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ORIGINAL RESEARCH

Psychometric Properties of the Generalized Anxiety Disorder Scale Among Saudi University Male Students

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Background: Various screening tools have been designed and developed to identify individuals with generalized anxiety disorder (GAD). The current study aimed to assess the psychometric validation of the GAD-7 in Saudi university male students.

Methods: Healthy university male students (n= 192) participated in this cross-sectional study. All the participants were informed about the study details. Participants were asked to complete the GAD-7, the Sleep Hygiene Index (SHI), Perceived Stress Scale (PSS), and demographic details.

Results: In general, the range of the GAD total score was 0–21. There was no issue of the ceiling or floor effects as only 12.5% of participants reported the minimum score of 0, and none of the participants reported the maximum score of 21. The internal consistency score of the GAD-7 was found to be good (Cronbach's alpha = 0.83). The internal homogeneity between item scores was 0.22–0.57 as indicated by the "Spearman correlation coefficient (*r*)". The total scores and individual item scores of the GAD-7 were statistically associated with the PSS total score (correlation coefficient $r = 0.21–0.37$), and scores of the 8th and 13th item of the SHI (correlation coefficient $r = 0.17–0.26$, and 0.21–0.40, respectively). The exploratory factor and confirmatory factor loadings of the GAD-7 items were ranged from 0.60 to 0.81 and 0.51 to 0.80, respectively.

Conclusion: This study supported the use of the GAD-7 to assess the anxiety level among Saudi university students.

Keywords: GAD-7, anxiety, stress, university students, validity, reliability

Introduction

Prevalence of Anxiety Disorders

Anxiety disorders are the commonest psychiatric disorders prevalent in both adults and adolescents. About 272.2 million people had been diagnosed with anxiety disorders globally.[1] The prevalence of anxiety disorders is almost double in women than men [point prevalence, 5.2% versus 2.8%].[1] The prevalence of anxiety disorders is highest in the age group of 20–64 years.[1] Previous study of the Global Burden of Disease reported the prevalence of anxiety disorders was highest in the Middle East/North Africa and the lowest in East Asia [point prevalence, 6.1% versus 2.1%].[1] Additionally, it is reported that high-income nations and Latin American nations have higher proportion of anxiety disorders.[2]

The generalized anxiety disorder (GAD) is considered the commonest psychological disorder.[3,4] The overall prevalence of GAD is about 6.2%,[4] and sometimes it remains unnoticed by Physicians.[5] The prevalence of GAD among university students in the United States was 7.5%.[6] In addition, around 19% prevalence rate

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of GAD among university students in India was reported.[7] Results of previous studies indicate that anxiety is a major public health issue, especially in Saudi students.[8,9] Given that the worldwide average age affected with GAD is in young and in early adulthood,[10–12] university students are susceptible to develop GAD. Previous studies reported high prevalence of anxiety and depression among university medical students in Saudi Arabia.[8,9] Preventive mental health and counselling services should be included in the routine clinical facilities provided for university students.[13]

Psychological Problems in University Students

University/College students face various stressors while they adjust their personal relationships, studies, work, and family or personal expectations.[14] Additionally, university life is highly challenging for many students as they are away from their home probably the first time and often face financial difficulties, academic pressures, and problems in career choices.[15] Moreover, needs of mental health in the current university/college students have been increased significantly compared to past generations.[14] Evidence indicates a high prevalence of anxiety-related disorders among college and university students in the USA.[16] In the Arab world, higher rates of anxiety-related disorders were reported among college students in Qatar and Lebanon than in their American counterparts.[15] The prevalence rate of anxiety and depression is about 10–44% in the developing countries.[17]

Research Gaps and Aims of Current Study

Psychological problems among college and university students in developed countries, for instance, Europe and USA are well acknowledged, and efforts are taken to deal with them. Therefore, various screening tools have been designed and developed to identify individuals with GAD effectively.[18,19] Similarly, Spitzer et al[20] developed a 7-item Generalized Anxiety Disorder Scale (GAD-7) designed to identify individuals with GAD. The GAD-7 has been used in the previous studies among various populations and is available in several languages.[21–23] However, the issue of psychological health and its various dimensions among university students are not well established in the developing countries and specifically Arab nations including Saudi Arabia. No previous studies validated the use of GAD-7 among Saudi university student population. Therefore, this study aimed to assess the clinimetric properties of the GAD-7 in Saudi university male students.

