ORIGINAL ARTICLE

Psychometric properties of the Czech version of the Beck Anxiety Inventory – comparison between diagnostic groups

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Abstract

OBJECTIVE: Beck anxiety inventory (BAI) is widely used self-rating questionnaire evaluating the severity of anxiety symptoms. The aim of our study was to confirm validity and reliability of Czech version of BAI, identify cut-off points and prove sensitivity to measure improvement after therapy.
METHODS: The patients selected for the study were treated in the department of psychiatry, University Hospital Olomouc between January 2008 and 2014. Patients meeting criteria for anxiety, or depressive disorder were involved.
RESULTS: 789 patients and 284 healthy controls agreed to participate in the study. Czech version of Beck anxiety inventory proved high internal consistency (α=0.92) and good test-retest reliability over one week (BAI seems to be independent of other used scales – Beck depression inventory and the Clinical Global Impression. BAI is also sensitive to measure change after therapy.
CONCLUSION: Czech version of BAI was found to have enough internal stability and test-retest reliability same as the original version. It may also be useful to detect improvement after therapy.

INTRODUCTION

Anxiety disorders belong to most prevalent disorders with many consequences. Therefore, it may be useful to measure the severity of anxiety symptoms in various diagnostic groups. There is a broad range of different psychological and somatic symptoms present in anxious patients. Various scales were created to evaluate the level of anxiety. Some of them are specific and focus on concrete symptoms of the disorder (Yale-Brown Obsessive Compulsive Scale is focused on obsession and compulsion (Goodman *et al.* 1989), PDSS on panic symptoms (Shear *et al.* 1997), ect.), others are non-specific (CGI, BDI, etc). Beck anxiety inventory (BAI; Beck *et al.* 1988) is a self-rating scale that can be used to measure severity symptoms in patients with anxiety and depression. It also proved to be a useful tool for measuring changes after therapy (de Beurs *et al.* 1997; Magán *et al.* 2008). The scale was already validated in several language versions (Ulusoy *et al.* 1998; Magán *et al.* 2008). A study

of the non-clinical sample also proved that BAI is the useful tool for measuring anxiety (Borden *et al.* 1991, Creamer *et al.* 1995).

Several questionnaires were created to measure the level of anxiety. Some of them examine the degree of specific anxiety (e.g. The Panic Disorder Severity Scale in panic disorder (Shear *et al.* 1997), the Liebowitz Social Anxiety Scale in patients with social phobia (Liebowitcz *et al.* 1987), Yale-Brown Obsessive Compulsive Scale in obsessive-compulsive patients (Goodman *et al.* 1986). Another measure level of general anxiety (e.g., Sheehan Anxiety Scale (Sheehan 1983), Beck Anxiety Inventory (Beck *et al.* 1988), Zung Self-Rating Anxiety Scale (Zung 1971), Hamilton Anxiety Rating Scale (Hamilton *et al.* 1976).

There is a broad range of anxiety disorders from specific phobia (anxiety about a particular object of situation), social phobia (fear or anxiety about one or more social situations), panic disorder (characterized by presence of panic attacks), agoraphobia (fear or anxiety about using public transportation, being in open or enclosed spaces, standing in the line, being in the crowd and/or being outside of home alone), generalized anxiety disorder (excessive anxiety and worry about a number of events or activities), substance/medication-induced anxiety disorder to other anxiety disorder due to medical condition. Other disorders associated with anxiety are obsessive-compulsive and related disorders (OCD) (presence of obsessions, compulsions, or both) and trauma- and stressor-related disorders (APA 2013).

The anxiety is not presented only in patients suffering from anxiety disorders. It can also be presented in patients suffering from depression, bipolar disorder, schizophrenia, personality disorders, sleep-wake disorders, neurodevelopmental disorders, substance-related and addictive disorders and neurocognitive disorders.

Although anxiety disorder differs from each other, anxiety is a common factor. Finding a questionnaire that would allow valid evaluation of the level of anxiety in the entire spectrum of anxiety disorders is advantageous both in terms of comparison, so in case of comorbidity disorders.

