

## ORIGINAL ARTICLE

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## Psychometric properties of Persian version of Beck depression inventory in coronary patients

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### ABSTRACT

#### BACKGROUND

Obtaining psychometric properties regarding specific populations increases diagnostic accuracy and reduces economic health burdens. Beck depression inventory-second version (BDI-II) is useful for the screening and assessment of depression in clinical and research settings. The aim of the present study was to investigate the psychometric properties of the Persian (Farsi) version of BDI-II in patients with coronary heart disease (CHD).

#### METHODS

A cross-sectional study was conducted on 284 patients with CHD admitted to Imam Ali Hospital in Kermanshah. They were first given a structured clinical interview (SCID-I) and then were asked to complete the Beck depression inventory-II (BDI-II), patient health questionnaire 9 (PHQ-9) and generalized anxiety disorder 7 (GAD-7). Data were analyzed by descriptive statistics, Cronbach's  $\alpha$ , Spearman's correlation coefficient, exploratory factor analysis and receiver operating characteristic curve (ROC).

#### RESULTS

The internal consistency measured using Cronbach's alpha was 0.90. The obtained correlation of BDI-II with PHQ-9 and GAD-7 was 0.74 and 0.65, respectively ( $p < 0.001$ ). Factor analysis of the inventory revealed 5 factors, namely cognitive, somatic, impaired performance, negative attitude to self and self punishment respectively. The cut-off point for CHD patients was 11 with sensitivity of 0.78 and specificity of 0.81 according to the Youden index and 10 with sensitivity of 0.80 and specificity of 0.77 according to the two-stage approach. The area under the curve was 0.86 (95% Confidence Interval 0.82-0.90).

#### CONCLUSION

The Persian version of the BDI-II possesses the acceptable psychometric properties that can be used to screen depression in CHD patients.

**Keywords:** Beck depression inventory-II, depression, coronary disease, psychometrics, sensitivity and specificity

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## INTRODUCTION

Depression is a comorbid disorder to severe physical problems,<sup>(1)</sup> such as cancer<sup>(2)</sup> and cardiovascular problems.<sup>(3,4)</sup> Depression is highly witnessed among coronary patients. A study in China estimated the prevalence to be between 34.6% to 45.8%.<sup>(5)</sup> Research carried out in Iran reported the prevalence of depression among coronary patients to be 66%.<sup>(6)</sup> Depression is one of the cardiovascular risk factors which has been reported to be linked to negative treatment results and even to increased death rates among such patients.<sup>(7,8)</sup> In case patients with cardiovascular problems are diagnosed with depression, there is an urgent need for psychotherapy.<sup>(9)</sup> Rapid and accurate diagnosis of depression in coronary patients is one of the pressing priorities. Interviews which lead to diagnosis impose time and cost restrictions on the healthcare system so the need for an accurate and specialized inventory to help with diagnosis is strongly felt. Various depression inventories are available, such as Beck depression inventory (BDI), properties patient health questionnaire 9 (PHQ-9), cardiac depression scale (CDS), and each displays different psychometric specifications.<sup>(9,10)</sup>

Regarding the major importance attached to the case of coronary patients, the need is felt to consider different depression inventories so that the best inventory with the most accurate sensitivity can be singled out and introduced as the appropriate choice for such patients. Beck depression inventory is an acceptable one, approved and suggested by the National Heart Foundation of Australia.<sup>(9)</sup> Although this questionnaire has shown acceptable reliability and validity in other countries for measuring depression in cardiac patients such as Indonesia<sup>(11)</sup> and Canada,<sup>(12)</sup> the need to investigate the reliability, validity, cut-off point, sensitivity, and specificity of BDI-II in Iranian cardiac patients is strongly felt.

As it is well proved that depression symptoms can surface differently in differing cultures,<sup>(13)</sup> it is necessary to investigate the

reliability and validity of the BDI in different countries and with different populations.

