebanese population affects the assessment of ADHD, making appropriate diagnosis, proposing appropriate recommendations for intervention, and finally evaluating the impact of any intervention.

At present in Lebanon, there is no evidence of diagnostic criteria for the assessment of ADHD. Based on a study

conducted by Shehab (2017), 55% of the interviewed school counsellors do not know of any tool used to diagnose ADHD. Of the remaining, 30% use observation for assessment and 10% use rating scales [16]. Accordingly, in Lebanon there is a lack of tools to assess ADHD.

The purpose of this study was to adapt and validate Conners-3 teacher and parent rating scales to the Lebanese population. More specifically, the study attempted to a) develop norms based on ratings of 509 Lebanese students registered in public and private schools by 108 teachers and 455 parents, b) establish internal consistency reliability and consistency over time for the scales and for each of the subscales of the Adapted-Conners-3 teacher and parent rating scales, and c) investigate the construct validity of the Adapted-Conners-3 parent and teacher rating scales through investigating their discriminatory ability between ADHD and non-ADHD groups. Similarly, and as part of construct validity, age and gender differences were investigated. Finally, exploratory factor analysis on content scale items was conducted to identify the factor structure of the Lebanese version and to see the extent the original factor structure is replicated in the adapted version.

The rationale for this study is to fill the gap in the literature and specifically in Lebanon for an ADHD assessment tool that uses different sources of information such as teachers and parents. Studies on ADHD in Lebanon have been limited to date, although ADHD is the most common disorder in child psychiatric clinics [10] with a prevalence of 3.2% (30 out of 934) as estimated from the first epidemiological study conducted by Richa and his colleagues (2014). At present in Lebanon, there is no evidence of diagnostic criteria for the assessment of ADHD, therefore there is a need for a tool that takes both the culture and the linguistic differences of the Lebanese society into consideration.

Adapting Conners-3 rating scale to the Lebanese context serves to inform both the research and the treatment of children with ADHD. It can aid the theory aspect (research) because “diagnosis is a necessary part of obtaining services and funding and can also help connect a child’s symptoms to relevant bodies of literature (e.g., effective treatment options, potential risks)” [17]. In addition, Conners-3 serves the practical (treatment) aspect, as it has been found to be instrumental in a variety of arenas for screening, assessment, treatment monitoring, and research [9]. For these reasons, adapting and validating Conners-3 to the Lebanese population will help clinicians in assessment of ADHD children and subsequently monitoring effect of intervention.

2. Method

2.1. Research Design

This study was done in multiple stages. The first stage involved adaptation and translation of the Conners-3. The second stage included piloting of the Adapted-Conners-3 teacher and parent rating scales and obtaining feedback from

the pilot sample to identify any problems in adaptation and translation. The third stage involved the administration of the Adapted-Conners-3 rating scales to the selected normative sample. The final stage focused on establishing reliability, internal consistency and test retest, and examining construct and discriminate validity of the Adapted-Conners-3 rating scales, in addition to the reporting of the norms. Norms were reported for the sample in the form of percentile ranks and T-scores for each age group and by gender.

2.2. Instrument

Conners-3 rating scale is the product of 40 years’ research. This revised version provides streamlined content focusing on ADHD and other comorbid disorders such as Disruptive Behavior Disorder and Conduct Disorder. It is a multi-informant assessment of children and adolescents of age 6 to 18 years [7] and provides a new scoring option for the Diagnostic and Statistical Manual of Mental Disorders- fifth edition (DSM-V). Conners-3 manual provides two ways of scoring, hand-scoring and computerized scoring. The reliability measures of Conners-3 are quite satisfactory. According to validity, it can distinguish between clinical groups of ADHD subtypes and other learning disorders and disruptive behavior [7].

