Application and Validation of the Beck Anxiety Inventory among Nepalese School Adolescents

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ABSTRACT

Anxiety is a common mental disorder (CMD) and it affects all the age groups including children and adolescents. Various scales and tools are available to screen and diagnose anxieties. Beck Anxiety Inventory (BAI) is a reliable tool recommended for 12-80 years to screen panic to geriatric anxiety. It is also applied and validated among Nepalese adults for Generalised Anxiety Disorder (GAD). This study was aimed to apply and validate the Beck Anxiety Inventory (BAI) against school adolescents in Nepal. BAI is a 21-item self-reported scale having four-point Likert scale from "0" (Not at all) through "3" (Severely-I could barely stand it). The tool was translated into Nepali and back-translated into English and several iterations were done till the original meaning was obtained. The tool was concurrently validated against seven-item Generalized Anxiety Disorder scale (GAD-7) as a gold standard, which possesses only seven items and similar Likert scale. Descriptive, inferential including sensitivity, specificity and principal component analysis were performed for 2007 sample adolescents from 13 public and ten private schools of five development regions of the country. The prevalence of generalized anxiety was 34.78% and descriptive data revealed that the BAI and GAD-7 scores were positively skewed. The concurrent validity was moderate (ρ=0.58, $p<0.001$) and the BAI showed a good internal consistency (a=0.86). The cut-off of 13/14 showed acceptable sensitivity (70.9%), specificity (73.1%), and AUC (80.0% (95%CI; 77.4-82.5)) ($p<0.001$). The principal component analysis showed six-factor explaining 52.04 percent variance, instead of four-factor in most of the literatures. The Nepalese BAI-Adolescent is a valid tool for age group 13-19 years; if applied cautiously regarding the items three, six and thirteen. It can screen 80.0% of the generalized anxiety cases with 70.9 percent sensitivity and 73.1 percent specificity among students and hence recommended to use in schools.

Key words: Adolescent, application, anxiety, Beck, Nepalese, school, validation.

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INTRODUCTION

Anxiety is a mental public health problem and prevalence is up to 30%, however, may differ due to geography, culture, ethnicity, conflict, socio-economic and health status among others.[1] Anxiety has different types and severity. Nationally representative data of adolescent and children regarding anxiety prevalence and a valid tool both are not well documented in Nepalese context. The community mental health workers including psychiatrists are short of providing mental health care in communities and schools accessibly. Short and simple assessment tool can screen the adolescent students at greater risks and hence can be referred to specialists or primary mental health workers. For this, short and simple scales are needed. Although Nepali version of BAI has been found to be a reliable and valid for adults, less attention has been paid to the prevalence of anxiety in pre-adolescent children and adolescents.[2] Although the tool has been validated among others[3], it has not been validated against Nepalese adolescents. In this line, the study aimed to apply and validate the BAI among school adolescents in Nepal.

METHODS

A cross-sectional school-based survey was conducted to collect data during November, 2014 to January, 2015. A self-administrable questionnaire (SAQ) was distributed to students of grade nine to 12 from 13 public and ten private schools across the country. One district was taken from each development region (Sunsari, Kathmandu, Kaski, Dang and Kailali). Out of 2480 SAQ distributed, 2086 returned (84.1% response rate); 79 discarded further due to incompleteness and age beyond 19 years, and finally 2007 samples analyzed quantitatively. Sample size was calculated based on the prevalence from systematic review (p=0.298)[1], allowable error (d=7% of p), standard normal variate (z=1.96), and non-response rate of 30%, that yielded 2413, however, 2480 taken to be safe and when adjusted to the classrooms. Principal component analysis was conducted applying the

extraction method as unrotated factor solution and rotation method as varimax rotation in order to maximize the variance among the factors to be extracted.

