

Psychometric properties of Mongolian versions of the PHQ-9 and GAD-7 in young adults

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Abstract: The Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) are standardized self-report tools for screening depressive and anxiety disorders, respectively. While they have been validated in various cultural contexts, their psychometric properties have not been thoroughly evaluated in Mongolia. This study aimed to validate the PHQ-9 and GAD-7 among young adults in Mongolia, ensuring their reliability and efficacy in assessing mental health. A cross-sectional study was conducted with 1,391 young adults (aged 17-29 years). Tests for internal consistency, test-retest reliability, and validity were performed, including exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Convergent validity and cut-off scores were assessed using the Hospital Anxiety and Depression Scale (HADS). Results: Both the PHQ-9 and GAD-7 demonstrated excellent internal consistency (Cronbach's alpha=0.913 and 0.895, respectively) and good test-retest reliability over time (ICC=0.637 for PHQ-9; ICC=0.782 for GAD-7). Factor analyses confirmed their unidimensional structures, explaining 59.1% and 61.5% of variance, respectively. Unidimensional models showed acceptable goodness-of-fit indices, with RMSEA values of 0.051 for PHQ-9 and 0.047 for GAD-7, indicating a close-to-good fit for both models. Strong correlations were observed between PHQ-9 and GAD-7 scores with HADS scores ($p<0.001$), indicating good convergent validity. Observed cut-off scores yielded high sensitivity and specificity in this sample population. The final Mongolian versions of the questionnaires exhibited robust psychometric properties. The PHQ-9 and GAD-7 were validated as reliable instruments for screening depression and anxiety among medical students in Mongolia. These findings improve the capacity for early identification and intervention in mental health among this population. However, further research should address limitations related to gender representation and the need for assessment in diverse settings.

Keywords: Depression; Anxiety; Mental health assessment; Validation; Cultural adaptation; PHQ-9; GAD-7; Mongolia

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1.0 INTRODUCTION

Currently, the only psychometrically validated tool used in Mongolia for detecting depression and anxiety is the Hospital Anxiety and Depression Scale (HADS), which is a measure for evaluating mental distress, anxiety, and depressive symptoms ([Lkhagvasuren et al., 2024](#); [Tumurbaatar et al., 2021](#)). According to recent research, the World Health Organization's GAD-7 and the PHQ-9 have become the leading choice of instruments to screen and diagnose anxiety and depression, respectively, in different populations globally. Considering their broad applications and well-established credentials across diverse cultural and clinical settings, it is essential to clarify their congruence with and relevance to the Mongolian setting. Although Mongolia has a high rate of suicide (18.5 per 100,000; [World Health Organization, 2025](#)) and the evidence of mental distress in the urban population is progressively increasing, no study has employed internationally validated PHQ-9 and GAD-7 to assess the prevalence of depression and anxiety at the population level. Lkhagvasuren et al. ([2024](#)) report that local research using the Hospital Anxiety and Depression Scale (HADS) found that the prevalence of depression and anxiety was very low, thus probably significantly underestimating the real rates because the instrument is shown to be psychometrically unstable in different cultural contexts. Worldwide meta-analyses based on the PHQ-9 and GAD-7, instead, consistently report an overall prevalence of 20–30% for moderate-to-severe symptoms. This gap between high suicide rates and low morbidity rates points to a fundamental problem of the measurement of these conditions. Hence, it is crucial to establish the reliability and discriminant validity of PHQ-9 and GAD-7 in Mongolia to produce data that are accurate, comparable, and useful for national mental health policy and intervention planning.

The research was based on the assumption that the Mongolian translations of the PHQ-9 and GAD-7 do not require validation procedures that involve special permissions, purchases, or copyright licensing agreements, in light of Mongolia's economic, health, and social situation. Validation of these measures is a critical step towards more standardized and

internationally comparable assessments of depression and anxiety within the Mongolian population. Moreover, establishing appropriate cut-off scores for these instruments would enable cross-national comparisons of prevalence rates and help build a more comprehensive picture of mental health trends in Mongolia. Our study seeks to pave the way for subsequent validation efforts among general and specific clinical subpopulations, thereby facilitating assessment of mental health and epidemiological research in the region.

We translated and validated the Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) into Mongolian, the primary language of communication in Mongolia. These two instruments are free, easy-to-administer, and cost-effective tools for assessing mental health. This study is aimed at filling a significant gap in mental health resources within the country, enabling healthcare professionals to screen for depression and anxiety among the population effectively. The validated PHQ-9 and GAD-7 in mental health settings will also serve as a source for clinical practice and research, in addition to advancing informed mental health policy development in Mongolia. Furthermore, we have prioritized validating the PHQ-9 and GAD-7 in different cultures and languages to ensure their reliability and accuracy in identifying depressive and anxiety disorders ([Gelave et al., 2013](#); [Konkan et al., 2013](#); [Sousa et al., 2015](#); [Wang et al., 2014](#)). Validation studies point to the necessity of continuous adaptation and testing of these instruments, given that cultural differences can influence the presentation and understanding of mental health symptoms ([Gopalkrishnan, 2018](#)). In particular, the need for validation is essential in regions where translated versions of these questionnaires have yet to be systematically evaluated ([Beaton et al., 2000](#)).