2.3. Adaptation and Translation of the Conners-3

Adaptation of the Conners-3- teacher and parent rating scales was based on latest edition of International Test Commission (ITC) Guidelines for Translating and Adapting Tests (2016). As a first step, the original Conners-3-teacher and parent rating scales were ordered and permission for adaptation was obtained from the publisher Multi-Health Systems (MHS). The second step involved translating Conners-3 scales using the forward/backward translation procedure. The translators were native speakers of the target language (Arabic) and proficient in the source language (English) and the Lebanese culture. Each translator worked independently. First, two professional translators forward translated the Conners-3 scales according to the ITC guidelines from the original to the target language (Arabic). Then, a third professional translator back translated the forms to the original language (English). Both versions (Original Conners-3 and the back-translated version) were compared and the back-translation process was repeated until the back-translated Conners-3 was satisfactorily like the original version. These forms were reviewed by two educational psychologists to ensure age appropriateness, cultural suitability, and language adequacy. As an example, item 11 in the parent’s form and 33 in the teacher’s form, “has forced someone into sexual activity”, were removed as they were deemed culturally inappropriate as per the recommendation of both the IRB (Institutional Research Board) and the Ministry of Education. As the concepts assessed in the Adapted-Conners-3 teacher and parent rating scales were cross-culturally relevant, no other items needed change.

2.4. Pilot Study

This step involved pilot testing the adapted Conners-3 scales to ensure the adequacy of the adaptation in terms of reliability, accuracy, and practicality before going on to the validation phase [12]. The purpose of pilot study was to identify possible problems in translation such as words that are difficult to understand or are confusing. The pilot study was done in one

of the nine schools that were randomly selected for the study. The sample was made up of $n=33$ students from grade levels 1 to 12. They were categorized according to four age level groups: 6-8 years, 9-11 years, 12-14 years, and 15-17/18 years. Thus, 33 parents and 30 teachers participated. This sample was not integrated with norming sample. Table 1 reports breakdown of pilot sample.

Table 1. Breakdown of Pilot Sample.

Grade level	Students	Parents	Teachers
1-3	2 randomly selected from each grade=6	6	1 from each grade=3
4-12	3 randomly selected from each grade= 27	27	3 from each grade (Math, Arabic, English) =27
Total	33	33	30

The piloting process involved several steps. First, consent forms were signed by principal, parents, and teachers. Then, teachers and parents were asked to complete the respective Adapted-Conners-3 rating scales and to provide in structured interviews any remarks or feedback about the test (language, age appropriateness...). Based on their input some minor editorial revisions were done.

2.5. Sampling Procedure and Sample

The sampling method used for this study is cluster sampling. In line with student population distribution in Lebanon of two thirds private and one third public, six private schools and three public schools were randomly selected from the pool of schools in the Beirut area, and the following sampling procedure was applied equally across the nine schools. Eight students of both gender (4 males and 4

females) were randomly selected from each grade in every school, resulting in 96 in total. These groups were categorized according to four age level groups: 6-8 years, 9-11 years, 12-14 years, and 15-17/18 years. The sample consisted of 576 students (576 parents and 108 teachers). Unfortunately, the final sample size declined to only 455 students rated by their parents on the Adapted-Conners-3 parent rating scale and 509 students rated by their teachers on the Adapted-Conners-3 teacher rating scale. The students who were rated by their parents are the same students who were rated by their teachers. The difference in number was because not all parents accepted to rate their children. Table 2 presents frequencies (f) and percentages (%) of final student sample based on responses of parents and teachers on the Adapted-Conners-3 rating scales broken down by gender and type of school (public, private).

Table 2. Frequencies (f) and percentages (%) of student by parents and teachers' responses on the adapted Conners-3 parent and teacher rating scales broken down by gender in public and private schools.

	Parents		Teachers	
	Females	Males	Females	Males
	F (%)	F (%)	F (%)	F (%)
Public Schools				
School A	35 (19.6%)	45 (25.1%)	36 (16.9%)	49 (23%)
School B	35 (19.6%)	34 (19%)	38 (17.8%)	36 (16.9%)
School C	15 (8.4%)	15 (8.4%)	30 (14%)	24 (11.3%)
Total	85 (47.5%)	94 (52.5%)	104 (48.8%)	109 (51.2%)
Overall total	179 (39.3%)		213 (41.8%)	
Private Schools				
School D	17 (6.2%)	22 (8%)	27 (9.1%)	32 (10.8%)
School E	35 (12.7%)	29 (10.5%)	20 (6.8%)	32 (10.8%)
School F	25 (9%)	20 (7.2%)	15 (5.1%)	15 (5.1%)
School G	24 (8.7%)	21 (7.6%)	38 (12.8%)	33 (11.1%)
School H	6 (2.2%)	4 (1.4%)	13 (4.4%)	15 (5.1%)
School I	37 (13.4%)	36 (13%)	30 (10.1%)	26 (8.8%)
Total	144 (52.2%)	132 (47.8%)	143 (48.3%)	153 (51.7%)
Overall total	276 (60.7%)		296 (58.2%)	
Total (public and private)	455 (100%)		509 (100%)	

2.6. Administration

Ministry of Education approval on the study and questionnaires was obtained prior to implementation to facilitate access to schools. Similarly, Institutional Research Board (IRB) approval was obtained, and principal, teacher, and parental

consent forms were prepared to meet IRB requirements. Implementing the study was done in three phases.

