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PSYCHOMETRIC PROPERTIES OF THE SCALE FOR ANXIETY MEASUREMENT (SAM)

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ABSTRACT Anxiety has many forms and affects a large section of society across the life span. Many tools have been developed to examine Anxiety as a trait; however, clinical aspects of Anxiety have not been assessed properly. Scale for Anxiety Measurement (SAM) is a self-report questionnaire that contains 65 items that measure anxiety on nine dimensions: generalized anxiety disorder, social anxiety disorder, panic disorder, phobias, separation anxiety disorder, somatic symptoms disorder, illness anxiety disorder, state and trait anxiety, and impact scale. We aim to develop a screening tool for the non-clinical population to identify areas of concern in anxiety as per DSM-V diagnostic categories. In this paper, we aimed to examine the validity and reliability of the SAM in a non-clinical setting. The standardization of the questionnaire was conducted on participants from the normal population (n=944) and clinical population (n=102). Principal Component Analysis and item analysis was performed to assess the reliability and validity of the questionnaire. Test-Retest Reliability of SAM was measured on a sub-set(n=34) who re-administered the SAM after a week. Results revealed that there are 16 dimensions and the total model explained 64.8% variance with 61 items. Internal consistency, using Cronbach alpha and test-retest reliability was strong. The SAM is a valid, reliable, and effective measure of anxiety. It will be a useful tool for screening and assessing anxiety symptoms in non-clinical as well as clinical Indian settings.

KEYWORDS : *Anxiety, Questionnaire, Types, Validity, and Reliability*

INTRODUCTION

Anxiety has been one of the most prevalent mental health disorders in India, affecting 44.9 million people in 2017 (Sagar et al., 2022). As newer anxiety management techniques have entered the realm of evidence-based strategies, making an accurate diagnosis has become all the more imperative as clinicians need to distinguish between clinical forms of anxiety and normal anxiety. DSM-V is the current globally accepted golden standard to diagnose anxiety disorders. Many questionnaires have been developed and validated to screen anxiety disorders, among them the better known and most widely used measure is the GAD-7 (Spitzer et al., 2006) which has good sensitivity and specificity. GAD-7 has been established as a reliable and valid tool across clinical (Kertz et al., 2013; Rutter and Brown, 2017) as well as the general population (Löwe et al., 2008; Hinz et al., 2017) but needs additional questionnaires to support anxiety disorder diagnosis. Another widely used measure STAI (Spielberger CD., 2005) gives an overview of state and trait anxiety but does not evaluate different kinds of anxiety. HAM-A (Maier W et al,.1985) is also a frequently used interview schedule in clinical set-ups but it doesn't capture the 'worry' factor (Koerner et al., 2010, Porter et al. 2017) and each tool has its own advantages and limitations such as it does not evaluate different kinds of anxiety.

Therefore, we developed a new questionnaire to measure multiple types of anxiety and clinical presentations. 'Scale for Anxiety Measurement (SAM)' is a self-report questionnaire. It includes 65 items, measuring anxiety disorders on nine dimensions: generalized anxiety disorder, social anxiety disorder, panic disorder, phobias, separation anxiety disorder, somatic symptoms disorder, illness anxiety disorder, state and trait anxiety, and impact scale.

The purpose to create SAM was to screen for anxiety disorders in the normal as well as clinical population. Nine dimensions of anxiety were selected so as to cover all facets of anxiety based on DSM-V criteria, thereby providing a holistic questionnaire to screen for anxiety disorders as well as tap state or trait anxiety with its impact on the life of subjects. In this paper, we aim to present the process of tool construction and the psychometric properties of SAM. The tool is intended to help clinicians to screen all types of anxiety disorders in the normal population as well as the clinical population in India.

METHODS

Development of SAM

SAM is a self-reported Likert's type scale that consists of 65 items. Initially, a pool of 82 items was developed, after reviewing and refining, the items were reduced to 75. The items were created based on the existing theories and reviewing available instruments and considering the stakeholders involved in the process. These items were sent to experts for content validation. Based on their feedback, the items were modified and reduced to 65. Responses were on a Likert-type scale, ranging from 0 = "Strongly Disagree", 1 = "Disagree", 2 = "Uncertain", 3 = "Agree", 4 = "Strongly agree".