Beck depression inventory -second edition (BDI-II) has been frequently used in various groups, including heart patients in Iran.<sup>(14-16)</sup> However, in all of the studies, the psychometric properties obtained in the general population or the general properties of the questionnaire have been used. That is the reason why the psychometric properties of various groups may be different and one of the limitations we encounter is the restricted ability to generalize data for example. Wang et al.<sup>(17)</sup> showed that the cut-off points for screening for depression in various populations are different, and the cut-off point for the BDI in the general population is in the lower range (from 10-16) compared to the clinical population (from 7-20) and the psychiatric population (from 19-31). In Iran, there is no study that has addressed the psychometric properties of this questionnaire in patients with coronary artery disease.

It is thus mandatory to investigate the psychometric properties and the diagnostic cut-off points of the inventory among coronary patients in Iran. Accordingly, the present research aims at investigating the reliability, validity, and cut-off point of the BDI-II in Iranian coronary patients.

## METHODS

### Participants and procedures

Among patients referred to Imam Ali Hospital in Kermanshah from June 22, 2018 to November 22, 2018, 289 patients with coronary heart disease were selected as samples. Excluded were patients with thyroid dysfunction, cognitive disorders such as dementia or Alzheimer's disease, records of brain strokes, severe psychological problems like psychotic symptoms and dissociative identity disorder as well as those who, due to severe heart problems, could not fill out questionnaires. Following briefing of the participants and acquiring their consent, clinical structured interviews were conducted by two

psychologists. The participants then completed the PHQ-9, GAD-7, and BDI-II questionnaires.

### Measurements

Structured clinical interview for DSM-5 (SCID): the structured clinical interview for DSM-V is the semi-structured interview for main diagnosis of DSM-5 (previously placed on the first axis). This instrument needs to be implemented by a clinical psychologist or a trained psychological health specialist familiar with diagnostic scales and classification of disorders in DSM-5.<sup>(18)</sup>

### Depression

Beck depression inventory (BDI-II) is a 21-question inventory that measures the severity of depression. The inventory uses a 4-point Likert scale that assigns a value of 0 to 3 to every answer. The higher the score, the more severe the depression would be. The total score ranges from 0 to 63. Scores 0 to 13 indicate minimal depression, scores 14 to 19 indicate mild depression, scores 20 to 28 indicate moderate depression and scores 29 to 63 indicate severe depression.<sup>(19)</sup>

Patient health questionnaire-9 (PHQ-9) is a self-report questionnaire which is designed to diagnose based on the Diagnostic and Statistical Manual for Mental Disorders-IV (DSM-IV). It has 9 questions and is derived from the complete version of PHQ. Participants need to report how they have felt over the past two weeks on a 4-point Likert scale ranging from not at all (0), several days (1), more than half the days (2), almost every day (3) and the total score ranges from 0 to 6.<sup>(20)</sup>

### Anxiety

Generalized anxiety disorder 7 (GAD-7) is a self-report seven-item questionnaire that was devised by Spitzer et al.<sup>(21)</sup> It basically includes 9 items and is based on DSM. It is scored according to a 4-point Likert scale from 0 to 3 (not at all = 0, several days = 1, more than half the days = 2, and nearly every day = 3). The obtained total score is between 0 to 21 and the questionnaire is of a

sensitivity of 0.89 and specificity of 0.82 at the cut-off point of 10.

### Data analysis

To analyze the data SPSS software version 21 was implemented. Cronbach's alpha was used to monitor the reliability. To investigate the validity, criterion validity based on the correlation between PHQ-9 and GAD-7 was used and to do so, Pearson correlation coefficient was calculated. To investigate the construct validity, exploratory factor analysis was performed. To interpret the ROC curve and obtain the best cut-off point, two methods suggested by Lowe et al.<sup>(22)</sup> were used. In the first method, maximal Youden Index (sensitivity + specificity - 1) was implemented. The second method implemented a two-stage approach for screening depression disorder. In this method, the cut-off point is obtained with maximum sensitivity and specificity, higher than 0.75. The two-stage approach sounds more congenial to the clinical situation where the positive results of screening are usually followed by long diagnostic interviews and treatment in case they are rendered necessary. The area under the curve (AUC) was considered as the accuracy of scale.