Generalized Anxiety Disorder (GAD) is a common psychiatric condition characterized by excessive worry and anxiety, which interferes with daily functioning. It is among the most prevalent anxiety disorders, impacting millions of individuals globally and significantly contributing to the overall burden of mental health

disorders ([Baxter et al., 2013](#)). Early detection and accurate assessment of GAD are crucial for implementing effective treatment strategies and preventing symptom escalation, which can lead to further psychological and physical health complications ([Bandelow et al., 2013](#)).

Depression, in turn, is a widely spread mental disorder that poses significant challenges to global public health, and it now affects individuals across all age groups and genders. According to the data presented by The World Health Organization, approximately 280 million people worldwide suffer from this debilitating condition ([Depressive Disorder \(Depression\), n.d.](#)). Recent studies have highlighted the multidimensional impact of depression in terms of not only the individual's health but also the social and economic aspects ([Hirschfeld et al., 2000](#); [Wang et al., 2003](#)). Depression is a major cause of social dysfunction, decreases workplace productivity, and can even lead to instability in relationships and family dynamics, which in turn, can multiply the suffering that comes from the disease, both on an individual and a social level ([Briley, 2011](#)). The negative effects of depression on the patient's health are not limited to its psychological nature, as the condition is most often linked with cardiovascular or other chronic diseases ([Moussavi et al., 2007](#); [Van Der Kooy et al., 2007](#)). Moreover, it is the main cause of the increased risk of death, including death by suicide, emphasizing the critical need for effective screening and intervention strategies ([Briley, 2011](#)). This complex interplay between mental and physical health further underscores the importance of comprehensive treatment approaches ([Goldman et al., 1999](#)).

The PHQ-9 is a self-report tool consisting of nine items based on the criteria for diagnosing depressive disorders as per the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) ([Kroenke et al., 2001](#)). Similarly, the GAD-7 is designed to identify potential cases of GAD with high sensitivity and specificity, which is confirmed by various studies performed in different populations ([Spitzer et al., 2006](#)). Both instruments have become integral components of mental health assessment due to their shortness and diagnostic accuracy ([Beard et al., 2016](#); [Plummer et al., 2016](#)).

This study's objective is to validate the PHQ-9 and GAD-7 in a specific cultural context by examining their psychometric properties among medical students to ensure they provide reliable and valid assessments of depression and anxiety. By confirming their diagnostic

accuracy and cultural appropriateness, healthcare providers will be better equipped to address these mental health challenges effectively, thereby contributing to improved mental health outcomes and enhanced patient care infrastructure ([Carroll et al., 2020](#)).

2.0 MATERIALS AND METHODS

2.1 Study population

The survey, conducted from 2021 to 2022, covered three Mongolian medical universities and was administered during lectures and lab sessions. Professors and instructors collected data while teaching classes. Multi-stage sampling began with convenience sampling, in which students were invited to participate freely via a web survey tool. Due to resource limitations and limited access, the researchers used a multi-stage convenience sampling method and, at the same time, implemented measures such as diverse recruitment and demographic comparisons to reduce bias in the sample. The inclusion criteria for the sample group were young adults aged 17–29 years. Since students were given the option to participate or decline, this constituted a non-probability sampling method. At the next stage, the snowball sampling method was used by asking for referrals in order to invite at least one student group to participate in the survey. To better manage the recruiting process, the number of referrals was deliberately limited. All the people who acted as referrers were given instructions and informed about the objectives and stages of the study so that the recruitment procedure would remain consistent. In addition, it should be noted that, as these referrers were university teachers and professors, they could ensure that the recruited participants' understanding and awareness of the mental health topics under investigation were at a high level. Those who were willing to take part opened the provided link, signed the consent form, and completed the survey. Participants who were not given informed consent or had withdrawn their consent before completing the survey were excluded from the final dataset. In this cross-sectional study, 1,391 students who met the inclusion criteria were invited to participate in the general validation study. The determination of sample size was based on the previous research ([Anthoine et al., 2014](#)), which suggested that the number of participants per item for psychometric studies should be 2–20. Sample sizes for independent variables were set at 1,391 for the main study, 307 for test-retest reliability, and 117 for convergent validity, thus providing sufficient data for a rigorous psychometric analysis. The participants for the

test-retest ($n=307$) and convergent validity ($n=117$) were the same medical students who were initially 1,391 in number.

2.2 Data collection

Data collection began on December 14, 2021, and the preliminary dataset was extracted on May 26, 2022. The study was conducted in Cyrillic Mongolian. The cross-cultural adaptation process included pilot tests using a nine-item draft of the PHQ-9 and a seven-item draft of the GAD-7. All participants completed form-based online questionnaires addressing their socio-demographic (gender, age, residency, major, religious belief, and family financial status) questions and the study instruments.