Despite the fact that in the Czech Republic, the Beck Anxiety Inventory widely used, the Czech version has not yet been validated. The aim of this study was to validate BAI in English in a population of patients with anxiety or depressive symptomatology, sensitivity to measure changes after therapy and identify the cut-off points.

METHODS

Probands

Participation in the study was offered to inpatients who had been hospitalized in the psychotherapeutic department of Department of Psychiatry, University Hospital Olomouc, the Czech Republic between January 2008 and September 2014. Included were patients suffering from any anxiety disorders, obsessive-compulsive and related disorders, trauma- and stressor-related disorders (or depressive disorder, older than 18, who agreed to participation in the study. The diagnosis was done by two independent, experienced psychiatrists. Patients meeting ICD-10 criteria any depressive or anxiety disorder (World Health Organisation 1992) were included in the study.

Control group

Healthy controls were selected from the general population in the Czech Republic using the "snowball technique" via email or postal service (Burgess 1991). The mail contained a request by filling out the questionnaire (in case of absence of a history of mental illness or previous examination by a psychiatrist). We asked a group of a psychiatrist from University Department of Psychiatry to invite their relatives and friend to participate in the study. Probands anonymously fulfilled BAI. To assure the heterogeneity probands were asked to add information about their age, sex, employment and level of education. No other personal data were gathered.

The investigation was carried out by the latest version of the Declaration of Helsinki and the Guideline for Good Clinical Practice (EMEA 2009). Subjects received no monetary compensation for study participation in the study.

Instruments

Beck Anxiety Inventory (BAI). The questionnaire was designed in 1988 by Aaron Beck (Beck 1988). It is a 21-item self-rating scale that evaluates the presence of both somatic and psychological symptoms of anxiety. This inventory can determinate depression and anxiety (Beck *et al.* 1988b). Patients were asked to evaluate the level of anxiety symptoms during the past week. Responders rate a degree of each anxiety symptoms on a four-point Likert-type scale. The zero value means that the symptom was not presented at all. If the symptom bothered only slightly, patients scored one ("it bothered me only slightly). In case of medium intensity patients scored two ("it was uncomfortable, but I could stand it"). The maximum score was three ("I could hardly stand it"). A total score ranging from 0 to 63 can be obtained. The original version of inventory was validated on 160 patients suffering from depression, dysthymia, atypical depression, panic disorder, agoraphobia with or without panic attacks, generalized anxiety disorder, social phobia, simple phobia, miscellaneous non-anxiety, non-depression disorders such as academic problems and adjustment disorders and/or other anxiety or depressive disorders. An inventory showed excellent internal consistency ($\alpha=0.92$) and test-retest reliability over one week ($r=0.75$) (Beck *et al.* 1988).

Beck Depressive Inventory (BDI). Beck depressive inventory second edition (Beck *et al.* 1961) is self-rating scale that is used to evaluate level of depression. The same as BAI BDI is also self-rating scale. It includes 21

questions. Patients rate degree of depressive symptoms on a four-point Likert-type scale during last week. It evaluates both psychological (feelings of failure, fear of the future, guilt) and somatic (sleep disorders, fatigue, decreased libido) symptoms.

Clinical Global Impression (CGI). This scale was created in 1976 by William Guy. It measures the severity of present psychopathology in global. There is two main version of the scale. The first (CGI-S) evaluate the severity of psychopathology on a seven-point scale. The second (CGI-I) measures change in clinical status from the initiation of the treatment. Both scales can be assessed by patients (subjective (s-CGI)) or psychiatrist (objective (o-CGI)). Administration of this scale is straightforward.

Procedure. After the initial interview with psychiatrist patients administered Beck Anxiety Inventory, Beck Depressive Inventory, and s-CGI-S scale. Patients fulfill these questionnaires the first day of the treatment and then every next week. Objective CGI was measured by independent rater, so as the level of improve-

ment (o-CGI-I). Administration Instructions for Beck Anxiety Inventory was:" We present to you a list of common symptoms of anxiety. Read each item on the list. Indicate the extent to which presented symptoms bother you during the past week, including today, placing a cross at the appropriate place in the box next to each symptom." Both patients and healthy volunteers received the same instructions.