### Ethical considerations

This research project was approved by the Ethics Committee of the Shahid Beheshti University of Medical Sciences under the code of ethics IR.SBMU.MSPREC.1396.286. As for those patients showing severe depression in clinical interviews, psychiatric counseling was requested after informing the cardiologic section of the hospital and the related specialist.

## RESULTS

### Characteristics of the subjects

Two hundred eighty-four patients admitted to Kermanshah's Imam Ali Hospital who were diagnosed with CHD filled out the questionnaires. The age range of the participants was 59.78 ± 10.19 years and there was an almost equal gender distribution, with 155 male participants making up

Table 1. Item analysis of BDI-II

Number	Item description	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
BDI 1	Sadness	9.2784	66.745	0.739	0.601	0.885
BDI 2	Pessimism	9.5804	69.016	0.577	0.408	0.890
BDI 3	Past failure	9.4510	68.359	0.612	0.474	0.889
BDI 4	Loss of pleasure	9.3451	65.605	0.540	0.415	0.891
BDI 5	Guilty feelings	9.5412	70.438	0.421	0.389	0.894
BDI 6	Punishment feelings	9.6627	70.516	0.442	0.390	0.893
BDI 7	Self-dislike	9.2588	65.232	0.495	0.426	0.894
BDI 8	Self-critical	9.5490	69.123	0.560	0.442	0.890
BDI 9	Suicidal thoughts	9.8392	72.411	0.399	0.310	0.894
BDI 10	Crying	9.3922	69.200	0.432	0.268	0.894
BDI 11	Agitation	9.3333	66.900	0.651	0.534	0.887
BDI 12	Loss of interest	9.5176	67.896	0.727	0.603	0.886
BDI 13	Indecisiveness	9.6314	70.541	0.555	0.417	0.891
BDI 14	Worthlessness	9.6431	69.876	0.554	0.429	0.891
BDI 15	Loss of energy	9.2902	69.057	0.550	0.474	0.890
BDI 16	Changes in sleep pattern	9.2667	67.740	0.484	0.360	0.893
BDI 17	Irritability	9.5882	70.613	0.486	0.345	0.892
BDI 18	Changes in appetite	9.5647	70.711	0.394	0.372	0.894
BDI 19	Concentration difficulties	9.6706	71.206	0.486	0.368	0.892
BDI 20	Tiredness and Fatigue	9.3294	69.175	0.555	0.534	0.890
BDI 21	Loss of interest in sex	9.0118	67.933	0.418	0.280	0.895

54.6% of the sample. Forty six participants were clerks (16.2%), 108 were business people (38%) and 130 were unemployed (45.8%). Ten percent of the population had bachelor or higher university degrees, 42% had diploma and associate degrees, 48% had some school education.

### Reliability

The reported Cronbach's alpha on the internal consistency of the BDI-II was 0.90 and the correlation of each item with the total score ranged from 0.34 to 0.79 ( $p < 0.001$ ). The results of item analysis also indicated that alpha was reduced after illuminating items and it was consistent over all items so it was concluded that every item was suitable. (Table 1)

### Validity

The correlation of BDI-II with PHQ-9 and GAD-7 was reported to be 0.74 and 0.65 respectively. Factor analysis was implemented to investigate the construct validity and the result of Kaplan-Meier-Olkin test was 0.90. The Bartlett

test proved significant which is an indication of the data being appropriate for factor analysis. Factor analysis results indicated that the questionnaire is of 5 factor loadings where the first factor explains 37.63% of the variation, the second factor explains 6.10%, the third factor 5.83% and the fourth and fifth factors explain 5.38% and 4.97%, respectively, of the variation. The factors totally explain 59.93% of the variation. (Table 2)

### Specification of the test for screening

To obtain accuracy and the optimal cut-off point, the ROC test was implemented. The results indicated that Beck Depression Inventory covers 0.86 (95% CI=0.82 -0.90) of the area under the curve (Figure 2). This data indicates that the second version of Beck depression inventory can recognize depressed coronary patients from the non-depressed.