2.3 Instruments

The Patient Health Questionnaire-9 (PHQ-9) is a self-report screening tool that measures the presence and severity of major depressive symptoms. It consists of 9 questions that are based on the 9 (DMS-IV) criteria for major depression. Major depression is diagnosed if 5 or more of the 9 depressive symptom criteria have been present at least “more than half the days” in the past 2 weeks, and 1 of the symptoms is depressed mood or anhedonia. Other depression is diagnosed if 2-4 depressive symptoms have been present at least “more than half the days” in the past 2 weeks, and 1 of the symptoms is depressed mood or anhedonia. As a severity measure, the PHQ-9 score can range from 0 to 27, since scores for each item range from 0 (not at all) to 1 (several days), 2 (more than half of the days), and 3 (nearly every day) ([Kroenke et al., 2001](#)).

The General Anxiety Disorder-7 (GAD-7) screening tool was employed to assess the severity of generalized anxiety disorder symptoms among participants. The GAD-7 consists of seven items that inquire about the frequency of various anxiety symptoms experienced over the past two weeks. Each item is rated on a four-point Likert scale, ranging from 0 (not at all) to 3 (nearly every day), yielding a total score between 0 and 21, with higher scores indicating greater anxiety severity ([Spitzer et al., 2006](#)).

A multidisciplinary expert committee translated and adapted PHQ-9 and GAD-7 into Mongolian. The committee comprised three professional mental-health researchers, an associate professor from the Department of Mental Health at the Mongolian National University of Medical Sciences and two psychiatrists from the National Center for Mental Health. Initial forward translations were independently

back-translated into English by two professionals specialized in medical and psychological terminology, neither of whom had previous knowledge of the original English versions. Back-translations were carefully discussed and reconciled by the expert committee into the final Mongolian versions. Finally, we administered the Mongolian versions of PHQ-9 and GAD-7 to study participants.

The Hospital Anxiety and Depression Scale (HADS) is a frequently used tool that measures symptoms of anxiety and depression. It is divided into an Anxiety subscale (HADS-A) and a Depression subscale (HADS-D), each containing seven items ([Zigmond & Snaith, 1983](#)). Scoring for each item ranges from zero to three, while the summed scores for both subscales range from 0 to 21. A subscale score greater than 8 indicates anxiety or depression. In this study, we used a version of the HADS that was translated into Mongolian and verified for its reliability and validity ([Tumurbaatar et al., 2021](#)).

2.4 Statistical analysis

The study characteristics were expressed as means with standard deviations for normally distributed variables, and as counts with percentages for categorical variables. The reliability of the questionnaire was assessed using Cronbach's alpha (excellent ≥ 0.9 ; good ≥ 0.8 ; acceptable ≥ 0.7) to evaluate internal consistency. The test-retest procedure was performed at two-week intervals, and the intraclass correlation coefficient (ICC) was calculated. ICC values of <0.5 , from 0.5 to 0.7, from 0.7 to 0.9, and >0.9 were considered to have poor, moderate, good, and excellent test-retest reliability, respectively ([Koo & Li, 2016](#)). Validity was evaluated by principal component analysis (PCA) with varimax rotation. Factor analysis suitability was examined by the Bartlett test of sphericity ($p < 0.001$) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, which yielded an acceptance value ($p > 0.65$), followed by determining the number of relevant factors via eigenvalue analysis. Factors with eigenvalues >1 were considered meaningful and retained for rotation ([Cattell, 1966](#)). A factor loading of 0.4 was established as the lower bound for a variable to be included in the respective factor structure (Koo & Li, 2016). Confirmatory factor analysis (CFA) was performed to assess the one-factor model fit using the following criteria for the structural equation modeling: the Tucker-Lewis index (TLI), a comparative fit index (CFI) close to 0.90 or above, and the root-mean-square error of approximation (RMSEA < 0.08). To assess convergent validity, Pearson's correlations were calculated with the HADS anxiety, depression, and total scores. The

correlation coefficients of 0.10-0.39, 0.40-0.69, 0.70-0.89, and 0.9-1.0 were weak, moderate, strong, and very strong, respectively (Schober et al., 2018). A receiver operating characteristic (ROC) curve and area under the curve (AUC) were constructed to evaluate the diagnostic capacity of different cut-off points for the PHQ-9 and GAD-7 in identifying the presence of mental health issues, as previously reported (Bat-Erdene et al., 2023; Lkhagvasuren et al., 2024; Tumurbaatar et al., 2023). The optimal cut-off point was determined by the maximum Youden index ($J > 0.5$), which represents the maximum sum of sensitivity and specificity on an ROC curve. Data analyses were performed using IBM SPSS v.30 for descriptive statistics and reliability analyses, and Amos v.26 for confirmatory factor analysis to assess the unidimensional structure and psychometric properties of the PHQ-9 and GAD-7.

2.5 Ethics approval and consent to participate

All procedures in this study were conducted in accordance with the ethical standards of the institutional research committee and the 1964 Declaration of Helsinki and its later amendments. The design and methods were reviewed and approved by the ethics committee at the Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia (number: MNUMS 21/3-06). This study was not classified as a clinical trial and, therefore, did not require registration. Informed consent was obtained from all participants prior to data collection, and all agreed to

participate in the study. All participants received individualized feedback on their PHQ-9 and GAD-7 results and attended a lecture on anxiety, depression, stress, and stress management to enhance mental health awareness. No formal follow-up or referral was conducted due to resource limitations.