Statistical analysis

Standard summary statistics were used to describe primary data, median mean and standard deviation was used for cardinal data, absolute and relative frequencies for nominal variables. The statistical significance of differences between patients and controls was analyzed using a t-test for two independent samples (for cardinal) and ML chi-square test (nominal variables).

Correlations between BAI, BDI, s-CGI-S and o-GCI-S were described by Spearman coefficient. Test re-test reliability was tested by Cronbach alpha coefficient. Identification of BAI cut-offs was identified by using

Tab. 1. Demographic characteristics for the whole sample.

	Sex		Age		Education				Employment	
	Male	Female	Median	Mean	Elementary	Vocational training	Secondary school	University	Yes	No
Patients/Dg	260 (33.0%)	529 (67.0%)	39	39	107 (13.9%)	247 (41.4%)	327 (41.4%)	108 (13.7%)	306 (38.9%)	481 (61.1%)
F31	2 (25.0%)	6 (75.0%)	47	44	1 (12.5%)	1 (12.5%)	5 (62.5%)	1 (12.5%)	5 (62.5%)	3 (37.5%)
F32	23 (35.4%)	42 (64.4%)	47	44	6 (9.2%)	18 (27.7%)	22 (33.8%)	19 (29.2%)	25 (39.1%)	30 (60.9%)
F33	17 (37.0%)	29 (63.3%)	46	46	4 (8.7%)	14 (30.4%)	19 (41.3%)	9 (19.6%)	24 (52.2%)	22 (47.8%)
F40	38 (54.3%)	32 (45.7%)	25	30	19 (27.1%)	19 (27.1%)	27 (38.6%)	5 (7.1%)	25 (35.7%)	45 (64.3%)
F41	81 (26.3%)	227 (73.7%)	40	41	37 (12.0%)	107 (34.7%)	126 (40.9%)	38 (12.3%)	113 (36.8%)	194 (63.2%)
F42	43 (51.2%)	41 (48.8%)	32	34	9 (10.7%)	24 (28.6%)	37 (44.0%)	14 (16.4%)	34 (40.5%)	50 (59.5%)
F43	39 (29.1%)	95 (70.9%)	36,5	36	19 (14.2%)	35 (26.4%)	66 (49.3%)	14 (10.4%)	51 (38.1%)	83 (61.9%)
F44	5 (20.0%)	20 (80.0%)	32	32	3 (12.0%)	12 (48.0%)	8 (32.0%)	2 (8.0%)	15 (60.0%)	10 (40.0%)
F45	12 (24.5%)	37 (75.5%)	45	44	9 (18.4%)	17 (34.7%)	17 (34.7%)	6 (12.2%)	9 (18.4%)	17 (34.7%)
Control group	96 (33.8%)	188 (66.2%)	29	33	34 (12.0%)	40 (14.1%)	124 (43.7%)	86 (30.3%)	96 (33.8%)	188 (66.2%)
Statistical analysis	Chi-square test		t-test		Chi-square test				Chi-square test	
p-value	0.794		<0.001**		<0.001**				0.125	

F31 – Bipolar disorder, F32 – Major depressive disorder, single episode, F33 – Major depressive disorder, recurrentF40 – Phobic anxiety disorders; F41 – Other anxiety disorders, F42 – Obsessive-compulsive disorder, F43 – Reaction to severe stress, and adjustment disorders, F44 – Dissociative and conversion disorders, F45 – Somatoform disorders; **statistically significant difference (α=0.01)

Tab. 2. Cronbach´s alfa for the BAI score in the whole group and each subgroup.