According to the Youden index, the optimal cut-off point to diagnose depression in this study, and for research purposes, is 11 with sensitivity

Table 2. Factor analysis of BDI-II

		Questions						Cumulative %	% of Variance	Total
Factor 1	Cognitive	1	2	3	7	12	13	37.63	37.63	7.90
		0.52	0.52	0.56	0.77	0.44	0.61			
Factor 2	Somatic	11	16	17	18	19	21	43.71	6.01	1.28
		0.61	0.49	0.67	0.50	0.63	0.49			
Factor 3	Impaired performance	4	15	20				49.57	5.83	1.22
		0.47	0.65	0.79						
Factor 4	Negative attitude to self and worthlessness	8	9	14				54.95	5.38	1.13
		0.50	0.72	0.69						
Factor 5	Self punishment	5	6	10				59.57	4.97	1.04
		0.74	0.80	0.52						

of 0.78 and specificity of 0.81. The cut-off point of 10 with sensitivity of 0.80 and specificity of 0.77 is recommended for clinical purposes (Table 3).

**DISCUSSION**

The internal consistency of BDI-II based on Cronbach’s alpha was 0.90. Generally, Cronbach’s alpha coefficients higher than 0.70 are considered as significant and coefficients equal or higher than 0.70 are trusted.<sup>(23)</sup> The

present study confirmed previous research carried out on coronary patients in Indonesia that came up with an alpha coefficient similar to ours ( $\alpha=0.87$ ).<sup>(11)</sup> In a study in the general and hospital population in the Dominican Republic, Cronbach’s alpha coefficients were reported between 0.70 to 0.89.<sup>(24)</sup>

The validity of the inventory was investigated through Pearson correlation of BDI with PHQ-9 and GAD-7, which turned out to be 0.74 and 0.65 respectively, indicating the inventory as valid. The above-mentioned study in Indonesia