3.0 RESULTS

3.1 Demographics and frequency of the PHQ-9 and GAD-7

Of the 1,391 young adults in the main study, 307 distinct participants were retested for reliability, and a separate group of 117 were assessed with the Hospital Anxiety and Depression Scale (HADS) for convergent validity, all drawn from the same initial sample. The mean age of all participants was 20.9 ± 2.0 years, with ages ranging from 17 to 29 years. Among the participants, there were 1,039 females (74.7%) and 352 males (25.3%). Additionally, 645 participants (46.4%) were residents of Ulaanbaatar, while 746 (53.6%) were registered residents of rural areas. Of the 1,391 participants, 774 (55.6%) were in their first to third academic years (courses 1–3) of the medical curriculum.

The mean score of the PHQ-9 was 6.7 ± 5.7 , with skewness 0.77, kurtosis 0.001, an IQR of 6 (2–10), and a range of 0 to 26. The mean score of the GAD-7 was 8.7 ± 4.9 , with skewness 0.48 and kurtosis -0.26. IQR was 8 (5–12), and the range was 0 to 21 (Table 1).

Table 1. Descriptive Statistics for PHQ-9 and GAD-7 scores.

Characteristics		Mean \pm SD	Skewness \pm SE	Kurtosis \pm SE	IQR	
Total participant	PHQ-9	6.69 \pm 5.67	0.769 \pm 0.066	0.001 \pm 0.131	6.00(2.00~10.00)	
	GAD-7	8.74 \pm 4.92	0.484 \pm 0.066	-0.263 \pm 0.131	8.00(5.00~12.00)	
Gender	Male, 352(25.3)	PHQ-9	6.35 \pm 5.77	0.895 \pm 0.130	0.259 \pm 0.259	5.00(1.00~10.00)
		GAD-7	8.54 \pm 5.04	0.562 \pm 0.130	0.016 \pm 0.259	8.00(5.00~11.00)
	Female, 1039(74.7)	PHQ-9	6.80 \pm 5.63	0.729 \pm 0.076	-0.071 \pm 0.152	6.00(2.00~10.00)
		GAD-7	8.81 \pm 4.87	0.458 \pm 0.076	-0.359 \pm 0.152	8.00(5.00~12.00)
Age group	<19, 424(30.5)	PHQ-9	8.27 \pm 6.17	0.505 \pm 0.119	-0.506 \pm 0.237	8.00(3.00~12.00)
		GAD-7	9.51 \pm 5.23	0.313 \pm 0.119	-0.559 \pm 0.237	9.00(5.25~13.00)
	20-24, 916(65.9)	PHQ-9	6.05 \pm 5.28	0.840 \pm 0.081	0.256 \pm 0.161	5.00(1.00~9.00)
		GAD-7	8.50 \pm 4.72	0.543 \pm 0.081	-0.071 \pm 0.161	8.00(5.00~11.00)
	>25, 51(3.7)	PHQ-9	4.96 \pm 5.51	1.337 \pm 0.333	1.481 \pm 0.656	4.00(0.00~9.00)
		GAD-7	6.71 \pm 4.79	0.809 \pm 0.333	-0.084 \pm 0.656	6.00(3.00~10.00)
Residency location	Ulaanbaatar city, 645(46.4)	PHQ-9	7.13 \pm 5.90	0.726 \pm 0.096	-0.101 \pm 0.192	6.00(2.00~11.00)
		GAD-7	9.23 \pm 5.05	0.376 \pm 0.096	-0.396 \pm 0.192	9.00(6.00~12.00)
	Rural areas, 746(53.6)	PHQ-9	6.30 \pm 5.43	0.788 \pm 0.090	0.047 \pm 0.179	5.00(1.75~10.00)
		GAD-7	8.32 \pm 4.76	0.574 \pm 0.090	-0.094 \pm 0.179	8.00(5.00~11.00)

3.2 Reliability

3.2.1 Internal consistency

Cronbach's alpha for the total scale was 0.913 and 0.895 for the Mongolian versions of the questionnaires, indicating high internal consistency (**Table 2**).

3.2.2 Test-retest reliability

The two-week test-retest reliability ($n=304$) of the total scores of the Mongolian versions of the PHQ-9 and GAD-7 were 0.778 and 0.782, respectively. Significant positive the strongest correlation between Test and Retest evaluated item 6 (ICC=0.693), and the lowest correlation in item 1 (ICC=0.536) for PHQ-9. The strongest correlation between Test and Retest was observed for item 6 (ICC=0.747), and the lowest for item 7 (ICC=0.623) in GAD-7 (**Table 3**).