In phase I, one to two visits to the selected nine schools were made to meet the school principals and to provide them with an overview of the study (purpose, focus, duration, and procedures).

During phase II, eight students were randomly selected from each grade. Then, consents were sent to the parents to be signed. During the second visit, the researcher collected the parental and the teacher consents. Teachers and parents who consented were asked to complete the Adapted-Conners-3 teacher and parent rating scales based on their observations and recollection of the student's behavior and actions over the past months. After one week, the completed rating scales were collected.

After three weeks from administration of the Adapted-Conners 3 scales, a re-administration of the Adapted-Conners-3 in one of the nine schools was done to test for test-retest reliability. The sample consisted of 36 randomly selected students from those who already participated in the study targeting three students from each grade level (grade 1 through grade 12). Thus, 36 parents and one teacher for each grade level (N=12) participated in this phase of the study where they had to refill the Adapted-Conners-3 rating scales.

2.7. Scoring Procedures

Scoring of the responses on the Adapted-Conners-3 parent and teacher rating scales was according to the guidelines in the manual using Conners-3 Scoring Software program which is a portable program (USB derive). The scoring scale of the Conners-3 scales is a 4-point Likert scale ranging from zero to three. If one of the items was not answered (omitted), the score was adjusted by using the formula in the manual [7].

2.8. Data Analysis Procedure and Assumptions

To investigate validity and reliability of Conners-3, the following data analysis procedures were followed using SPSS version 22.

Reliability of the of the Adapted-Conners-3 scales was investigated as follows:

1. Test-retest reliability coefficient of the Adapted-Conners-3 scales was obtained by correlating 29 responses of parents and 26 responses of teachers who completed the Adapted-Conners-3 rating scales twice over a 3-week interval.
2. Internal consistency was obtained by calculating Cronbach alpha for the each of the subscales and for the total scales of the Adapted Conners-3.
3. Validity of the adapted scales was investigated as follows:
4. Content validity was presumed to be established since it was already established in the original Conners-3 and very minor changes were done.
5. Construct validity of the Adapted Conners-3 scales was examined using following procedures:
 - 1) Two-way ANOVAS were performed to examine the interaction between ADHD and gender and ADHD and age. The literature reports that ADHD increases with age and that there are gender differences in ADHD in favour of males.
 - 2) T-test was used to compare the means of the two contrasted groups, clinical diagnosed with ADHD (N=17, randomly selected from clinic of a child psychiatrist) and control (N=17, randomly selected

from one of the selected sample of schools).

- 3) Factorial structure was investigated to examine if the factor structure of the original Conners-3 scales was replicated on the Lebanese sample. A series of exploratory factor analysis (EFA) was conducted to uncover underlying structure, relationships within construct and to determine item loadings. No a priori hypotheses were developed and tested because we wanted to examine factor structure in a different culture. Items were excluded from the final solution if they loaded less than 0.35 on any factor or cross-loaded onto more than one factor [7]. Then, the remaining items were again factor analyzed to remove items that meet the exclusionary criteria. Later, varimax rotation was done for the Adapted-Conners-3 scales to better define factors. Varimax rotation was used for its simplicity and conceptual clarity even though it keeps factors uncorrelated and in this case they could be.

Norms were reported for the sample in the form of percentile ranks and T-scores for each age group and by gender. Raw scores were first calculated for the Adapted-Conners-3 teacher and parent rating scales and subscales, and then these were converted to percentile ranks by gender (male and female) and age (four age groups). In addition, T-scores (standard scores) were calculated to enhance the comparison of each obtained score to the same reference value and allow comparison of subscale scores. Due to space limitation norms will not be included in manuscript but can be requested from authors.