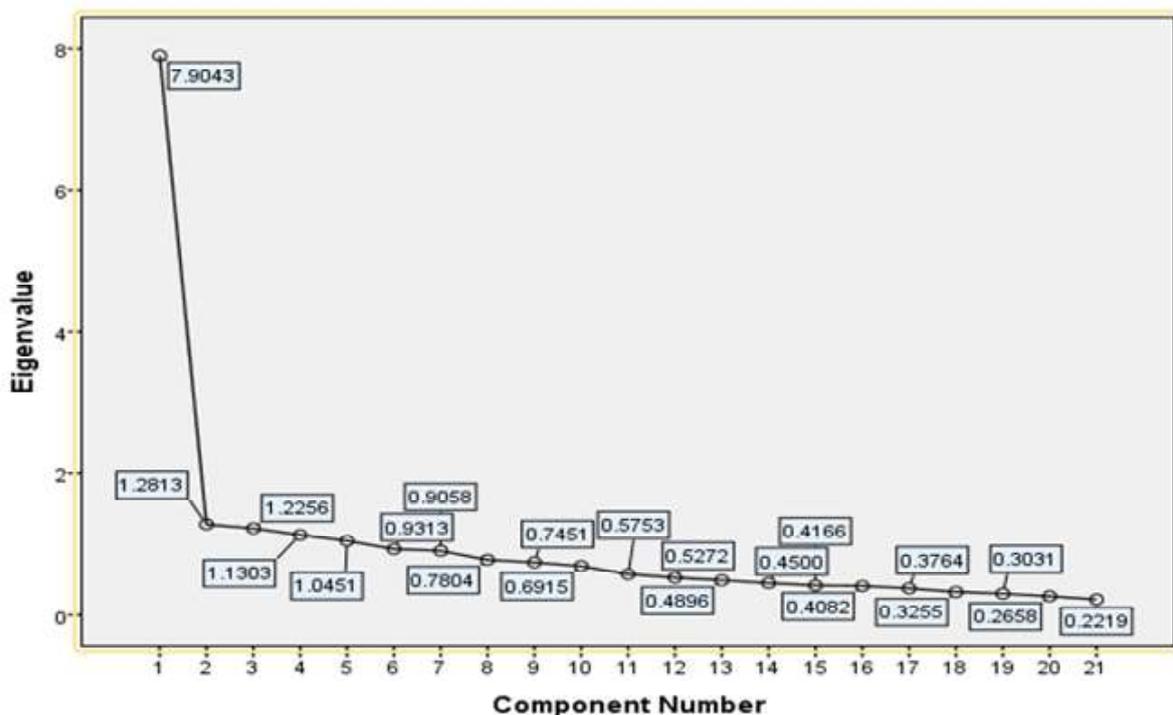


Figure 1. Screen plot for Beck depression inventory

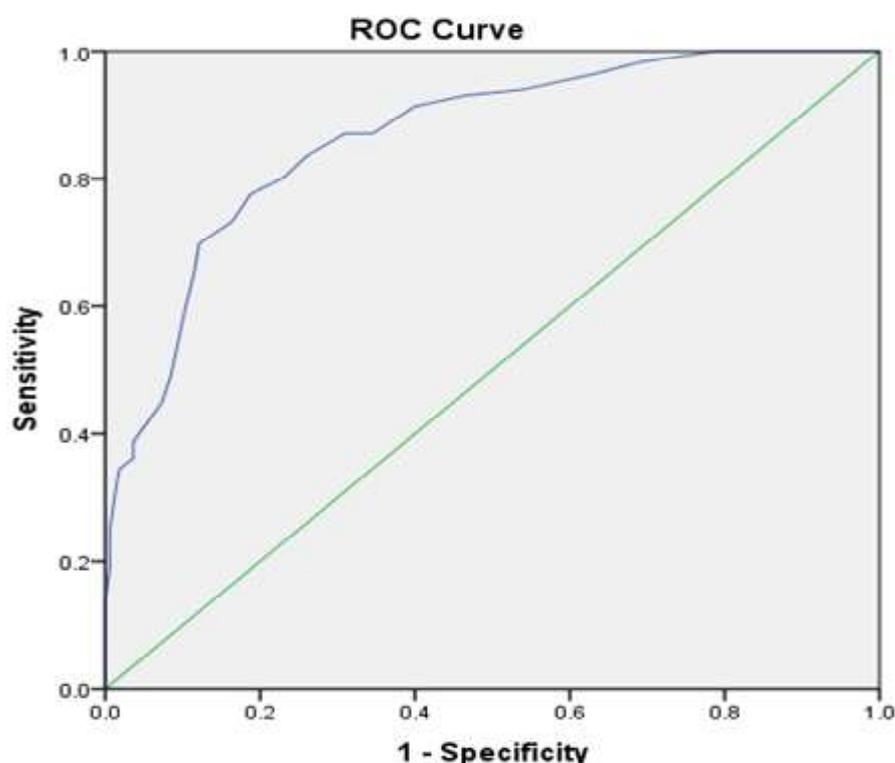


Figure 2. Receiver operating characteristic curve for BDI-II

<sup>(11)</sup> on coronary patients, and depressed and healthy people investigated the correlation of BDI with questionnaires of type D personality scale (DS14), Beck anxiety inventory (BAI), multidimensional scale of perceived social support (MSPSS), and life orientation test-revised version (LOT-R), yielding correlation coefficients of 0.52, 0.52, -0.039 and -0.46, respectively, which are lower than the values of the present study.