3.3 Validity

3.3.1 Construct validity

The criteria used for factor analysis were evaluated using the Kaiser-Meyer-Olkin measure of sampling

adequacy (KMO) and Bartlett's test of sphericity. KMO was 0.934, indicating the adequacy of the sample, and Bartlett's test of sphericity was significant ($p<0.001$), indicating that the factor analysis was justified. The exploratory factor analysis of the PHQ-9 extracted only one factor. All 9 items accounted for 59.1% of the observed variance, with an Eigenvalue of 5.320 indicating depression. The criteria used for factor analysis were evaluated using the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and Bartlett's test of sphericity. KMO was 0.908, indicating the adequacy of the sample, and Bartlett's test of sphericity was significant ($p<0.001$), indicating that the factor analysis was justified. The exploratory factor analysis of the GAD-7 extracted only one factor. All 7 items explained 61.5% of the observed variance, with an Eigenvalue of 4.306 indicating general anxiety (**Table 4**). RMSEA was 0.092, and TLI was 0.939 for the overall model fit ($\chi^2 = 345, p<0.001$) for PHQ-9. RMSEA was 0.101, and TLI was 0.938 for the overall model fit ($\chi^2 = 214, p<0.001$) for GAD-7.

Table 2. Cronbach's Alpha Values Per Item for PHQ-9 and GAD-7 Scales ($n=1391$).

Items	PHQ-9 Depression	GAD-7 Anxiety
Item 1	0.899	0.881
Item 2	0.897	0.879
Item 3	0.902	0.880
Item 4	0.899	0.874
Item 5	0.901	0.880
Item 6	0.901	0.882
Item 7	0.902	0.880
Item 8	0.909	-
Item 9	0.915	-
Total	0.913	0.895

Table 3. Intraclass Correlation Coefficients per Item for PHQ-9 and GAD-7 ($n=307$).

Items	ICC (95% CI)	
	PHQ-9 Depression	GAD-7 Anxiety
Item 1	0.536 (0.419-0.630)	0.631 (0.538-0.706)
Item 2	0.581 (0.474-0.665)	0.637 (0.545-0.710)
Item 3	0.627 (0.533-0.702)	0.649 (0.560-0.720)
Item 4	0.605 (0.505-0.685)	0.660 (0.573-0.728)
Item 5	0.657 (0.570-0.726)	0.637 (0.545-0.711)
Item 6	0.693 (0.615-0.755)	0.747 (0.684-0.798)
Item 7	0.621 (0.525-0.697)	0.623 (0.527-0.699)
Item 8	0.555 (0.443-0.645)	-
Item 9	0.594 (0.491-0.676)	-
Total	0.778 (0.722-0.823)	0.782 (0.727-0.826)

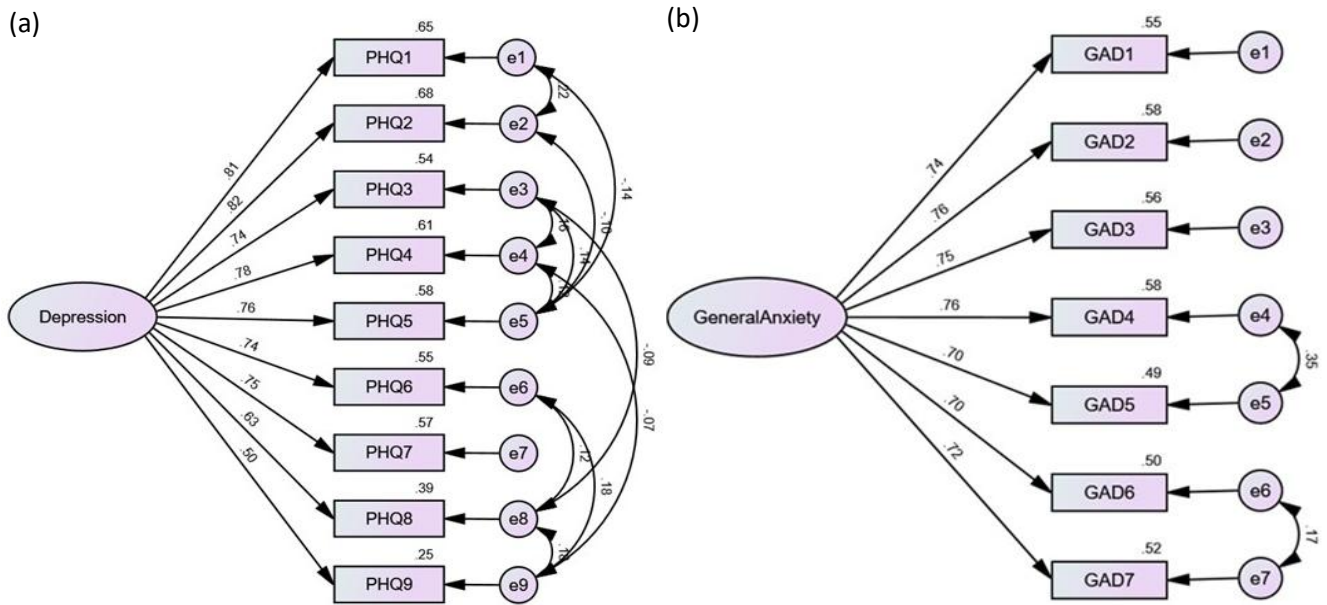


Figure 1. Confirmatory factor analysis path diagram. Rectangles indicate measured variables, and large ellipses represent subscales. Covariances of errors between items with similar content are shown. (a) Path diagram of the PHQ-9; (b) Path diagram of the GAD-7.