Methods

Participants and Study Design

Purposively sampled students from the college and university of the "King Saud University, Riyadh, Saudi Arabia" participated in this cross-sectional study. Aim of study and procedures was explained to each participant. Participants were excluded if they had self-reported memory problems or use of neuro-psychotic drugs. Participants were asked to complete the original version GAD-7, the Perceived Stress Scale (PSS), the Sleep Hygiene Index (SHI) in addition to their demographic details. A written informed consent was taken from the participant. "The institutional ethical committee, Rehabilitation Research chair, King Saud University, Saudi Arabia approved this study". All the experiment was performed according to the Declaration of Helsinki.

Measures

GAD-7

The GAD-7 scale is a 7-item questionnaire designed to evaluate the level of anxiety as per the "Diagnostic and Statistical Manual of Mental Disorders-IV-TR".[20] Each item is scored between 0 (not at all) and 3 (nearly every day). Total possible score ranges from 0 to 21, with cut off scores ≥5, ≥10, and ≥15 signifying a mild, moderate, and severe level of anxiety, respectively.

PSS-10

The PSS is a 10-item questionnaire developed to assess the self-reported amount of stress. Each item is scored from 0 (never) to 5 (very often) with a total possible score between 0 and 40. Higher score signifies an increasing amount of perceived stress.[24]

SHI

The SHI is a 13-item self-reported questionnaire developed to evaluate participants sleep hygiene behaviour as per the criteria of the "International Classification of Sleep Disorders".[25] Each question is scored between 0 (no) and 1 (yes). The SHI total score (range of 0 to 13) is calculated by adding together all the raw item scores. A higher SHI total score suggests poor sleep hygiene. Additionally, two items of the SHI (item 8 and item 13) also assess perceived stress and worry at sleep time. Hence, these items

were used to evaluate the construct validity of the GAD-7.[25]

Statistical Analysis

Statistical analysis was done using the SPSS version 16.0 for Windows (SPSS Inc., Chicago, USA). Descriptive data including mean, standard deviation, percentage, and frequency were presented. Skewness (statistics, standard error and z) and kurtosis (statistics, standard error and z) determined the distribution characteristics of the GAD-7 score. The internal consistency and the internal homogeneity of the GAD-7 were assessed using the Cronbach's alpha test and the Spearman correlation test, respectively. The Spearman correlation test evaluated the convergent construct validity. The "Exploratory Factor Analysis (EFA)" used the "Principal Axis Factoring extraction" with an unrotated solution. The "Confirmatory factor analysis (CFA)" was conducted using "Maximum likelihood extraction" technique. The "standardized estimates" of the factor loadings on the latent factors for each item of the GAD-7 scale were computed. Multiple indices from various categories for assessment of fit were employed according to the standard procedures.[26] Chi-square statistics, "Incremental fit index (IFI)", "root mean square error of approximation (RMSEA)", and "Comparative Fit Index (CFI)" were calculated.

Table 1 Participant Characteristics of Saudi University Students

Characteristics	Mean ± SD/Frequency
Age (years)	20.50 ± 1.96 (18–25)
BMI (kg/m^2)	22.90 ± 10.28
Presence of chronic conditions/diseases	
No	180 (93.7%)
Yes	4 (2.1%)
Did not report	8 (4.2%)
GAD-7 scale	5.26 ± 4.38
PSS	16.08 ± 5.95
SHI	6.58 ± 2.36
Smoking	
No	150 (78.1%)
Yes	22 (11.5%)
Did not report	20 (10.4%)
Tea/coffee consumption	
No	63 (32.8%)
Yes	113 (58.9%)
Did not report	16 (8.3%)
Beverage consumption	
No	94 (49%)
Yes	74 (38.5%)
Did not report	24 (12.5%)

Abbreviations: SD, standard deviation; BMI, body mass index; GAD-7, Generalized Anxiety Disorder-7; PSS, Perceived Stress Scale; SHI, Sleep Hygiene Index.

Results

Participants' Characteristics

Table 1 details the participant's characteristics of Saudi university students. Most of the participants (93.7%) had no history of chronic conditions. Only a few participants (11.5%) reported a history of smoking [Table 1]. Most of the participants (58.9%) reported tea or coffee consumption. About half of the participants (49%) indicated an absence of beverage consumption [Table 1].