Instruments

Nepali translation of the inventories was done by the researcher self so as to maintain the content validity of the construct and it was translated back into English by a bi-linguist and lecturer of English. The process of translation and back translation carried out until the original meaning was the same. The earlier version was applied among the adults clinical setting in Nepal and a cut-off of 13/14 for the BAI provided sensitivity of 0.91 and specificity of 0.89 against a gold standard DSM-IV diagnosis of generalized anxiety. The gold standard of GAD-7 items were given in both Nepali and English version in order to assure the validity. BAI is a 21-item self-report questionnaire that lists symptoms of anxiety. The respondent was asked to rate how much each symptom has bothered him/her in the past week. The symptoms were rated on a four-point scale, ranging from ''not at all'' (0) to ''severely'' (3). The instrument has excellent internal consistency (a = .92) and high test–retest reliability (r =.75).[4]

Although the age range of BAI is 17-80 years, the tool has been used among the adolescents of 12 years and older and construct validity had been established.[3] However, four or five factor structure was observed in a study conducted among the psychiatric patients and school adolescents. The tool applied among the different cultures showed different scores, higher among the girls. The other studies revealed two factors in most observations.[5] BAI showed good specificity and sensitivity to DSM-IV diagnoses of generalized anxiety disorder and is recommended that for community epidemiological surveys13/14 or a lower threshold be employed in order to capture the majority of anxiety cases.[6-7]

Instruction to the participant was given as to indicate clearly how much s/he has been bothered by the symptom during last one week indicating from 0 (not at all) through 3 (severely-it bothered him/her a lot).

Data management

Researcher trained bachelor level public health students to collect and enter the data in SPSS. The students were clearly instructed with sufficient time to ask on the questionnaire distribution day and assured again the following envelope collecting days. All students and their parents were required to give their written consent before administering the questionnaire. Verbal in all and written permissions from some schools and written consents from students were obtained. Frequency and central tendency measures were calculated for descriptive, and sensitivity, specificity, area under the curve (AUC) were calculated for validation and significance level was set at 0.05.

RESULTS

The prevalence was calculated as 34.78 percent. The descriptive analysis showed that the BAI and GAD-7 scores were positively skewed. The concurrent validity was moderate (ρ=0.58, $p<0.001$) and the BAI showed a good internal consistency (a=0.86). The cut-off of 13/14 showed acceptable sensitivity (70.9%), specificity (73.1%), and AUC (80.0% (95%CI; 77.4-82.5)) ($p<0.001$). The principal component analysis revealed six-factor explaining 52.04 percent variance, instead of four-factor in most of the literatures.

Background characteristics of adolescents

Table 1 shows that more than two-thirds (68.8%) students were from the middle adolescent group and majority (51.5%) were female. Almost nine in every ten (88.6%) were Hindus; followed by Buddhist (5.5%); Christian (3.7%); Kirat (1.4%) and Muslim (0.6%). Almost two-thirds (65.5%) students were from public or community schools, whereas, plurality (35.4%) of them were from grade 11 and around one-fifth in each grade of nine, ten and 12. The majority (72.9%) were living with their parents; followed by less than one in every ten in each of with relatives (9.5), in rent (9.4) and in hostel. The plurality (31.0%) of the students was from Kailali district followed by Dang (26.4%); Sunsari (18.2%); Kaski (16.7%) and Kathmandu (7.6%). Slightly less than one in every five students (15.3%) reported that they had suffered from severe psychological events such as demise of family members or close friends and such in last one week.

Statistical association with gold standard

The prevalence of generalized anxiety was found to be 17.99% based on gold-standard and anxiety was 34.78% based on BAI cut-off 12/13. As per gold standard of GAD-7 score <10 (anxiety absence) or ≥10 (anxiety presence); BAI severity categories of minimal, mild, moderate and severe were found to be significant ($p<0.001$). Similarly, age, history of last one week, student's status of living were also significantly associated with the presence of generalized anxiety disorder. However, sex, religion and type of school were not found to be associated (Table 1).