We next conducted a confirmatory factor analysis to assess the goodness-of-fit of the factor model for the Mongolian versions of the PHQ-9 and GAD-7 (**Figure 1**). The unidimensional model of the questionnaires showed an excellent model fit. The factor loadings ranged between 0.585 and 0.841 for PHQ-9, and between 0.768 and 0.822 for GAD-7. Furthermore, we proposed models that could be improved by allowing correlations among the error variances, items, factors, and inter-item correlations. Modifications were made to optimize the unidimensional structure of the questionnaires according to the modification indices,

which suggested adding covariances between error items (PHQ-9: 1-2, 1-5, 2-5, 3-4, 3-5, 3-8, 4-5, 4-9, 6-8, 6-9, 8-9; GAD-7: 4-5, 6-7). After that, the models showed acceptable goodness-of-fit indices. The RMSEA was 0.051, CFI was 0.992, TLI was 0.982, RFI was 0.977, and NFI was 0.990 for PHQ-9. RMSEA of this model was 0.047, CFI was 0.992, TLI was 0.987, RFI was 0.982, and NFI was 0.990 for GAD-7 in these models. The unifying structure of the model was assessed using the summary of fit indices, with $\chi^2/df < 5$, fit indices > 0.90 , and $RMSEA < 0.08$ indicating a good fit (**Table 5**). These findings indicate that the models were well-fitted.

Table 4. Exploratory Factor Analysis ($n=1391$).

Items	PHQ-9 Depression	GAD-7 Anxiety
Item 1	0.820	0.774
Item 2	0.841	0.788
Item 3	0.781	0.777
Item 4	0.813	0.822
Item 5	0.789	0.780
Item 6	0.788	0.768
Item 7	0.781	0.780
Item 8	0.690	-
Item 9	0.585	-
Eigenvalues	5.320	4.306
Total variance explained	59.1%	61.5%

Table 5. Confirmatory Factor Analysis ($n=1391$).

	<i>p</i> -value	CMIN/df	RMSEA	TLI	CFI	RFI	NFI
PHQ-9 Unidimensional model	<0.001	4.551	0.051	0.982	0.992	0.977	0.990
GAD-7 Unidimensional model	<0.001	4.089	0.047	0.987	0.992	0.982	0.990

Table 6. Convergent Validity Correlations ($n=117$).

Questionnaires	HADS-A	HADS-D	HADS total score
PHQ-9	0.612***	0.474***	0.644***
GAD-7	0.802***	0.406***	0.728***

*** $p < 0.001$; *p*-values were calculated using Pearson's correlations.

Table 7. Cut-off scores of the PHQ-9 and GAD-7 ($n=117$).

Questionnaires	State variable (HADS scores)	AUC	Cut-off points	Sensitivity	Specificity	Youden's Index
PHQ-9	Depression >9	0.694	7.00	0.906	0.435	0.342
GAD-7	Anxiety >9	0.908	9.00	0.822	0.875	0.697

3.3.2 Convergent validity

To determine convergent validity, we calculated the correlations of the total scores of PHQ-9 and GAD-7 with the anxiety, depression, and total scores of the HADS. The PHQ-9 total score correlated with the HADS scores (anxiety: $r=0.612$, $p < 0.001$; depression: $r=0.474$, $p < 0.001$; total score: $r=0.644$, $p < 0.001$), indicating that the construct identifies anxiety and depression symptoms as a whole construct of mental distress. In contrast, the total GAD-7 score correlated with the HADS scores (anxiety: $r=0.802$, $p < 0.001$; depression:

$r=0.406$, $p < 0.001$; total score: $r=0.728$, $p < 0.001$), which indicates that the construct identifies anxiety (Table 6).

3.3.3 Cut-off scores of the PHQ-9 and GAD-7

The AUC values for the PHQ-9 were 0.694, while the AUC values for the GAD-7 were 0.908. Based on the maximum Youden index, a score of 7 or higher on the PHQ-9 is identified as a critical threshold for detecting depression. Similarly, a score of 9 or more on the GAD-7 indicates clinically significant anxiety (Table 7, Fig. 2).