		BAI
All diagnoses	N (%)	735 (93.2%)
	Cronbach´s alfa	0.919
F31	N (%)	7 (87.5%)
	Cronbach´s alfa	0.818
F32	N (%)	59 (90.8%)
	Cronbach´s alfa	0.904
F33	N (%)	42 (91.3%)
	Cronbach´s alfa	0.951
F40	N (%)	68 (97.1%)
	Cronbach´s alfa	0.924
F41	N (%)	289 (93.8%)
	Cronbach´s alfa	0.917
F42	N (%)	76 (90.5%)
	Cronbach´s alfa	0.917
F43	N (%)	124 (92.5%)
	Cronbach´s alfa	0.910
F44	N (%)	23 (92.0%)
	Cronbach´s alfa	0.875
F45	N (%)	47 (95.9%)
	Cronbach´s alfa	0.939
Control group	N (%)	284 (100%)
	Cronbach´s alfa	**0.886**

BAI – Beck Anxiety Inventory, F31 – Bipolar disorder, F32 – Major depressive disorder, single episode, F33 – Major depressive disorder, recurrentF40 – Phobic anxiety disorders; F41 – Other anxiety disorders, F42 – Obsessive-compulsive disorder, F43 – Reaction to severe stress, and adjustment disorders, F44 – Dissociative and conversion disorders, F45 – Somatoform disorders

Tab. 3. Test re-test reliability.

BAI-2	**BAI-3**	**Interclass correlation**
Mean ± SD	**Mean ± SD**	
21.2±13.2	20.6±13.5	0.904**

BAI-2 – BAI score measured in the second week, BAI-3 – BAI score measured in the third week, SD – standard deviation
** statistically significant difference (α=0.01)

Tab. 4. Spearman correlation between BAI, BDI, sCGI and oCGI.

	BAI	**s-CGI-S**	**BDI**	**o-CGI-S**
BAI		–0.010	–0.008	0.004
sCGI	–0,010		0.307**	0.337**
BDI	–0.008	0.307**		0.713**
oCGI	0.004	0.337**	0.713**	

BAI-Beck Anxiety Inventory, sCGI – Clinical Global Impression scale evaluated by patient, BD – Beck Depressive Inventory, oCGI – Clinical Global Impression scale evaluated by psychiatrist
** statistically significant difference (α=0.01)

ROC analysis as point with highest sum of sensitivity and specificity.

Analyses were performed using the IBM SPSS 22.0.0 (IBM Corporation 2013).

RESULTS

Subjects

789 patients and 284 healthy volunteers agreed with participation in the study. The sample on which the analysis was carried out was made of groups of probands with primary diagnoses of major depressive disorder (n=65), recurrent depression (n=46) or bipolar affective disorder (n=8), and 672 patients met criteria for any anxiety disorder, OCD or trauma- and stressor-related disorders. There were patients suffered from mixed anxiety-depressive disorder (n=165), adjustment disorder (n=111), panic disorder and/or agoraphobia (n=110), obsessive-compulsive disorder (n=84), dissociative or somatization disorder (n=79), social phobia (n=63), generalized anxiety disorder (n=36) and post-traumatic stress disorder (n=23). Age, gender, and other demographic variables are presented in Table 1. There was a significant different in age ($p<0.001$) and education level ($p<0.001$) between patients and healthy controls. There was no statistical difference between groups in gender and employment ($p=0.794$; resp. $p=0.250$).

Internal consistency

Our findings demonstrated high internal consistency in the each diagnostic group rating from 0.818 in patients with bipolar disorder to 0,951in patients with recurrent depression. Beck anxiety inventory has high inner stability in the whole group of patients. Inner consistency was measured using Cronbach´s alpha. Alpha coefficients are listed in Table 2.

Test re-test reliability

The whole group of patients was included in this phase of the study (n=684). A non-significant difference ($p=0.904$) was found between test (mean = 21.2) and retest (mean=20.6). The inventory showed good reliability in test-retest over one week.

Convergent and divergent validity

Spearman correlation between BAI, BDI, s-CGI-S and o-GCI-S showed no correlation between BAI and the other scales (Table 4). Our result showed that BAI is independent of the other scales.