3. Result

3.1. Reliability

The internal consistency reliability of the total scale of the Adapted-Conners-3 parent rating was $\alpha=0.95$, and that of the Adapted-Conners-3 teacher rating was $\alpha=0.96$ (Table 3). The reliability coefficients of most subscales of the Adapted-Conners-3 parent rating scale were high ranging between $\alpha=0.72$ and $\alpha=0.93$ except for few which were lower. Similarly, the reliability coefficients of different subscales of the Adapted-Conners-3 teacher rating scale were adequately moderate to high ranging between $\alpha=0.70$ and $\alpha=0.97$.

The 3-week test-retest reliability of the total scale of the Adapted-Conners-3 parent scale was $r=0.89$ and that of the Adapted-Conners-3 teacher scale was $r=0.94$ (Table 4). The test-retest reliability of the different subscales of the Adapted-Conners-3 parent and teacher scales were moderate to high ranging between $r=0.72$ and $r=0.97$, and $r=0.66$ and $r=0.96$, respectively.

3.2. Validity

3.2.1. T-test for the Clinic-referred ADHD and Non-ADHD Groups

T-test results comparing the means of two contrasted groups, clinic-referred and another non-ADHD group,

revealed significant mean differences between the clinical and non-clinical samples on the total and on all the subscales of Adapted-Conners-3 parent and teachers rating scales except for the emotional lability subscale. For example, for the Conners-3 GI Total, descriptive statistics for clinical ($M=17.5$, $SD=0.6$) were significantly higher than non-clinical samples ($M=5.6$, $SD=0.5$), $t=19.6$, $p<0.01$ for the parent scale. Similarly, for the teacher scale, the clinical descriptive ($M=70.4$, $SD=1.1$) were significantly higher than non-clinical samples ($M=12.0$, $SD=1.0$), $t=3.77$, $p<0.05$. This indicates that both the Adapted-Conners-3 teacher and parent scales discriminated between both groups.

3.2.2. Age and Gender Effect

Results of two-way ANOVAS (gender by age) investigating

age and gender differences revealed that on most subscales of the Adapted-Conners-3 parent scale significant gender differences were not observed except for the DSM-IV-TR-ADHD-Hyperactive/Impulsive and DSM-IV-TR-ADHD-ODD subscales where males were found to score significantly higher than females on these subscales. On the other hand, significant age differences were observed on most of the Adapted-Conners-3 parent scale and subscales and as expected with older children exhibiting lower scores on ADHD-Hyperactive/Impulsive, conduct disorder and oppositional defiant disorder subscales. As for the Adapted-Conners-3 teacher scale, significant gender and age differences were not observed on all subscales except on emotional lability subscale (gender effect) in favour of females.

Table 3. Internal Consistency of the Adapted Conners-3 parent and teacher rating scales.

Subscale	Cronbach Alfa (α)	
	Conners-3 P	Conners-3 T
Scale	0.95	0.96
Inattention	0.88	0.92
Hyperactivity/impulsivity	0.93	0.97
Learning problems/ Executive Functioning (Conners-3 T)	-	0.74
Learning Problems (Conners-3 P)	0.79	-
Executive Functioning (Conners-3 P)	0.83	-
Aggression	0.60	0.89
Peer Relation	0.61	0.70
Conners-3 AI ADHD Index	0.35	0.92
DSM-IV-TR-ADHD- Inattentive	0.86	0.91
DSM-IV-TR- ADHD-Hyperactive- Impulsive	0.86	0.89
DSM-IV-TR-Conduct Disorder	0.51	0.71
DSM-IV-TR-Oppositional Defiant Disorder	0.75	0.70
Conners-3 GI Total	0.84	0.74
Restless- Impulsive	0.72	0.72
Emotional Liability	0.52	0.71

Table 4. Test-retest correlation coefficients of A-Conners-3 parent and teacher rating scales.

Subscale	R	
	Conners-3 P	Conners-3 T
Scale	0.89	0.94
Inattention	0.77	0.94
Hyperactivity/impulsivity	0.77	0.95
Learning problems/ Executive Functioning (Conners-3 T)	-	0.96
Learning Problems (Conners-3 P)	0.73	-
Executive Functioning (Conners-3 P)	0.83	-
Aggression	0.85	0.85
Peer Relation	0.82	0.92
Conners-3 AI ADHD Index	0.89	0.77
DSM-IV-TR-ADHD- Inattentive	0.91	0.95
DSM-IV-TR- ADHD-Hyperactive- Impulsive	0.97	0.75
DSM-IV-TR-Conduct Disorder	0.85	0.81
DSM-IV-TR-Oppositional Defiant Disorder	0.88	0.86
Conners-3 GI Total	0.72	0.66
Restless- Impulsive	0.77	0.90
Emotional Liability	0.78	0.66

