



## Factorial Structure Analysis of a Psychometric Instrument in Comparison with Multiple Cultures: Mental Health Symptomatologic Perspective

Dr. Sana Zahra<sup>1</sup>, Dr. Attiya Iqbal<sup>2</sup>

<sup>1</sup> Postgraduate Research (PGR), Bakhtawar Amin Hospital, Multan, Pakistan. Email: zharasana@gmail.com

<sup>2</sup> Postgraduate Research (PGR), Bakhtawar Amin Hospital, Multan, Pakistan. Email: attiyasuma@gmail.com

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### ABSTRACT

Depression is a global problem that has significant repercussions for society and the economy. Within the context of a sample of married people in Bahawalpur, this research investigates the reliability and structure of the Beck Depression Inventory (BDI). Despite the fact that the BDI is a widely used instrument, there have been findings that indicate the existence of cross-cultural differences in terms of the identified components or dimensions of the instrument (BDI). In order to examine the reliability of the BDI and to define the factor structure of the instrument, the purpose of this study is to. A sample of 160 married adults was used to collect the data for this study. Cronbach's Alpha and Principal Component Analysis were both utilized in the process of analyzing the data. The identification of four components allows for a better understanding of the many symptoms associated with depression. This work makes a contribution to a more comprehensive understanding of mental health symptomatology by shining light on potential cultural influences that alter the expression and perception of psychological symptoms reported by the Beck Depression Inventory (BDI) instrument.

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Corresponding Author's Email: zharasana@gmail.com

### 1. Introduction

Depression affects almost 300 million individuals worldwide, making it a major factor in the overall burden of disease (World Health Organization, 2018). Additionally, it ranks as the fourth most common cause of years lived with disability (YLD)(World Health Organization, 2001). In addition to being more common in poor and middle-income countries (Lund et al., 2010) depression results in significant financial burden due to reduced productivity, absenteeism from work, outpatient care, hospitalizations, and the use of medications (Contreras-Valdez, Hernández-Guzmán, & Freyre, 2015). The symptomatology of depression is characterized by disturbances in mood, sleep, hunger, energy, body weight, concentration, decision-making capacity, self-confidence, and self-worth. The lack of evaluation tools for depression can have a detrimental impact on the early detection of depression symptoms in primary care units and the creation of evidence-based interventions that are culturally responsive (García-Batista, Guerra-Peña, Cano-Vindel, Herrera-Martínez, & Medrano, 2018). However, even without the use of scientifically validated techniques, the identification and treatment of depression have become a significant focus in low- and middle-income countries (Patel, 2017).

The BDI has emerged as a highly popular tool for assessing symptoms and severity of depression in the general population. The reliability and convergent validity of the BDI have been established through various studies conducted in diverse populations and countries (Basker, Moses, Russell, & Russell, 2007; Bonilla, Bernal, Santos, & Santos, 2004; Khan, Marwat, Noor, & Fatima, 2015; Subramaniam, Harrell, Huntley, & Tracy, 2009). While globalization is decreasing cultural divergence, significant cross-cultural variances still exist in the symptomatology of depression (Ferrari et al., 2013). The symptoms of depression may also differ depending on the cultural context (Kirmayer, 2001). Varying results have been discovered in earlier investigations with regards to the factor structure of BDI. Various studies have examined different models for the factorial structure of BDI. These include single factor, two factor, three factor, four factor, five factor, six factor, and seven factor models. The studies by (Basker et al., 2007; Bernal, Bonilla, & Santiago, 1995; Bonilla et al., 2004; Golin & Hartz, 1979; Hill, Kemp-Wheeler, & Jones, 1986; Khan et al., 2015; Subramaniam et al., 2009; Teri, 1982) have all contributed to the understanding of these models. Therefore, the research indicates that the factor structure of BDI is uncertain, and BDI is better understood as a multidimensional construct for measuring depression (Shek, 1990). However, it is not possible to draw broad conclusions from the findings obtained from various cultural situations (García-Batista et al., 2018).

Hence, the primary objective of the current study is to assess the reliability of the BDI for the married population of Bahawalpur. Additionally, the study aims to identify and analyze the factor structure of the BDI.

## 2. Material and Methods

One hundred sixty married individuals from the Bahawalpur sub-district were selected to participate in the study's sample. To collect primary data on depression, the Urdu version of the Beck Depression Inventory (BDI) was applied. During the course of the empirical investigation, a reliability study which utilized Cronbach's Alpha and a Principal Component Analysis (PCA) were carried out. For each participant, the BDI scores (Beck, Steer, & Brown, 1987) were calculated in order to obtain the research objectives.

### 2.1. Psychometric Instrument: The Beck Depression Inventory

In the BDI (Beck et al., 1987), there are 21 items that make up the BDI, which is a self-report evaluation that is extensively utilized. The degree of depression is evaluated with the use of this tool. A Likert scale with four points, ranging from 0 to 3, is used to evaluate each item. The scale is based on the subject's level of depression over the course of the previous two weeks. In light of this, the overall BDI score can range anywhere from 0 to 63 points, with 0 being the lowest possible score.