Sensitivity to treatment-related changes

Improvement after treatment was measured by BAI, BDI, o-CGI and s-CGI. Patients were treated with a combination of group Cognitive Behavioral Therapy and psychopharmacotherapy for six weeks. There was a significant decrease in all used scales after treatment using pair t-test (Table 5). Sensitivity to changes was measured by comparing changes of scores using Spear-

Tab. 5. Sensitivity to changes (BAI-1 a BAI-L) vs oCGI-imp (oCGI-1 – oCGI-L), sCGI-imp (sCGI-1 – oCGI-L), BDI-imp (BDI1 – BDI-L).

Indexes	N	Before treatment Mean ± SD	After treatment Mean ± SD	Difference between averages ± SD	*p*-value
BAI-1 – BAI-L	660	23.8±12.9	19,6±13.7	4.21 ±19.6	<0.001*
oCGI-1 – oCGI-L	671	4.0±1.2	3.1±1.5	0.9±1.3	<0.001*
sCG-I – sCGI -L	599	4.3±1.4	3.0±1.3	1.3±1.8	<0.001*
BDI-1 – BDI-L	664	24.6±10.3	18.2±11.7	6.4±9.6	<0.001*

BAI-1 – Beck Anxiety Inventory measured at the begging of the therapy, BAI-L – Beck Anxiety Inventory measured after therapy, oCGI-1 – objective Clinical Global Impression measured at the begging of the therapy, oCGI-L – objective Clinical Global Impression measured after therapy, sCGI-1 – subjective Clinical Global Impression measured at the begging of the therapy, sCGI-L – subjective Clinical Global Impression measured after therapy, BDI – Beck Depressive Inventory measured at the begging of the therapy, BDI-L – Beck Depressive Inventory measured after therapy; *statistically significant difference (α=0.05)

man correlation. Beck Anxiety Inventory showed sensitivity to measure changes after treatment comparing with all three other scales (Table 6).

Cut off scores for different demographic groups

We also evaluated cut-off points for different demographic groups (compare to healthy controls) based on the utilization of ROC curves based on the highest sensitivity and specificity. For each subgroup, there was detected a BAI score that differ patients from healthy controls. The ability to differ patients from healthy controls on the 0–1 scale indicates the area under the curve (AUC). The optional cut-off for the BAI in the whole group was the score of 17, which had a sensitivity of 0.639 and specificity of 0.803 (Table 7).

DISCUSSION

The aim of our study was to evaluate psychometric properties of Czech version of Beck Anxiety Inventory in a mixed group of both depressive and anxiety

Tab. 6. Correlation between changes in scales.

	o-CGI – I	s-CGI – I	BDI-Imp	BAI-Imp
oCGI – Imp		0.400**	–0.604**	–0.402**
s-CGI – Imp	0.400**		–0.478**	–0.383**
BDI-Imp	–0.604**	–0.478**		0.316**
BAI-Imp	–0,402**	–0,383**	0,316**	

BAI-I – (BAI-1 – BAI-L), o-CGI-I (oCGI-1 – oCGI-L), s-CGI-I (s-CGI-1 – s-CGI-L), BDI-I (BDI1 – BDI-L)
** Statistically significant difference (α=0.01)

patients compare to healthy controls. We also want to prove its sensitivity to show changes after therapy and find cut-off scores for various demographic groups.

Up to our results showed Czech version of Beck Anxiety Inventory, same as the original version, good inner psychometrical properties. Similar results also showed studies of other language versions of this inventory (Quintao *et al.* 2013; Sanz *et al.* 2012; Magán *et al.* 2008).

Tab. 7. Sensitivity and Specificity of the cut-off scores.