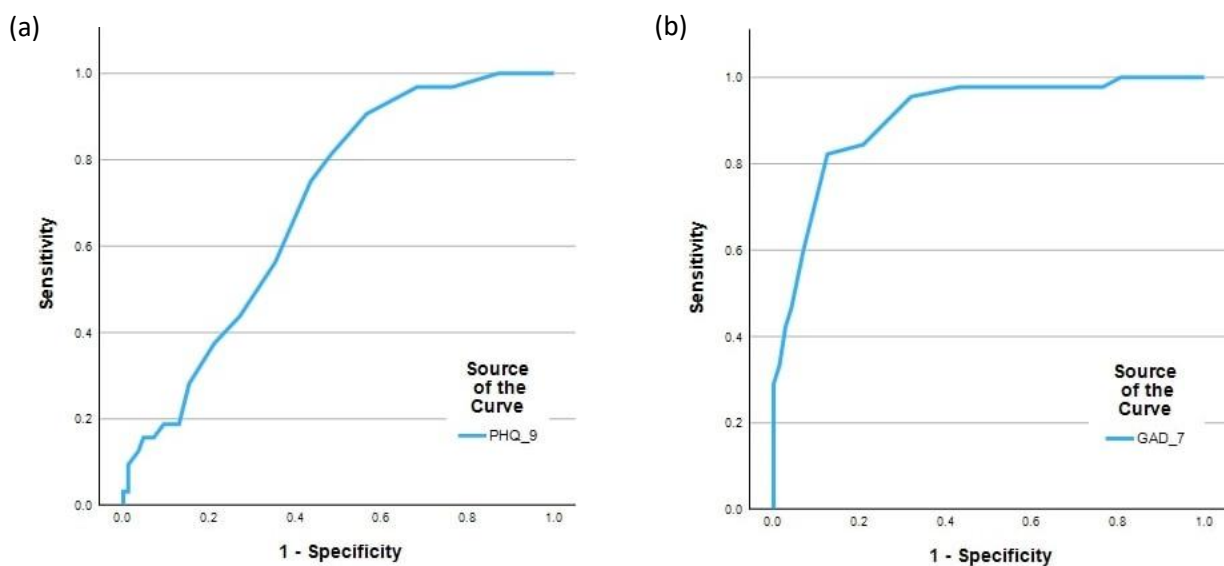


Figure 2. ROC curves of the PHQ-9 and GAD-7. (a) sensitivity and specificity were plotted at a variety of thresholds for a single variable created by dichotomizing the HADS depression score with the cut-off score of 10. (b) The sensitivity and specificity were plotted at a variety of thresholds for a single variable created by dichotomizing the HADS anxiety scores with the cut-off score of 10 (Lkhagvasuren et al., 2024).

4.0 DISCUSSION

The PHQ-9 (mean=6.7±5.7) and GAD-7 (mean=8.7±4.9) indicated mild to moderate depressive and anxiety symptoms, respectively, among Mongolian medical students, reflecting their sensitivity to the target population's mental health challenges. The excellent internal consistency (Cronbach's alpha=0.913 for PHQ-9, 0.895 for GAD-7) confirms that the translated items measure depression and anxiety cohesively, while the good test-retest reliability (ICC=0.778 for PHQ-9, 0.782 for GAD-7) supports their stability for longitudinal use. These findings affirm the psychometric robustness of the Mongolian PHQ-9 and GAD-7, making them reliable tools for screening and monitoring mental health in this context.

We validated two self-report questionnaires, the PHQ-9 and the GAD-7, which have been shown to be reliable instruments for screening mental health issues among younger adults. Our results indicate that both questionnaires demonstrate excellent internal consistency and high external reliability. EFA revealed unidimensional constructs consisting of 9 items for the PHQ-9 and 7 items for the GAD-7. These findings were reinforced by CFA, which confirmed excellent construct validity as reflected by favorable fit indices. The final Mongolian versions of these questionnaires have been established as valid and reliable measures for screening mental health issues in students who have not been diagnosed previously.

Convergent validity was supported by strong associations found between the scores of both questionnaires and scores of anxiety, depression, and mental distress as assessed by the previously validated Mongolian version of the Hospital Anxiety and Depression Scale (HADS). The hypothesized unidimensional structure observed in our study sample of medical students was confirmed through both PCA and CFA.

Additionally, prior research has focused on modifying the PHQ-9 to better capture cultural expressions of depression. One study showed that an adapted version of the PHQ-9 exhibited strong psychometric properties within Spanish-speaking populations, affirming its relevance and effectiveness across diverse cultural contexts ([Muñoz-Navarro et al., 2017](#)). Likewise, the GAD-7 has been adapted for use in several languages, including German ([Löwe et al., 2008](#)), Arabic ([Sawaya et al., 2016](#)), and Chinese ([Tong et al., 2016](#)), reinforcing its utility across different populations.

Both questionnaires have been validated, demonstrating strong internal consistency and construct validity, indicating successful adaptation across various cultural contexts. Our findings also support previous results. For instance, a study involving university students reported an excellent Cronbach's alpha coefficient for the PHQ-9, underscoring its reliability as a measure of depressive symptoms in this demographic ([Keum et al., 2018](#); [Zhang et al., 2013](#)). Likewise, the GAD-7 demonstrated an excellent Cronbach's alpha coefficient, affirming its reliability for assessing anxiety severity within the same group ([Byrd-Bredbenner et al., 2021](#); [White & Karr, 2023](#)). Our results highlighted the excellent internal consistency of both questionnaires.

Interclass correlation (ICC) values for these questionnaires are often strong to excellent coefficients, consistent with our findings, suggesting strong agreement between repeated measures and reinforcing their reliability in clinical assessments ([Kroenke et al., 2001](#); [Petersen et al., 2015](#); [Sousa et al., 2015](#)). Furthermore, studies have shown that both the Hospital Anxiety and Depression Scale (HADS) and the PHQ-9 reliably identify depression and anxiety, indicating significant correlations between their scores across different populations ([Cameron et al., 2008](#); [Hansson et al., 2009](#)). A notable association has also been found between the HADS anxiety subscale and GAD-7 scores, with strong correlation coefficients. This reinforces the notion that the GAD-7 is an effective tool for measuring generalized anxiety in various clinical populations alongside the HADS ([Baker et al., 2018](#); [Esser et al., 2018](#); [Gong et al., 2021](#)).