3.2.3. Factor Analysis

The factor loadings for of the Adapted-Conners-3 parent rating scale yielded four main factors explaining 81.98% of the variance (Table 5). The first factor was Hyperactivity/impulsivity, which loaded with a high

correlation coefficient 0.93 and explained 59.42% of variance. The second factor was Inattention, which loaded with high correlation coefficient 0.81 and explained 10.19% of the variance. The third factor was Emotional liability, which loaded with high correlation coefficient 0.86 and explained 5.05% of the variance. The last factor was Peer Relation, which loaded with high correlation coefficient 0.97 and

explained 6.87% of the variance. These four factors had high component loadings that could explain each factor significantly (0.69-0.94) except for the fourth factor, Peer Relation had 0.36 but it was kept because it was above the 0.35 adopted threshold and explained around 7% of the variance.

Exploratory Factor Analysis done on the Adapted-Conners-3 teacher rating scale and 13 subscales with varimax rotation yielded three main factors explaining 86.70% of the variance. The first factor was Hyperactivity/impulsivity,

which loaded with a high correlation coefficient 0.93 and explained 73.08% of variance. The second factor was Inattention, which loaded with high correlation coefficient 0.85 and explained 8.75% of the variance. The third factor was Learning Problems/Executive Functioning, which loaded with high correlation coefficient 0.94 and explained 4.87% of the variance. Similarly, these three factors had high component loadings that explained each factor significantly (Table 6).

Table 5. Factor Loadings for Exploratory Factor Analysis of the adapted Conners-3 parent rating scale.

Subscale	Factors			
	1	2	3	4
Hyperactivity/impulsivity	0.83			
Conners-3 AI ADHD Index	0.85			
Restless- Impulsive	0.89			
Conners-3 GI Total	0.94			
Inattention		0.75		
Learning Problems		0.70		
Executive Functioning		0.72		
Aggression		0.76		
DSM-IV-TR-ADHD- Inattentive		0.78		
DSM-IV-TR- ADHD-Hyperactive- Impulsive		0.78		
DSM-IV-TR-Conduct Disorder		0.76		
DSM-IV-TR-Oppositional Defiant Disorder		0.76		
Emotional Lability			0.69	
Peer Relation				0.36

Table 6. Factor Loadings for Exploratory Factor Analysis of the adapted Conners-3 teacher rating scale.

Subscale	Factors		
	1	2	3
Hyperactivity/impulsivity	0.90		
DSM-IV-TR- ADHD-Hyperactive- Impulsive	0.90		
Conners-3 GI Total	0.96		
Restless- Impulsive	0.93		
Inattention		0.87	
Conners-3 AI ADHD Index		0.85	
Aggression		0.89	
DSM-IV-TR-ADHD- Inattentive		0.89	
DSM-IV-TR-Conduct Disorder		0.86	
DSM-IV-TR-Oppositional Defiant Disorder		0.85	
Learning Problems/ Executive Functioning			0.77
Peer Relation			0.67
Emotional Lability			0.59

3.3. Norms Development

Norms were reported in the form of percentile ranks for each age group (6-18 years- in three years' interval) and by gender (male and female) for the thirteen subscales of the Adapted-Conners-3 teacher rating scale and fourteen subscales of the Adapted-Conners-3 parents rating scale. Moreover, percentile ranks for each subscale of both Adapted-Conners-3 parent and teacher rating scales were reported for each age [2].

4. Discussion

The purpose of this study was to adapt and validate Conners-3 teacher and parent rating scales to the Lebanese

population as it can be used to assess ADHD of children aged six to eighteen years. In addition, this study aimed to examine the reliability and validity of the Adapted-Conners-3 teacher and parent rating scales. The rating scale was adapted following ITC guidelines (2016), was piloted, and revised. The study was done based on a final sample of 509 Lebanese students whose teachers filled the Adapted-Conners-3 teacher rating scale out of which 455 parents filled the Adapted-Conners-3 parent rating scale. The ages of these students ranged between 6-18 years old and were enrolled from grade 1 through grade 12. The following sections will discuss the results of the adaptation study in addition to its limitations, implications for theory and practice, and finally present recommendations for future research.