Participants

The participants (n=944) were from 4 different cities in India namely Surat, Baroda, Ahmedabad, and Pune, belonging to the age group 14-84 age. Adolescent groups were from a local school and others were recruited using a convenient sampling method. The participants entered the study voluntarily after being informed about the study. Instructors were recruited to collect data on behalf of the principal investigator. In total, data was collected from 1080 participants over a period of six months. Participants were assured of anonymity and that the information obtained would be used by the researcher for the purpose of an article only.

As one of the objectives of the study is to prove the factorial construct validity of the tool, the sample size should be decided based on the requirement for factor analysis. Consider, factor analysis is a technique that requires a large sample size and is based on the stability of the correlation matrix of the variables involved (Tabachnick& Fidell, 2001) (Comrey& Lee's 1992). The advice regarding sample size is: 50 cases is very poor, 100 is poor, 200 is fair, 300 is good, 500 is very good, and 1000 or more is excellent. If factor loadings were kept above 0.5, a sample size of 120 is satisfactory. (Statistical Software, Inc., 1993).(Stevens, 2003)

Data analysis

The collected data was cleaned and processed before the final analysis. A principal component analysis was used to establish the factorial validity of the items of the SAM scale. The acceptable level of communalities and factor loadings for items would be 0.5 and eigenvalues greater than one would be considered for component factors. For the data reduction, the following norms were considered: Principal component analysis, Varimax rotation, Communalities > 0.5, Factor loading > 0.5(as the study sample size is more than120), Sample size 980, KMO/MSA> 0.45, Anti image correlation matrix > 0.45, Correlation matrix >30% and Eigenvalue > 1(Kaiser H & Caffrey J 1965).An item analysis was done to check the reliability of the scale components and Cronbach's alpha Demographic and clinical informations were presented as counts, percentages or means, and standard deviations appropriately. Relative test-retest reliability was determined by the Intraclass correlation coefficient. And the Absolute

reliability determined by standard error of measurement (SEM) using the formula SEM = SD, where SD is the average standard deviation of the two session scores. The minimal detectable change was calculated using the formula 1.96 x √2 x SEM..The limits of agreement between two session scores was evaluated by plotting the difference in scores during the two testing occasions against the baseline scores in the Bland-Altman graph. The limits of the agreement was 95% confidence interval within the difference score..The IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp was used for analysis and the statistical significance was set at $p<0.05$

RESULTS

Factor analysis with 65 items(n=944)

Initially, the factorability of the 65 items SAM scale was examined. Several well-recognized criteria for the factorability of a correlation were used. Firstly, all the 65 items correlated at least 0.3 with at least one other item, and the Determinant was 0.001. Moreover, an inspection of the correlation matrix revealed that more than 30% of correlations are significant at the 0.01 level, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.917, above the recommended value of 0.6, and Bartlett's test of sphericity was significant ($\chi^2(2080) = 15794.72$, $p < 0.05$). The diagonals of the anti-image correlation matrix were all over 0.5, supporting the inclusion of each item in the factor analysis. Finally, the communalities were all 4 and above, further confirming that each item shared some common variance with other items.

Principal components analysis was used because the primary purpose was to identify and compute composite coping scores for the factors underlying the SAM scale. The initial analysis considering factors with more than one Eigenvalue produced a seventeen-factor solution with 54.264% total variance. The initial Eigenvalues showed that the first factor explained 17.86% of the variance, the second factor 4.81% of the variance, and a third factor 3.34% of the variance. The other fourteen factors had eigenvalues between 1% and 2% without rotation loadings.There was little difference between the varimax and oblimin solutions, thus both solutions were examined in the subsequent analyses before deciding on varimax rotation for the final solution.