Moreover, Exploratory Factor Analysis (EFA) conducted on college student samples has revealed a strong one-factor solution for the PHQ-9, explaining a significant proportion of variance in the data. This unidimensionality is also supported in primary care settings ([Arroll et al., 2010](#); [González-Blanch et al., 2018](#)). Similarly, EFA results for the GAD-7 showed a one-factor solution, indicating that it effectively captures generalized anxiety symptoms in diverse populations, including those with clinical and non-clinical presentations ([Beard & Björgvinsson, 2014](#); [Spitzer et al., 2006](#)).

The cut-off scores established for the Patient Health Questionnaire-9 (PHQ-9) and the Generalized Anxiety Disorder 7-item scale (GAD-7) are crucial for identifying the presence of mental health issues. Recent studies indicate that clinically calculated cut-off scores for both

questionnaires are often above 10 ([Moriarty et al., 2015](#); [Schueller et al., 2015](#); [Snijkers et al., 2021](#)). However, our established cut-off scores of 7 for the PHQ-9 and 9 for the GAD-7 are largely supported by some research, although slight variations in the recommended thresholds may arise depending on the specific findings and clinical contexts ([Grapp et al., 2025](#); [Levis et al., 2024](#); [Manea et al., 2012](#); [Plummer et al., 2016](#)).

These cut-off scores inform clinicians about the necessity for further evaluation and potential intervention, thereby enhancing the opportunity for timely mental health care ([Kroenke et al., 2001](#); [Spitzer et al., 2006](#)). Continuous validation of these scores remains essential, particularly as they are applied in diverse populations and healthcare settings. While the established cut-off scores provide a valuable framework for assessment, it is crucial to recognize that these scores may vary based on context, demographic factors, cultural differences, and clinical population or general population.

In summary, both the PHQ-9 and GAD-7 have undergone successful cross-cultural adaptations and validation, demonstrating their reliability and effectiveness in assessing depression and anxiety across diverse cultural contexts. However, the study population presented certain limitations. The gender composition of our sample, with female students constituting 75% of participants, did not accurately reflect the gender distribution of Mongolia's overall population. Previous research indicates that women have a higher prevalence of mental disorders, such as depression and anxiety, compared to men ([Asher et al., 2017](#); [Bromet et al., 2011](#)). This disparity may suggest that women in Mongolia are more engaged with their healthcare needs and consequently more willing to participate in research.

Many studies suggest that the PHQ-9 functions as a single-factor model, indicating that a single factor accounts for most of the variance in responses. However, some research has proposed the potential for a two-factor model that differentiates between somatic symptoms and cognitive/affective symptoms ([Granillo, 2012](#); [Tibubos et al., 2021](#)). In contrast, the eigenvalues derived from factor analysis of the GAD-7 offer strong evidence for its unidimensionality, confirming that this questionnaire is an effective tool for assessing generalized anxiety. Our results align with those of previous publications, showing relatively high eigenvalues exceeding 4, particularly following a sharp

decline observed in the scree plot ([Dhira et al., 2021](#); [Johnson et al., 2019](#)).

This study has several methodological limitations. First, because participants were exclusively medical students, the questionnaires' unidimensional structure may be applicable only to this specific population. The sample drawn through snowball sampling may not wholly represent the broader Mongolian population. Future research should aim to test the Mongolian versions of these questionnaires in different demographic groups. Second, the gender imbalance in the sample likely impacted the survey results, and future studies should also investigate the influence of socioeconomic status on mental health outcomes. Third, while we assessed construct and convergent validity, this study did not explore criterion and discriminant validity.

Furthermore, to more robustly determine the sensitivity and specificity of the questionnaires, assessments should be conducted in both clinical and nonclinical settings using a longitudinal design and diagnostic criteria.

5.0 CONCLUSIONS

This study successfully validated the PHQ-9 and GAD-7 among medical students in Mongolia, demonstrating excellent internal consistency (Cronbach's alpha: 0.913 for PHQ-9, 0.895 for GAD-7) and good test-retest reliability (ICC: 0.778 for PHQ-9, 0.782 for GAD-7). These instruments are reliable tools for screening depression and anxiety in this population. We recommend the following: (1) Integrate the PHQ-9 and GAD-7 into routine health screenings at universities for early intervention. (2) Provide training for healthcare providers and university counsellors on administering and interpreting these tools to facilitate timely referrals to mental health services. (3) Expand the use of these validated instruments to other Mongolian populations. (4) Develop mental health awareness programs to educate students on managing depression and anxiety. (5) Conduct longitudinal studies to monitor symptom changes using these tools. These recommendations aim to maximize the practical utility of the PHQ-9 and GAD-7 for improving mental health outcomes in Mongolia.

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