4.1. Reliability of Adapted-Conners-3 Teacher and Parent Rating Scales

4.1.1. Internal Reliability

Both adapted scales reported Cronbach Alfa coefficients that were high across the whole scales and moderate to high across their subscales. The Cronbach Alfa coefficient of the whole scale of the Adapted-Conners-3 parent scale was $\alpha=0.95$ and of the Adapted-Conners-3 teacher scale was $\alpha=0.96$. Such results compare well with the original Conners-3 reported internal consistency reliabilities of 0.91 (ranging from 0.85 to 0.94) for the Conners-3 parents scale, and 0.94 (ranging from 0.92 to 0.97) for the Conners-3 teachers scale [7]. Similar findings were obtained with the Swedish adaptation of the Conners-3 rating scales, as internal consistency of $\alpha>0.80$ was reported for most of the subscales rated by teachers and parents except for conduct problems assessed by parents [19]. So, the adapted Conners-3's internal consistency reliability and in comparison, with the original and adapted Swedish Conners-3 parent and teacher scales is comparable, and it can be concluded that the Adapted-Conners-3 version can provide reliable results when used to assess ADHD and other disruptive behavior in children and adolescents.

4.1.2. Test-Retest Reliability

The 3-week test-retest reported results showed that the Adapted-Conners-3 parent and teacher scales test-retest reliability coefficients were high $r=0.89$ and $r=0.94$, respectively. Similarly, the test-retest reliability coefficients of the fourteen subscales of the Adapted-Conners-3 parent scales and those of the Adapted teacher scales were moderate to high ranging between $r=0.72$ and $r=0.97$ and $r=0.66$ and $r=0.96$, respectively. Such results are like those reported on the original Conners-3 parent and teacher scales. With respect to the Swedish adaptation, Thorell et al (2018), reported higher test-retest reliability coefficients mainly due to overestimation as the sample size for this analysis was small ($n=22$).

Overall, the test-retest reliability coefficient indicated that the Adapted-Conners-3 scales are reliable tools with moderate to high stability over time for subscales and a high one for full scale.

4.2. Validity of Adapted-Conners-3 Teacher and Parent Rating Scales

4.2.1. Construct Validity

While investigating the Adapted-Conners-3 construct validity in terms of its ability to identify and discriminate between clinical and non-clinical samples, the results demonstrated that the Adapted-Conners-3 significantly differentiated between ADHD and non-ADHD groups. The findings are like other studies reported in Germany and Sweden where the Adapted-Conners-3 scales differentiated between ADHD and non-ADHD groups [6, 19]. Accordingly, the Adapted-Conners-3 scale can be used as a valid tool to assess ADHD symptoms and other comorbid disorders such

as oppositional deficit disorder (ODD) and conduct disorder (CD) in children and adolescence [19]. With respect to construct validity investigated in terms of gender and age differences, the parent scale confirmed age differences on all subscales and gender differences in favor of males on some scales, while the teacher scale did not identify any age or gender differences except on one subscale. This finding is not in agreement with what the American Psychiatric Association DSM-V (2013) reports that ADHD is more frequent in males than females in the general population. The ratio of males with respect to females is approximately 2:1 in children and 1.6:1 in adults. With respect to age differences in ADHD, the literature reports that ADHD persists into adulthood in about 58% [3] and symptoms of ADHD continue in adolescence but the expression and nature change.

4.2.2. Gender and Age Effect

In this section, the gender and age results are discussed. With respect to gender, some subscales of the Adapted-Conners-3 parent rating scale showed significant gender differences like executive function, DSM-IV-TR-ADHD-Hyperactive-Impulsive, and DSM-IV-TR-ADHD-ODD subscale with males showing significantly higher scores than females. On the other hand, significant age differences were observed on most of the Adapted-Conners-3 parent rating scale subscales with older children showing lower scores on ADHD subscales. With respect to the Adapted-Conners-3 teacher scale, no significant gender and age differences were observed except on emotional lability subscale (gender effect in favor of males) and aggression subscale (age effect).

ADHD is more frequent in males than females in general population with ratio approximately 2:1 of males with respect to females [1]. In Lebanon, Richa and his colleagues (2014) confirmed that ADHD is significantly more prevalent in boys 4.5% than in girls 1.8% [15].