Factor analysis with 61 items(n=944)

During several steps, a total of four items were eliminated because they did not contribute to a simple factor structure and failed to meet a minimum criteria of having a primary factor loading of .5 or above, and no cross-loading of .3 or above. The items " I get tense before going for any social functions", " I cannot tolerate seeing blood/ receiving injections", "While thinking, I am unable to sit still and have to move around" and "It is difficult for me to concentrate on whatever I am doing due to interfering thoughts".did not load above .5 on any factor. They are item numbers 2, 19, 31 and 36 removed from analysis for the next step, reducing the number of items for analysis to 61. The Kaiser-Meyer-Olkin measure of sampling adequacy was .916, above the recommended value of .6, and Bartlett's test of sphericity was significant ($\chi^2(1830) = 14674.44$, $p < .05$). The analysis considering factors more than one eigenvalue produced a sixteen-factor solution with 54.41% total variance. The initial Eigenvalues showed that the first factor explained 6.18% of the variance, the second factor 4.76% of the variance, and a third factor 4.67 % of the variance. The factors had Eigen values more than the one explained variance between 2% and 4 %.

Factor analysis with 61 items in patient population (n=102)

The Kaiser-Meyer-Olkin measure of sampling adequacy was .612, above the recommended value of .6, and Bartlett's test of sphericity was significant ($\chi^2(1830) = 3209.65$, $p < .05$). The analysis considering factors more than one eigenvalue produced a sixteen-factor solution with 68.44% total variance.

Item analysis for internal consistency

The internal consistency reliability was tested by Cronbach's coefficient for the SAM scale showed high reliability with Cronbach's alpha 0.913. and for each of the factor components, the observed coefficients ranged from 0.910 to 0.915, also indicating high reliability. By convention, a lenient cut-off of 0.60 is common in exploratory research; alpha should be at least 0.70 or higher to retain an item on an "adequate" scale. Many researchers require a cut-off =0.80 for a "good scale(Encyclopedia of Gerontology1996). Moreover split-half reliability was also carried out for scale reliability which showed Cronbach's alpha .849 for the first thirty-one items and .840 for the second thirty items. And the Guttmann split-half coefficient was .889. (Streiner D et al.,2008)

Test-Retest reliability (n=34)

The ICC value based on the total scores of the first (test) and second (retest) assessment, was 0.917 (ICC 2,1; 95% CI = 0.842–0.958; $p<0.001$).(Deyo RA et al.,1991)The descriptive data for different dimensions of the scale are shown in Table 1 and ICC for different dimensions of the scale is shown in Table2.The ICC values range from 0 to 1: 1 = perfect reliability,0.90–0.99 = very high correlation, 0.70–0.89 = high correlation,0.50–0.69 = moderate correlation, 0.26–0.49 = low correlation, and 0.00–0.25 = little, if any, reliability.(Portney L,&Watkins M., 2000)

Agreement

The Bland-Altman Plot shows the difference in total scores against the mean total scores. The standard error of measurement (SEM) for the SAM scale was 9.30. Calculations revealed a minimum detectable change(MDC) of 25.78 points for the SAM scale (scale range = 0–244). The mean difference approached zero, indicating that no bias had occurred and only one outlier was seen outside the 95% CI limits (Bland JM., 1986)(Bland JM., 1999) The Bland and Altman plot indicated that the measure of within-subject variation (i.e., the bias) was very minimal, as the mean difference was close to zero (mean difference [d] = −2.44), and the limits of agreement were excellent (+23.78 to − 26.66), with very few outliers. The Bland-Altman analysis showed that the mean difference was -2.44±13.38 for the SAM scale (Figure 1)

Table 1: ***Mean and Standard Deviations for test-retest data*** **(n=34)**

	Test		Re-test	
SAM Dimensions	M	SD	M	SD
GAD	12.32	6.27	11.8	6.08
PHO	10.94	5.80	11.1	5.64
SAD	9.94	6.27	11.8	6.08
SOM	5.70	3.38	5.91	3.49
ID	4.88	1.90	5.23	2.61
SOC	12.73	4.79	12.8	4.92
IMPACT	5.00	3.14	5.64	3.27
S	7.88	4.04	7.97	4.33
T	7.58	4.30	7.79	4.23
LSCORE	10.85	4.45	12.4	4.69
TOTAL SAM	93.26	31.7	95.7	34.1