Table 1: Associative characteristic of variables with presence and absence of GAD-7

Variables	GAD-7<10(%)	GAD-7≥10 (%)	χ^2(df)	p-value
Age				
EA(13-14)	222(86.7)	34(13.3)		
MA(15-17)	1132(82.0)	249(18.0)	6.25(2)	0.044*
LA(18-19)	292(78.9)	78(21.1)		
BAI Categories				
Minimal(0-8)	883(94.6)	50(5.4)		
Mild(9-12)	321(85.4)	55(14.6)		
Moderate(13-20)	312(75.9)	99(24.1)	376.4(3)	<0.001**
Severe (21-63)	130(45.3)	157(54.7)		
Mean±sd	9.3±7.1	19.6(10.3)		
Median (Q1~Q3)	8 (4~13)	19 (11~26)		
Sex				
Female	847(81.9	187(18.1)	0.01(1)	0.48
Male	799(82.1)	174(17.9)		
Religion				
Hindu	1458(82.0)	320(18.0)		
Buddhist	87(79.1)	23(20.9)	2.46(3)	0.48
Christian	65(87.8)	9(12.2)		
Others(Muslism,Kirat,others)	36(80.0)	9(20.0)		
Student's status of living				
Hostel	103(67.8)	49(32.2)		
With Parents	1223(83.6)	240(16.4)	28.63(4)	<0.001**
In rent	147(78.2)	41(21.8)		
Others	9(69.2)	4(30.8)		
History of last one week#				
No serious event	1423(83.9)	274(16.1)	25.2(1)	<0.001**
Serious event	223(71.9)	87(28.1)		
Type of school				
Public/Community	1091(83.0)	223(17.0)	2.7(1)	0.10
Private	555(80.1)	138(19.9)		
Total (n=2007)	1646	361		

*Significant at 0.05 level; **Significant at 0.01 level; #History includes the death of any family member or close friend or any serious accident of self or friend or family member.

Reliability of the scales and correlation

Internal consistency of BAI and GAD-7 both were in acceptable level, BAI (α)=0.86; GAD-7 (α)=0.79. The BAI and GAD-7 total score were moderately correlated, r(2007)=0.58. The internal consistency was found higher among the boys (0.87) than girls (0.85) in BAI-items (Table 2).

Table 2: Mean, median, reliability coefficients and bivariate correlation

Scale	Mean (sd) (n=2007)	Median (Q1~Q3) (n=2007)	Alpha (α)			No. of Items	Bivariate (ρ)	p-value
			Tot (n=2007)	Girls (n=1034)	Boys (973)			
BAI	11.13(8.72)	9(5~16)	0.86	0.85	0.87	21	0.58	<0.001**
GAD-7	5.68(4.2)	5(2~8)	0.79	0.76	0.81	7		

**Significant at 0.01 level

Item four, five, six, seven, eight, nine and 17 were moderately correlated with total BAI score. Remaining items were mildly correlated. Inter-item correlations ranged from negligible, ρ=0.11 through mild, ρ=0.41 (Table 3).

Table 3: Inter-item and total correlation* of BAI score (ρ)

#	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Tot
1	.23	.21	.23	.18	.21	.18	.20	.17	.19	.17	.19	.17	.16	.23	.17	.22	.21	.18	.14	.14	.44
2		.21	.19	.22	.27	.29	.22	.23	.22	.15	.18	.17	.23	.21	.17	.20	.22	.17	.20	.24	.48
3			.24	.22	.23	.27	.26	.21	.22	.21	.39	.20	.22	.24	.15	.27	.16	.16	.20	.18	.48
4				.33	.17	.27	.29	.28	.34	.16	.22	.21	.25	.20	.21	.22	.19	.15	.17	.14	.51
5					.25	.35	.34	.41	.30	.16	.16	.17	.19	.22	.22	.29	.23	.17	.21	.13	.58
6						.29	.27	.25	.23	.21	.25	.22	.21	.28	.20	.25	.22	.15	.22	.18	.52
7							.38	.40	.29	.22	.22	.24	.22	.28	.23	.30	.23	.18	.25	.16	.59
8								.36	.33	.21	.23	.23	.24	.26	.26	.28	.23	.20	.24	.15	.57
9									.34	.15	.19	.19	.17	.24	.23	.36	.28	.20	.22	.14	.58
10										.16	.18	.19	.24	.20	.24	.23	.21	.17	.21	.13	.52
11											.26	.23	.16	.27	.13	.22	.21	.12	.16	.19	.40
12												.25	.22	.30	.14	.27	.17	.14	.25	.22	.48
13													.25	.21	.19	.19	.22	.20	.21	.12	.40
14														.24	.22	.17	.14	.19	.20	.19	.42
15															.21	.28	.23	.16	.19	.19	.49
16																.27	.17	.25	.20	.11	.40
17																	.30	.20	.27	.21	.58
18																		.19	.19	.18	.48
19																			.22	.11	.35
20																				.27	.45
21																					.38