In this study, gender differences were not evident on ADHD index especially on teacher scale. Studies report that girls could be underdiagnosed [5]. That is because girls with ADHD manifest fewer primary symptoms (hyperactivity, inattention, and impulsivity) and externalizing problems (disruptive behavior) in comparison to boys with ADHD do [11, 14]. They are usually rated higher on social impairment, internalizing problems and intellectual impairments [8, 11] and are more referred to assessment for school-related difficulties or learning disabilities (LD) [11]. Hence, females with ADHD may be easily missed in the ADHD diagnostic process [14]. Literature reports that ADHD comorbid and coexists with other disorders such as oppositional defiant disorder and conduct disorder [4].

According to American Psychiatric Association (2013), DSM-V, ADHD occurs in most cultures in a prevalence of about 5% of children and about 2.5% of adults. Consequently, ADHD decreases with increasing age and persists into adulthood. Symptoms of ADHD continue in adolescence; however, the expression and nature change with age [20].

The difference in results between parents and teachers' responses might be explained that parents were filling questionnaire on their child, while teachers were filling it on several (N=8) students in one sitting and possibly were not as specific. In addition, some teachers may not want to show that they have ADHD students in their classroom.

In summary, gender and age effects were not conclusive in our study and were not totally aligned with literature reviews and other studies. That could be attributed to different reasons such as cultural differences, bias in teachers and parents' responses, and some unanswered items [20].

4.2.3. Factor Analysis

The Adapted-Conners-3 parent rating scale's 14 subscales were subjected to Exploratory Factor Analysis (EFA) with a Principal Components Factor extraction that yielded four main factors hyperactivity/impulsivity, inattention, emotional lability, and peer relation explaining 81.98% of the variance. With respect to the original Conners-3 parent rating scale, the EFA revealed five factors learning problems, aggression, hyperactivity/impulsivity, peer relation and executive functioning explaining 53.8% total variance [7]. In comparison to the German Conners-3 parent rating scale, the EFA also revealed five factors inattention/learning problems, hyperactivity/impulsivity, aggression, peer relation, and defiance for 53.10% total variance [6]. So, though some of the derived factors are similar in the three studies (hyperactivity/impulsivity, peer relation) yet there are differences in the number and reported factors. In parents' view, aggression loaded on inattention/learning problems in the Adapted-Conners-3 and was considered like conduct disorder and oppositional defiant behavior.

The Adapted-Conners-3 teacher rating scale's 13 subscales were subjected to EFA that yielded three main factors hyperactivity/impulsivity, inattention, and learning problems/executive functioning explaining 86.70% of the variance. Referring to the original Conners-3 teacher rating scale, EFA revealed four factors learning problems/executive functioning, aggression, hyperactivity/impulsivity, and peer relation for 63.8% total variance [7]. Similarly, the EFA done on the German Conners-3 also revealed four factors Inattention/Learning problems, Hyperactivity/impulsivity, Aggression/Defiance, and Peer relation explaining 59.43% of total variance [6]. So again, the Adapted-Conners-3 teacher scale factor structure agreed with previous research on two of the factors, hyperactivity/impulsivity and learning problems/executive functioning, but missed on aggression and peer relation. Aggression in Lebanese culture is quite common and considered by teachers as part of conduct oppositional behavior.

The four factors of the Adapted-Conners-3 parent scale and the three factors of the Adapted-Conners-3 teacher scale clearly categorize the subscales of what the Conners-3 parent and teacher scales are intended to measure. Original Conners-3 had also different number structure for parent and teacher scales. Factors might differ from country to another because parents and teachers might view those different

domains differently due to cultural differences. The two main factors which differed, aggression and peer relation (teachers), are culturally influenced.

In a summary, the obtained psychometric properties, in terms of both reliability and validity, provide initial evidence that the Adapted-Conners-3 parent and teacher scales can be used for the assessment of ADHD and other comorbid disorders.

4.3. Implications of Findings to Theory and Practice in the Lebanese Context

The results of this study provide a preliminary confirmation of the validity and reliability of the Adapted-Conners-3 teacher and parent scales to inform both research and treatment of children with ADHD in Lebanon.

With respect to the practical aspect, Lebanese psychiatrists and psychologists can use these scales at the diagnostic, pretreatment, treatment, and post-treatment levels. Therefore, they will be useful at the two levels prevention and intervention.