	BAI cut-off	AUC (95% IS)	*p*-value	Sensitivity	Specificity
Whole Group	>17	0.799 (0.770–0.827)	<0.001*	0.639	0.803
female	>17	0.779 (0.743–0.816)	<0.001*	0.661	0.761
male	>10	0.843 (0.800–0.886)	<0.001*	0.800	0.740
Younger than 25 years	>25	0.741 (0.680–0.802)	<0.001*	0.493	0.913
26–49 years	>10	0.849 (0.815–0.884)	<0.001*	0.813	0.720
50 years old and older	>17	0.790 (0.758–0.821)	<0.001*	0.631	0.802
Grammar school	>11	0.747 (0.651–0.842)	<0.001*	0.832	0.588
Apprentice training	>9	0.807 (0.729–0.885)	<0.001*	0.868	0.675
Secondary school	>23	0.802 (0.760–0.844)	<0.001*	0.542	0.944
University	>17	0.792 (0.729–0.855)	<0.001*	0.617	0.884
Employed	>12	0.830 (0.797–0.863)	<0.001*	0.758	0.729
Unemployed	>17	0.740 (0.688–0.792)	<0.001*	0.677	0.698

The same as in the original research of Beck (Bect *et al.* 1988) our sample consist of patients suffering from various anxiety disorders and depressive disorder same as original. However, we also included patients with bipolar disorder, dissociative and conversion disorders, somatoform disorders and obsessive-compulsive disorder. On the other hand, there were no patients diagnosed as dysthymia or atypical depression. Our study, therefore, provides information on a wider sample of patients than the original article.

In our study, Beck Anxiety Inventory proved excellent internal consistency both in patients from all diagnostic groups and healthy controls. This finding is by other studies that also proved good internal consistency in a non-clinical sample, with alpha rating from 0.88 to 0.93 (De Ayala *et al.* 2005; Magán *et al.* 2008). Good internal consistency was also confirmed in studies concentrated on social phobia with alpha rating from 0.88 to 0.92 (de Lima *et al.* 2011). High coefficient alpha (0.92) was also found in the study published by Steer *et al.* (2003) evaluating anxiety in psychotic patients.

Our test of stability showed that the various items of BAI significantly correlate with each other. This means that they evaluate the only one variable. This finding is in contrast with other studies that obtained bi-factor solution (somatic symptoms and affective-cognitive factor) (Beck *et al.* 1988; Hewitt *et al.* 2003; Chapman *et al.* 2009), or three-factor solution (de Lima Osório 2011). But other authors showed close correlation between the two factors that allow the similar interpretation of the two factors, which support the idea of the one-dimensionality of the BAI (Magán *et al.* 2008; Osman *et al.* 2002).

The inventory also showed excellent test-test reliability over one week (0.90). This finding is in agreement with other published studies. The correlation was higher than presented by Beck *et al.* (1988) (0.75), Lykke *et al.* (2008) (0.67), and De Beurs *et al.* (1997) (0.83). Better rest-retest reliability over one week (0.93) showed study made by Julian (2011).

The Beck Anxiety Inventory proved a real ability to assess treatment-related changes. The sensitivity of BAI to measure treatment-related changes was also confirmed in another study (de Bleurs 1997). BAI thus may be tool useful evaluating treatment outcome.

In original work of Beck *et al.* (1988) the BAI was mildly correlated with Hamilton Depression Rating Scale and moderately with Hamilton Anxiety Rating Scale. In our study, there was no other correlation with other scales. The explanation may be that we again used the subjective scale to measure depression. Statistically, a significant correlation between BAI and BDI showed a study of de Beurs *et al.* (1997).

The cut-off scores were examined in patients with different diagnoses (Leyfer *et al.* 2006). In our study, we focused on cut-off points in various demographic groups. Up to our results is a cut-off point higher in female (17 points) than in males (10 points). Another factor that influence the cut-off point was employment. Cut-off points were also different in various age groups. The lowest was in patients between 26 to 49 years. Patients younger than 25 years had the highest cut-off score (25 points). Also, the level of education influenced the cut-off points. There was a significant different in age and education level between patients and healthy controls.

Our study had used several limitations. One of the most important one is that the control group and patients group statistically differ in education level and age. How our results showed both factors can influence BAI score. Younger and more educated patients had higher cut-off points. Other important limitations are different number of patients in various diagnostic groups.

CONCLUSION

In conclusion, Czech version of Beck Anxiety Inventory showed similar psychometric properties as the original version. It also proved its ability to measure changes in therapy and so it may be recommended as the useful tool for measuring the level of anxiety in patients suffering from any anxiety disorder or depression.

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