*All the values are significant at <0.001

Table 4: Descriptive summary of items of log-transformed BAI score and correlation with GAD-7 total score

Item	Mean	SD	n*	r
Numbness or tingling(1)	0.11	0.17	882	0.23**
Feeling hot(2)	0.13	0.18	768	0.26**
Wobbliness in legs (3)	0.12	0.18	747	0.30**
Unable to relax(4)	0.14	0.19	792	0.40**
Fear of worst happening (5)	0.17	0.20	1141	0.42**
Dizzy or lightheaded (6)	0.13	0.19	892	0.26**
Heart pounding or racing (7)	0.14	0.19	908	0.36**
Unsteady(8)	0.13	0.19	762	0.39**
Terrified(9)	0.14	0.19	1056	0.37**
Nervous(10)	0.14	0.19	719	0.41**
Feelings of choking(11)	0.10	0.17	586	0.20**
Hands trembling(12)	0.10	0.17	720	0.27**
Shaky (13)	0.10	0.17	400	0.26**
Fear of losing control(14)	0.10	0.17	419	0.29**
Difficulty breathing(15)	0.10	0.17	598	0.27**
Fear of dying(16)	0.13	0.19	376	0.36**
Scared (17)	0.11	0.18	1177	0.35**
Indigestion or discomfort in abdomen (18)	0.10	0.17	910	0.26**
Faint (19)	0.12	0.18	273	0.27**
Face flushed (20)	0.09	0.16	530	0.30**
Sweating (not due to heat) (21)	0.13	0.19	567	0.22**
Total BAI	0.94	0.37	1899	0.52**
Total GAD-7	0.69	0.32	1841	

*Some items had 0 value and excluded **p-value significant at <0.001

Since data were found positively skewed (BAI score skewness=1.19, SE=0.06; GAD-7 score skewness=0.93, SE=0.06); log-transformation of each item including total BAI score and total GAD-7 score was calculated. Scores of all the items of BAI were mildly correlated; being lowest in item 11, r(586)=0.20 through highest in item 5, r(1141)=0.42 (Table 4).

Table 5: Summary item statistics of log-transformed BAI score

Statistics (n=2007)	Mean	Minimum	Maximum	Range	Max/Min	Variance
Item Means	0.30	0.16	1.58	1.4	9.96	0.09
Item Variances	0.05	0.01	0.07	0.60	8.26	0.00
Inter-Item Covariances	0.03	-0.01	0.06	0.08	-4.23	0.00
Inter-Item Correlations	0.70	0.28	1.0	1.28	-3.52	0.06

Descriptive statistics showed a mild correlation among items i.e., no co-linearity. The mean covariance between the items is 0.03; that showed to be low variation in correspondence between the greater and smaller values. However, the item mean-variance is 0.30; that showed the items are distinct (Table 5).

Principal component analysis

The principal component analysis revealed only four factors with eigenvalues greater than one and the total variance explained was only 42.83% and clearly showed that six factors yielded greater than average variance. In so doing, when six factors opted, the rotated component matrix converged in nine iterations revealed total variance of 52.04 percent and seven items in factor one; four items in factor two; three items in each of factor three and four; and two items in each of factor five and six (Table 6). The model was observed and found to be fit (KMO statistic=0.93; Barlett's test statistic=8411.23, p=<0.001). Item-3 (wobbliness in legs) and item-13 (shaky) showed high loadings in two factors. Item-6 (dizzy or lightheaded) showed low loading.