Factorial analysis of BDI implemented for coronary patients led to 5 major factor loadings

listed here under the headings cognitive, somatic, impaired performance, negative attitude to self and, and self punishment. Previous studies, carried out on differing populations, have reported different factor loadings, while previous researches on coronary patients share cognitive, emotional and physical factor loadings with ours.<sup>(11)</sup> With distinct samples of HIV patients factorial structures of cognitive/emotional and physical as well as factorial structures of negative thoughts, dysfunction and physical signs were

Table 3. Sensitivity, specificity, predictive values, and likelihood ratios at various cut-off scores of the BDI-II

	Cut-off point	Sensitivity	Specificity	PPV	NPV	LR+	LR-
BDI-II	≥7	0.78	0.66	0.63	0.87	2.52	0.19
	≥8	0.78	0.69	0.66	0.88	2.81	0.18
	≥9	0.84	0.74	0.69	0.86	3.20	0.22
	≥10*	<b>0.80</b>	<b>0.77</b>	<b>0.71</b>	<b>0.84</b>	<b>3.48</b>	<b>0.25</b>
	≥11**	<b>0.78</b>	<b>0.81</b>	<b>0.74</b>	<b>0.83</b>	<b>4.12</b>	<b>0.27</b>
	≥12	0.73	0.84	0.75	0.81	4.47	0.31
	≥13	0.70	0.88	0.80	0.80	5.73	0.34
	≥14	0.66	0.89	0.8	0.85	5.69	0.39

\*Recommended cut-off points for a two-stage screening (maximal sensitivity and ≥75% specificity)

\*\*Optimal cut-off points according to maximal Youden Index (sensitivity+specificity-1).

reported.<sup>(13)</sup> Considering the fact that depression surfaces differently in differing communities, the observed differences can be due to distinct communities.

The results of the ROC curve demonstrated that the AUC of the BDI-II was 0.86, which is considered good according to the conventional classification system.<sup>(25)</sup> In the Indonesian study on heart disease mentioned earlier, the AUC was 0.81, which is similar to that of the present study.<sup>(11)</sup>

The obtained cut-off point in this study was 11 with sensitivity of 0.78 and specificity of 0.81 which indicates the instrument to be suitable for diagnosis and screening purposes. Confirming the present study results, a study on heart patients in Canada reported the optimal cut-off point, independent of demographic variables, as 10 with sensitivity of 83% and specificity of 73%.<sup>(12)</sup> In yet another research in Lithuania a cut-off point of 14 with sensitivity of 0.89 and specificity of 0.74 was reported.<sup>(26)</sup> As well, in a study in Indonesia on depressed, non-depressed and coronary patients, the cut-off point of 17 was obtained with sensitivity and specificity of 0.73 which is a bit different from the results of the present study as well as the two aforementioned studies.<sup>(11)</sup> It is worth mentioning that the population in Indonesian study was a combination of healthy, depressed and coronary patients and it aimed at diagnosing minimal depression which could explain the different reported cut-off point.

The present study has some limitations that should be taken into consideration. The present study investigated the BDI-II in a sample of the patients with CHD; therefore, the findings should be generalized to other populations with caution. Due to the limitations of this study, it is recommended that these questionnaires be studied in a different group of patients.

## CONCLUSION

This study indicated that BDI was of a suitable reliability and validity in patients with

coronary heart disease in Iran. In Iran, the cut-off point of 10 could be implemented for clinical purposes and the cut-off point of 11 suits research purposes better.

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## CONFLICT OF INTEREST

There is no conflict of interest between the authors.

## CONTRIBUTORS

SMA and AMA contributed to the Study concept and design. SMA, AMA, MB, MHDE, and RM contributed to the analysis and interpretation of data. AMA contributed to the drafting of the manuscript and critical revision of the manuscript for important intellectual content. MB and MHDE contributed to the study supervision. All authors have read and approved the final manuscript. 

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