Preliminary Item Analysis and Internal Consistency

In general, the range of the GAD total score was 0–21; 12.5% reported the minimum score of 0, but none reported the maximum score of 21. Therefore, there was no issue of the ceiling or floor effects in the GAD-7 total score. However, an analysis of individual item scores showed the presence of the floor effect, but none had the ceiling effect [Supplementary Table S1]. The internal consistency test of the GAD-7 was good as suggested by the Cronbach's alpha of 0.83. The internal homogeneity between item scores was 0.22–0.57 as indicated by the "Spearman correlation coefficient (r)" [Supplementary Table S2].

Convergent Validity

The total scores and individual item scores of the GAD-7 were statistically correlated with the PSS total score (correlation coefficient r = 0.21–0.37) [Table 2], and scores of the 8th and 13th item of the SHI (correlation coefficient r = 0.17–0.26, and 0.21–0.40, respectively) [Table 2].

Factor Analysis

The GAD-7 scores in the Saudi university students fulfilled the conditions for the factor analysis as noted by the results of the "anti-image matrix" (>0.84), "Bartlett's test of sphericity" (<0.001), communality (≥0.4), the determinant score (0.12) and the "Kaiser–Meyer–Olkin test of sampling adequacy" (0.85) (Table 3). Four tests were utilized to identify the number of factors (s) in EFA, ie the cumulative variance rule (>40%), the "Kaiser's criteria (Eigenvalue>1)", and the "Scree plot and the parallel

Table 2 Convergent Validity: Correlations of the Generalized Anxiety Disorder-7 (GAD-7) Scale with Related Measures in Saudi University Male Students

Items of the GAD-7 Scale	PSS Total Score	SHI-8	SHI-13
Item-1	0.32**	0.17*	0.22**
Item-2	0.29**	0.08	0.24**
Item-3	0.28**	0.12	0.32**
Item-4	0.28**	0.26**	0.21**
Item-5	0.25**	0.18*	0.24**
Item-6	0.21**	0.13	0.32**
Item-7	0.22**	0.12	0.29**
GAD total score	0.37**	0.18*	0.40**

Notes: SHI-8 and SHI-13 are items of the SHI which assess self-reported measures of stress and worry at bedtime. **p<0.01; *p<0.05.
Abbreviations: PSS, Perceived Stress Scale; SHI, Sleep Hygiene Index.

Table 3 Measures of the Sample Size Adequacy and Sample Suitability for Factor Analysis: Generalized Anxiety Disorder-7 (GAD-7) Scale Scores in Saudi University Male Students

Measures	Values
Anti-image matrix	0.84–0.89
Bartlett's test of sphericity	<0.001
Communality*	0.36–0.66
Determinant	0.12
Kaiser–Meyer–Olkin test of sampling adequacy	0.85

Note: *Exploratory factor analysis was performed with principal component analysis extraction for unrotated solution.
Abbreviation: GAD-7, Generalized Anxiety Disorder Scale.

analysis" (Supplementary Figure S1) identified a 1-factor model for the GAD-7. The loadings of the GAD-7 items that were retained in the EFA for performing the CFA ranged from 0.60 to 0.81 [Table 4]. The 1-Factor model indicated a perfect fit to the data, ie non-significant χ^2test [Table 5]. The 1-Factor model showed adequate values for the IFI, CFI, RMSEA, and χ^2/df [Table 5]. The average loading on the CFA model was 0.64 with a range of 0.51–0.80 (Supplementary Figure S2).

Table 4 Exploratory Factor Analysis of the Generalized Anxiety Disorder-7 (GAD-7) Scale in Saudi University Male Students

Items of the GAD-7 Scale	Factor Loadings
Item-1	0.69
Item-2	0.77
Item-3	0.81
Item-4	0.65
Item-5	0.69
Item-6	0.60
Item-7	0.69
Eigenvalues	3.48
Cronbach's alpha	0.83
Total variance explained	49.66

Note: Exploratory factor analysis was performed with principal component analysis extraction for unrotated solution.

Table 5 Fit Statistics of the Generalized Anxiety Disorder-7 (GAD-7) Scale in Saudi University Male Students

Models	IFI	CFI	RMSEA	χ^2	*df*	*p*	χ^2/*df*
1-Factor	0.96	0.96	0.08 (.04–.11)	29.32	14	0.009	2.09

Abbreviations: IFI, incremental fit index; CFI, comparative fit Index; RMSEA, root mean square error of approximation.