Table 6: Factor scores and variance explained of BAI components

Item (No.)	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Nervous(10)	**0.64**	0.06	0.20	0.08	0.05	<-0.01
Fear of worst happening (5)	**0.63**	0.05	0.08	0.16	-0.01	0.28
Unable to relax(4)	**0.62**	0.08	0.17	0.21	0.05	-0.15
Terrified(9)	**0.61**	0.07	0.09	0.05	0.06	0.45
Unsteady(8)	**0.59**	0.17	0.20	0.05	0.11	0.13
Heart pounding or racing (7)	**0.56**	0.29	0.05	0.09	0.15	0.25
Wobbliness in legs (3)	**0.47**	0.29	-0.15	0.19	0.42	-0.18
Feelings of choking(11)	0.05	**0.70**	0.06	0.06	-0.01	0.24
Hands trembling(12)	0.28	**0.58**	-0.07	0.04	0.42	-0.16
Difficulty breathing(15)	0.18	**0.57**	0.11	0.30	-0.06	0.17
Shaky (13)	0.11	**0.53**	0.44	-0.06	0.16	0.04
Faint (19)	0.12	0.02	**0.67**	0.07	0.18	0.21
Fear of losing control(14)	0.20	0.26	**0.55**	0.29	0.07	-0.27
Fear of dying(16)	0.33	0.06	**0.53**	0.16	-0.03	0.15
Numbness or tingling(1)	0.15	0.14	0.11	**0.69**	-0.02	0.04
Feeling hot(2)	0.15	<-0.01	0.10	**0.67**	0.28	0.16
Dizzy or lightheaded (6)	0.26	0.34	0.06	**0.37***	0.11	0.20
Sweating (not due to heat) (21)	-0.03	0.04	0.10	0.27	**0.69**	0.17
Face flushed (20)	0.21	0.06	0.37	-0.11	**0.61**	0.19
Indigestion or discomfort in abdomen (18)	0.12	0.22	0.14	0.20	0.12	**0.62**
Scared (17)	0.35	0.22	0.10	0.09	0.22	**0.48**
Variance explained %	26.98	5.84	5.21	4.81	4.70	4.52

*Shows low factor loadings; scores in bold show the highest loadings among six factors

Cut-offs, sensitivity, specificity, predictive values, and ROC curves

The percentage of adolescents of BAI score increased simultaneously with GAD-7 score ≥ 10. The percentage was found almost ten (8.9) for up to 15 score of BAI; whereas, it increased to almost one-third (32.6%) for 16 to 23 score and majority were found when the score was increased to 24 to 36. It reached 100% when it was >36 (Fig.1).