*[**GAD**-Generalized Anxiety Disorder; **PHO**-Specific Phobia; **SAD**-Separation Anxiety Disorder;* **SOM**- Somatic Symptoms Disorder; **ID-** Illness Anxiety Disorder; **SOC**- Social Anxiety Disorder; **IMPACT**- Impact on Functioning; **S**-State Anxiety; **T** – Trait Anxiety; **Lscore**- Lie Score]

Table 2: Test retest reliability of SAM scale (n=34)

SAM Dimensions	ICC with 95% CI[p<0.001]
GAD	0.909 [0.819–0.954]
PHO	0.892 [0.784–0.946]
SAD	0.875 [0.748–0.937]
SOM	0.797 [0.592–0.899]
ID	0.733 [0.469–0.866]
SOC	0.876 [0.750–0.938]
IMPACT	0.892 [0.781–0.947]
S	0.849 [0.592–0.899]
T	0.845 [0.697–0.925]
LSCORE	0.869 [0.677–0.941]
TOTAL SAM	0.917 [0.842–0.958]

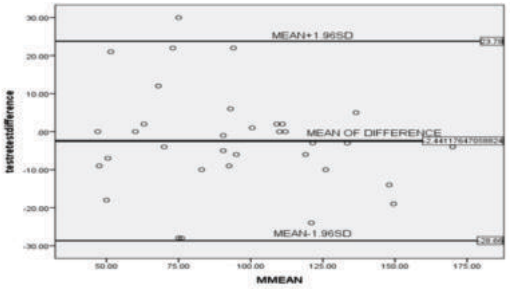

Figure 1: The Bland-Altman agreement analysis for reliability

Floor and ceiling effect

The SAM scale Skewness statistic showed no floor and ceiling effect for the scale as it's value-0.122(0.080) was in between +1 to -1.(Terwee CB et al.,2007)

Normal distribution and Stanine score Calculation for SAM

The total scores were normally distributed, with a range of 7–193, mean of 99.52, and a standard deviation (SD) of 30.06(Figure 2). Stanine score frequency and percentile distribution of SAM are shown in Table 3,4 & figure 3.

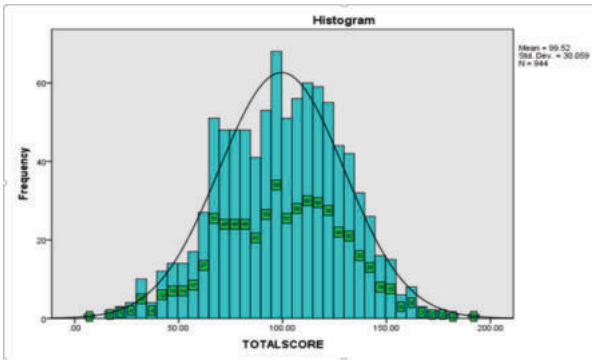

Figure 2: Histogram representing normal distribution of SAM

Table 3 Stanine score frequency distribution of SAM

Stanine score	Frequency	%	Cumulative %
1.00	42	4.4	4.4
2.00	51	5.4	9.9
3.00	133	14.1	23.9
4.00	146	15.5	39.4
5.00	177	18.8	58.2
6.00	172	18.2	76.4
7.00	132	14.0	90.4
8.00	64	6.8	97.1
9.00	27	2.9	100