1. At the *diagnostic level*, the use of the scales can help clinicians to make appropriate diagnosis and intervention recommendations that will improve children's over all mental health and behavior.
2. At the *pretreatment level*, they can be used for identification of children who show symptoms of ADHD and these can be referred to psychiatrists for further diagnosis.
3. At the *treatment level*, clinicians can use these scales to monitor the treatment plan (medication, behavior medication, and accommodations), and thus can assess its effectiveness.
4. At the *post-treatment level*, the Adapted-Conners-3 scales can help the psychiatrist and psychologist to measure treatment outcome.

5. Conclusion

Conners-3 rating scale is used in the assessment of ADHD and most common comorbid problems in children and adolescents. The purpose of this study was the adaptation and validation of Conners-3 teacher and parent rating scales. The forward/backward translation procedure was used based on the ITC guidelines. Both Conners-3 teacher and parent rating adapted scales were pilot tested on 33 students (from grade 1 to grade 12) in one school to ensure their adequacy before going on with the validation process. Later, the adapted Conners-3 teacher and parent rating scales were given to the parents and teachers of students from grade 1 to grade 12 who were randomly selected from nine private and public schools (six private and three public) in Greater Beirut, Lebanon. The parent rating scale sample consisted of 455 students rated by their parents, and the teacher rating scale sample consisted of 509 students rated by their teachers. After two weeks, re-administration of the adapted Conners-3 teacher and parent rating scales were done for test-retest reliability. The sample of students, who already participated

in the study before, were randomly selected from each grade level (grade 1 through grade 12).

Statistical analysis was done in order to investigate the construct validity by examining reliability (test-retest reliability), internal consistency, construct and discriminant validity between ADHD and non-ADHD groups among gender and age and Exploratory Factor Analysis of the adapted Conners-3 parent and teacher rating scales. The reliability of the test both internal and over time was good. Both adapted Conners-3 teacher and parent rating scales had good results. Investigating factor analysis of the adapted Conners-3 parent rating scale loaded 4 factors while the adapted Conners-3 teacher rating scale loaded 3 factors. In summary, the psychometric properties, in terms of both reliability and validity, indicated that the adapted Conners-3 parent and teacher rating scales can be used for the assessment of ADHD and other comorbid disorders such as oppositional deficit disorder (ODD), conduct disorder (CD), learning problems, and emotional problems in Lebanon.

6. Limitations

There are several limitations to this study that might limit the generalizability of the results like the restriction of the norming sample to the Beirut area only, and the relatively small sample size as several schools, specifically private schools, did not grant approval to conduct the research on their campus. They refused for different reasons such as that they do not allow studies on their campuses especially related to behavioral assessment, or that some parents were illiterate in Arabic, or that parents will be skeptical about the reason for selecting their children. Another reason for having a relatively small sample size was that some parents and teachers did not return the rating scales, or they may not have been given to them by their children.

In addition, the public schools that were selected had students from grade 1 to grades 8 or 9 only and this affected the sample size of the older age groups.

Moreover, the reliability of the study might also have been affected by other factors that could have influenced teachers and parents while filling out the forms such as social desirability, halo effect, proximity errors, and leniency errors. In addition, some parents might not be familiar with rating scales.

7. Recommendations for Future Research

Future research on the Adapted-Conners-3 teacher and parent scales should extend the present research by having a larger more representative sample. In addition, it is important to translate and adapt Conners-3 self-report scale to provide a comprehensive multi-informant approach for assessment of children with ADHD, and the abbreviated Conners-3 scale as it can provide a quick screening tool for ADHD assessment. Further work on the construct validity of the scales needs to

be done in terms of conducting confirmatory factor analyses to further validate the obtained factor structure on a larger normative sample.

Declaration

Compliance with Ethical Standards.

Funding

No funding for this research.

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical Approval

The manuscript 'Adaptation and Validation of Conners-3 Teacher and Parent Rating Scales on Lebanese Children' meets ethical guidelines. It went through rigorous review by my institution's Institutional Review Board (IRB), signed consent was obtained from parents, teachers, and principals. Participation was voluntary and all information was confidential and coded.

Statement

1. One teacher for each grade level participated in this study. Consequently, the total number of teachers was $n=12$ from each school and the total number of teachers of all schools was $n=108$.
2. Although our results did not show significant gender differences on the subscales, percentile ranks for each subscale were reported for each age as they might be used by clinicians.

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