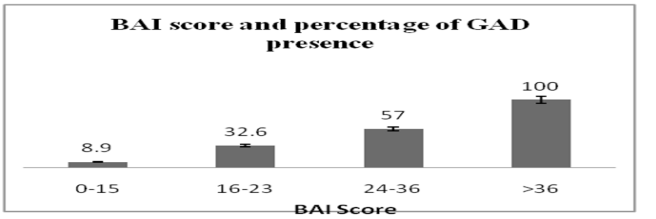
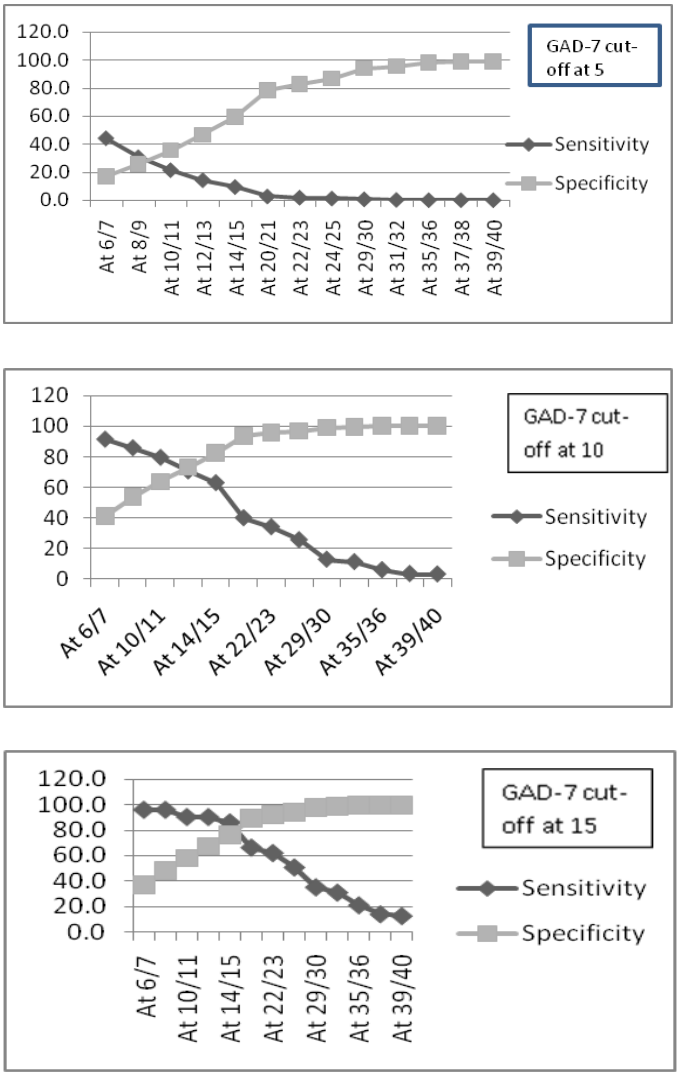