Discussion

The evaluation of clinimetric properties of any outcome scale is essential to provide a complete clinical picture and utility of a specific outcome scale. For instance, previous study suggests the importance of adding basic psychometrics analysis with clinimetrics[27] and later it was known as the science of clinical measurements.[28] Similarly, other studies have designed various methods to evaluate the validity of outcome scales from a clinimetric point of view.[27,29–31] The clinimetric analysis includes macro- and micro-analyses to assess the clinical utility and validity of an outcome scale.[27,29] A recent systematic review has suggested the inclusion of clinimetric analysis in the psychometric model to confirm that the outcome scales are not only psychometrically robust but also clinically valid.[32]

This study is the first to assess the clinimetric properties of the original English version of the GAD-7 scale in the Saudi university students. The present study indicated the evidence for the clinimetric validation of the GAD-7 in Saudi university students. Overall, there was no issue of the floor effect or the ceiling effects for the GAD-7 in this sample of Saudi university students, and this indicated the internal structural validity of the GAD-7 total score.[33] This is in line with the results of past studies. In an earlier study, Sousa et al[34] reported no floor or ceiling effects in the Portuguese version of the GAD-7 scale. In the current study, the GAD-7 scale had an adequate internal consistency as noted by the value of the Cronbach's alpha (0.83) in the population of Saudi university students. However, previous studies reported little higher values of the Cronbach's alpha (ranges, .88-.94). Sousa et al[34] reported a Cronbach's alpha value of 0.88 in the Portuguese population, while Zhong et al[35] reported a Cronbach's alpha value of 0.89 in the Peruvian pregnant women. Also, Mills et al[36] noted a Cronbach's alpha value of 0.94 in the Hispanic Americans. Nonetheless, a direct comparison between past studies and the current study is unlikely since the former studies were not carried on the young adult population of the university students. There was only little fluctuation in the Cronbach's alpha

value when items were deleted one at a time, indicating importance and relevance of each item for the structural validity of the GAD-7 among Saudi university students.

A significant association between the PSS total score with the GAD-7 total score and each of the 7-items support its convergent validity [Table 2]. These results are corroborated by the convergent validity identified in the previous study.[36] Moreover, the expected correlation between anxiety and stress is indicated by the significant correlation between the GAD-7 (total and each item scores) and the item-8 and item-13 of the SHI scores.

The results of the CFA and the EFA both supported the original 1-Factor model of the GAD-7 scale in the Saudi university students. All the four measures of the factor retention in the EFA ie the Cumulative variance rule (>40%), the "Kaiser's criteria (Eigenvalue>1)", and the Scree plot suggested a 1-Factor model. The results from the CFA further confirmed the unidimensionality of the GAD-7 scale in Saudi university students' population. The original 1-Factor model of GAD-7 had absolute fit to the data as suggested previously.[37] In addition, this model had adequate values for the IFI, CFI, $\chi 2$/df, and the RMSEA.[37–40] Similarly, the CFA in the previous study produced a good fit.[41] Also, Bártolo et al[2,4] had confirmed the unidimensionality of the GAD-7 scale to assess the anxiety level among college students.

The present study had some limitations. The result of the current study is limited to male students. In the current study, the diagnostic interview was not performed which limit the assessment of concurrent validity. Future studies using the diagnostic clinical interview to assess the concurrent validity of the GAD-7 in Saudi students are required. This may help in the establishment of the population-specific cut-off values of the GAD-7. Future studies may benefit from employment of psychiatric diagnosis using the Mini International Neuropsychiatric Interview (MINI) as gold standard. Such a diagnosis may be used to perform a receiver operating characteristic curve analysis, which may help in operationalizing a cut-off score for different types of anxiety disorders in the target population. Such an analysis may help in determining clinimetric properties including clinical validity and utility, sensitivity, and scalability of the scale. Therefore, future studies focusing evaluation of these clinical properties of this scale are warranted to provide a complete picture and usage of this scale to measure anxiety level in university students. Nevertheless, the study provided adequate evidence for some of the important psychometric properties such as factor analysis, internal consistency, internal homogeneity, convergent validity and preliminary item analysis in Saudi university students.

Conclusions

This findings of adequate factorial validity, internal consistency, convergent validity and preliminary item analysis provide initial support for the use of the GAD-7 in the Saudi university students for measuring the anxiety level. Future research to establish the diagnostic validity of the GAD-7 to screen anxiety disorders in the study population is needed.

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Disclosure

The authors report no conflicts of interest in this work.

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