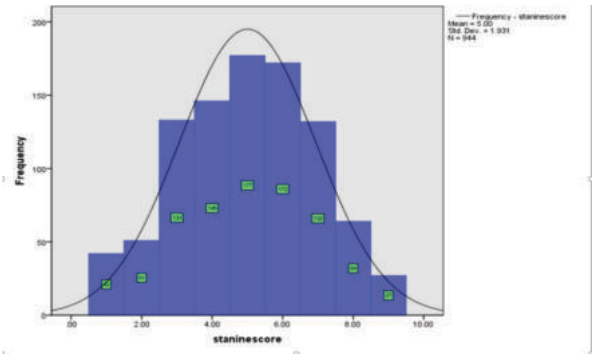

Figure 3: Stanine score frequency normal distribution of SAM

Table 4 Stanine score- mean and standard deviation distribution of SAM

	Total score				
Stanine score	M	SD	n	Max	Min
1.00	34.62	9.14	42	46	7
2.00	55.10	4.46	51	61	47
3.00	69.50	4.04	133	76	62
4.00	84.30	4.73	146	92	77
5.00	99.70	4.27	177	107	93
6.00	114.9	4.18	172	122	108
7.00	129.3	4.27	132	137	123
8.00	144.1	4.24	64	138	152
9.00	164.1	9.78	27	193	153

DISCUSSION

The current study's objective was to create a new questionnaire to assess various forms of anxiety and their clinical manifestations. The "Scale for Anxiety Measurement (SAM)" is a self-reported questionnaire with 65 items that assesses nine dimensions of anxiety disorders. In both the normal population and the population of anxiety patients, it was intended to determine the Factorial validity, internal consistency, test-retest reliability, agreement, and minimal detectable change (MDC) of SAM.

The SAM scale was created based on a requirements assessment of important stakeholders and the application of particular theoretical ideas. The rational and pragmatic approaches kept the important components of the questionnaire by removing four items. Furthermore, the remaining 61 items, which addressed significant areas of anxiety evaluation, were stated more simply and plainly for the assessment participants. Hence, it was gratifying to note that the reduction of the items to 61 in the final version resulted in a significant improvement in reliability, Factorial validity, and internal consistency of the scale.

The sixteen-factor principal component analysis of the SAM scale illustrates the scale's multidimensionality. It is significant not just for its apparent diagnostic usefulness, but also for providing a more complex and realistic evaluation of the numerous anxiety characteristics (Wheaton MG et al., 2012). However, the scale did not match up with the dimensions of the other scales. (RI Kabacoff et al., 1997).

Other psychometric property tests demonstrated high test-retest reliability, agreement, and internal consistency. The strong test-retest reliability value (ICC = 0.917) was comparable to the ICC reported for other anxiety measures and clearly supports the SAM's repeatability, which is one of the crucial measurement qualities necessary for any instrument. The low CIs obtained for the ICCs clearly show that this questionnaire, like the other available instruments, may yield trustworthy findings when conducted on many occasions. (Stanley MA et al., 1996) The Bland and Altman analysis indicated that all measures fell within the 95% confidence interval around the mean, showing a very good agreement between the scores obtained on the two occasions with very little within-subject variation, strongly supporting the ICCs found. The SEM and MDC can help clinicians and researchers identify actual changes in measurement in response to a therapy intervention that isn't due to random measurement error. The SAM had an MDC of 25.78 points, indicating that scores at or above these MDC levels are most likely attributable to patient progress rather than measurement error. The item analysis revealed acceptable internal discrimination of items, as well as excellent consistency in displaying the amount of shared variation, or covariance, among the items comprising the scale to the total variance. The questionnaire revealed no ceiling or floor impacts. Ceiling and floor effects are deemed to be present if more than 15% of respondents obtained the lowest or highest possible total score, and were investigated by measuring the distribution's skewness. The Stanine scores are a nine-point scale that rescales raw SAM scores into a single number, making it easier to compare individuals without having to worry about minute discrepancies in raw SAM scores. The interpretation of SAM is supported by this score, as well as the raw score and percentile scores of people with a normal distribution.

Nevertheless, the authors would like to mention that there are certain limitations to the study of reliability and validity of SAM. One of which is that the study is ongoing and more sample data is still being gathered, due to which confirmatory factor analysis (CFA) was not done. Future research can also explore comparing SAM to other measures to determine its construct and criterion validity

CONCLUSION

The current study provided preliminary support for SAM's reliability and factorial validity. The SAM is a valid, reliable, and useful anxiety measure for screening and measuring anxiety symptoms in both nonclinical and clinical populations in India. Moreover, its features are broadly similar to those reported in the literature, but further study is needed to establish it as a comprehensive instrument for anxiety assessments.

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