Fig. 1. Percent of anxiety in BAI score according to GAD-7 at cut-off 10



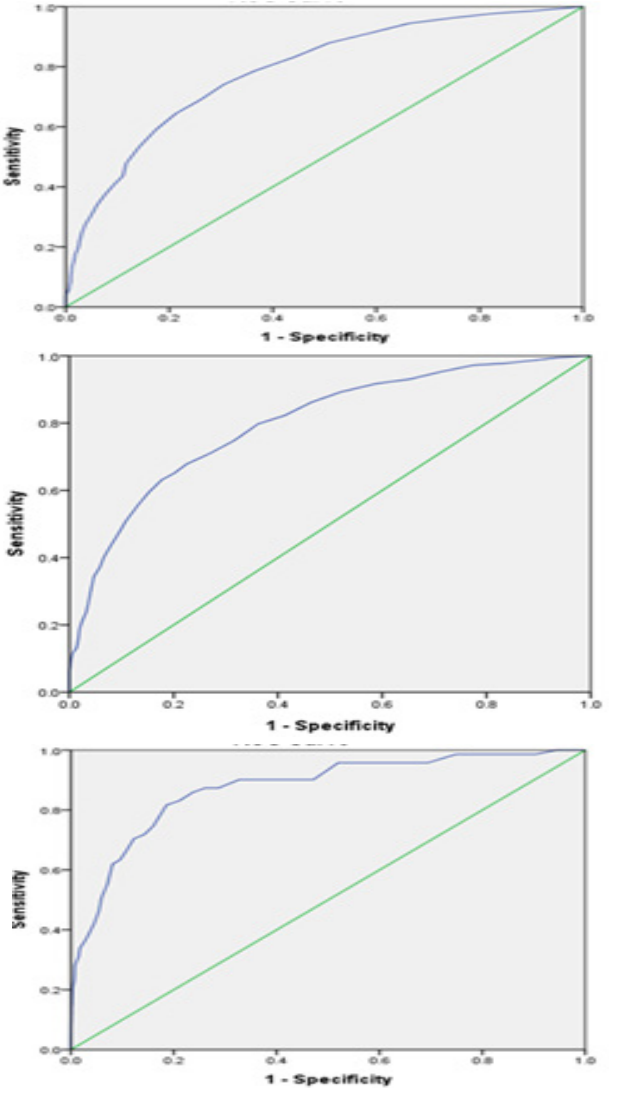


Fig. 2. Sensitivity and specificity for BAI categories cut-offs against GAD-7 cut-offs and corresponding ROC curves (from top to bottom, BAI minimal-mild at GAD-7 at 5, AUC (78.8; 95%CI; 76.9-80.8); BAI mild-moderate at GAD-7 at 10, AUC (80.0; 95%CI; (77.4-82.5); BAI moderate-severeat GAD-7 at 15, AUC (87.3; 95%CI; 82.9-91.7)).

Minimal-mild-moderate-severe cut-offs for BAI were sensitive and specific at 8-12-20 inclusive. Sensitivities, specificities, and AUC scores were acceptable (Fig. 2). The values are illustrated in table 7.

Table 7: Sensitivity, specificity and AUC of BAI for GAD-7 different cut-off score

GAD-7 Cut-off	n=2007		BAI					
	+ve cases	-ve cases	cut-off	Sensitivity	Specificity	AUC Percent (95% CI)	Standard Error	p-value
4/5	1056	951	8/9	30.6	25.9	78.8 (76.9-80.8)	0.010	<0.001**
9/10	361	1646	12/13	70.9	73.1	80.0 (77.4-82.5)	0.013	<0.001**
14/15	71	1936	20/21	66.2	89.3	87.3 (82.9-91.7)	0.022	<0.001**

** Significant at 0.01 level

Distribution of mean and 95% CI for different categories of both BAI and GAD-7 scores were significant (Fig. 3).

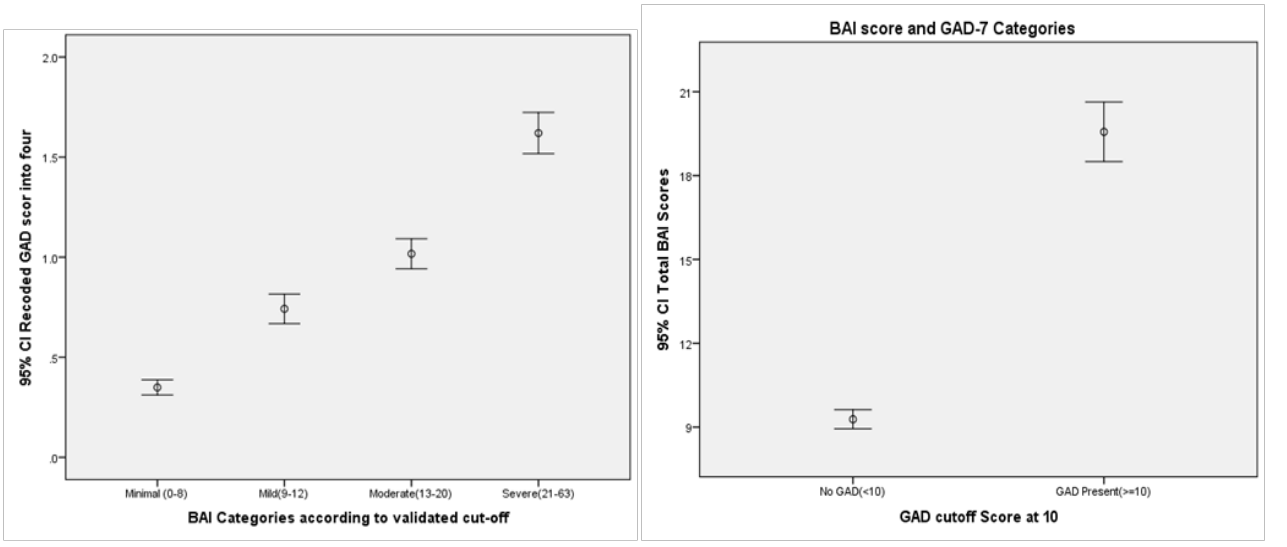


Fig. 3. Mean and 95% CI of severity categories and absence and presence of BAI score according to GAD-7 severity groups and GAD-7 absence (<10) and presence (≥10)

DISCUSSION

Measurement of BAI

Beck anxiety inventory (BAI) is a 21-item scale to assess the anxiety level and has been translated in Nepalese version and validated against gold standard of generalized anxiety disorder (GAD-7) of DSM-IV among the adults.[7] Literature showed that various anxiety and depression scales have been applied and validated in different languages and cultures, and mostly among adults. Nonetheless these tools also have potential to use among adolescents.[8-9] BAI has been compared with both generalized and specific anxieties and found strong quality with selected ones when assessed.[6]

Since students from grade nine to 12 were taken, the data skewed positively and median age was 16 years. A similar study among the age group of 15-18 showed the higher proportion of female (56%)[9], whereas, current study showed that girls were found to be 51.5 percent. The social distress was reported more among the boys than girls, however, in current study showed no statistical significance among boys and girls for generalized anxiety, which is similar to social anxiety among the Finnish adolescents.[10]

Validation of the tool

The BAI score in this study revealed the mean of 11.13±8.72; which is slightly less than the study carried out among the adults admitted in a University (12.32 ±13.88).[11] The sample showed that the proportion of students increased as the severity of BAI score increased corresponding to GAD score >10; i.e., the presence of GAD. The mean score among the GAD presence was more than double (19.6±10.3) than among the GAD absence (9.3±7.1). Similar findings observed with the findings of the University study.[12]

The internal consistency of 21-items was observed excellent (Cronbach's a= 0.86) though slightly less than the original BAI (a=0.92)[4], however, it was closer (0.87) among the boys. The item-total correlations ranged negligible through mild showed weak correlations among the items revealed no colinearity and minimal differences showed very low inter-

item covariances between factors of high and low loadings.

The original version showed clearly four factors such as subjective, neurophysiological, panic and autonomic; and this is supported by further subsequent literature[4-5,12], however, the present study revealed two more factors; altogether six that explained 52.04%. Item-3 (wobbliness in legs) and item-13 (shaky) showed high loadings in two factors and need to be carefully applied in the future and Item-6 (dizzy or lightheaded) showed low loadingthat might be discarded for further application among Nepalese adolescents. These items focus less among selected autonomic items. The cut-off scores of BAI for minimal-mild was observed at 8/9 but both the sensitivity and specificity were very low. However, AUC was 78.8 % (95% CI, 76.9-80.8). The cut-off of 9/10 covered 70.9% sensitivity and 73.1% specificity for the presence and absence of generalized anxiety according to the gold standard. The similar study conducted in Jumla and Kathmandu recommended for 13/14 encompassing sensitivity (0.90) and specificity (0.89)[6]. However, when the cut-off score was 14/15, the sensitivity decreased to 66.2%; specificity increased to 89.3%; covering 87.3% (95% CI, 82.9-91.7) AUC ($p<0.001$) (tab.8). The percentage of anxiety increased directly proportional according to gold standard when BAI score increased (fig.1). The concurrent validity was found moderate ($\rho=0.58$, $p<0.001$) between BAI and GAD-7.

LIMITATIONS

The data including the gold standard were gathered basically from the respondents' perceptions and comprehension and was limited to the schools of urban areas, which might limit the validity.Few schools were in-between their examination schedule, and experiencing severe psychological events by some students might have increased the anxiety levels of the students.

CONCLUSION

Beck Anxiety Inventory (BAI) was found to be applicable to screen anxiety among the adolescents of age group 13-19 but with caution; the items-3, 6 and 13 revised by further translation and iteration. The tool showed good internal consistency of score 0.86; however slightly weaker (70.9%) sensitivity and 73.1% specificity; and good taping [80.0% (95% CI; 77.4-82.5)] of the cases. When the cut-off score increased to 36 or more, all cases (100%) were tapped. Nonetheless clinical affirmation is suggested before reaching the firm conclusion.

CONFLICT OF INTEREST

Author declares no conflicting interest.

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