### 2.2. Principal Component Analysis (PCA)

Factor analysis is a statistical method employed to reduce the amount of information from multiple original variables into a more concise collection of dimensions known as factors. The interpretation of each factor is based on its loadings, which represent the degree of correlation between the factor and the original variables. The Varimax rotation method was utilized to apply Principal Component Analysis (PCA) for factor extraction (Bonilla et al., 2004; Khan et al., 2015; Subramaniam et al., 2009).

**Table 1: Measure of Sampling Adequacy and Test of Sphericity**

<b>KMO measure</b>	0.901
<b>Bartlett's Test (Approx. Chi-Square- Degree of Freedom</b>	1619.216*** 210

The Kaiser-Meyer-Olkin (KMO) overall measure of sampling adequacy for our dataset was 0.901, which is greater than the recommended threshold of 0.5. This indicates that our dataset has a higher level of diversity. The fact that this is the case demonstrates that the dataset possesses a high level of correlation and that factor analysis can be effectively carried out. An additional indication that factor analysis can be reliably used to the dataset is provided by the fact that the results of Bartlett's test of sphericity were extremely significant (Chi-square value = 1619.216,  $p < 0.000$ ). According to Kaiser's criterion, factors that were considered significant

were those that had eigenvalues that were more than one. Eigenvalues are a measure of the amount of variation that can be attributed to each component.

### 3. Results and Discussion

#### 3.1. The BDI Scale and its Subscales: Statistics on the Internal Consistency & Reliability

The table 2 presents a thorough summary of the averages, variations, item counts, and internal consistency reliability (measured by Cronbach's Alpha) for each subscale within the BDI, as well as for the overall BDI scale. These statistics provide valuable insights into the score distribution and the instrument's reliability in assessing several dimensions of depression.

**Table 2: Internal Consistency and Reliability Statistics for the BDI (Sub-)Scale(s)**

Statistical Attributes	BDI (Sub) Scale				
	1) Negative Cognition & Nutrition	2) Cognitive-behavioral & Performance Difficulties	3) Negative Affective	4) Negative Attitude	Overall BDI Scale
Mean	3.83	3.14	4.56	1.63	13.72
Std. Deviation	4.23	4.17	3.78	2.41	12.32
N of Items	6	6	5	4	21
Cronbach's Alpha	0.846	0.865	0.73	0.766	0.92

The initial scores are related to the Negative Cognition & Nutrition subscale of the Beck Depression Inventory (BDI). The average score of 3.83 indicates a moderate level of depressive symptoms in this area. Individual answers fluctuate around this average, as shown by the standard deviation of 4.234. The subscale comprises six items, and its internal consistency, as determined by Cronbach's Alpha at 0.846, indicates a rather high level of reliability in capturing the intended construct of negative cognition and nutritional elements related to depression.

Regarding the Cognitive-behavioral & Performance Difficulties subscale, the average score of 3.14 indicates a relatively lesser degree of depression symptoms in this category when compared to Negative Cognition & Nutrition. The standard deviation of 4.175 signifies a substantial level of diversity in individual responses. The internal consistency of the second subscale is also high, as indicated by a Cronbach's Alpha of 0.865. This suggests that the six questions in this category effectively and consistently evaluate cognitive-behavioral and performance-related issues.

The third subscale, Negative Affective, reveals a mean score of 4.56, suggesting a comparatively heightened presence of negative affective symptoms. The standard deviation of 3.778 indicates a lower level of variability in comparison to the first two subscales. The subscale has acceptable internal consistency with a Cronbach's Alpha of 0.730, albeit slightly lower than the alphas of the previous subscales.

The Negative Attitude subscale, with an average score of 1.63, indicates a reduced presence of depressive symptoms associated with negative attitudes. The standard deviation of 2.413 suggests a lower level of variability in individual answers. The internal consistency, as assessed by Cronbach's Alpha at 0.766, is moderately strong, indicating that the four items in this category effectively and consistently measure negative attitudes as a whole.

Based on the Overall BDI Scale, the mean score of 13.72 indicates the average severity of depressed symptoms across all subscales. The high standard deviation of 12.323 suggests a significant amount of variability in the total scores. The high Cronbach's Alpha value of 0.920 indicates that the 21 items in the BDI exhibit a strong level of internal consistency. This shows that the scale is reliable in measuring overall depressed symptoms.

#### 3.2. The Internal Consistency and Reliability of the Items of the BDI Scale

The table 3 (for each item of the BDI scale) provides a mean score, a standard deviation, the corrected item-total correlation (indicating its relationship with the overall subscale), and if this item is deleted, Cronbach's Alpha (a measure of internal consistency) for each item.

**Table 3: Internal Consistency and Reliability Statistics for the BDI Scale Items**

<i>BDI subscale</i>	<i>BDI Item</i>	<i>BDI Item Name</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Corrected Item-Total Correlation</i>	<i>Cronbach's Alpha if Item Deleted</i>
<b>1) Negative Cognition &amp; Nutrition</b>	BDI3	Past Failure	0.64	0.984	0.609	0.824
	BDI13	Indecisiveness	0.65	0.923	0.702	0.805
	BDI14	Worthlessness	0.58	0.959	0.696	0.806
	BDI15	Loss of energy	0.65	0.944	0.621	0.821
	BDI18	Changes in appetite	0.67	0.886	0.581	0.828
	BDI19	Concentration	0.58	0.926	0.550	0.834
<b>2) Cognitive-behavioral &amp; Performance Difficulties</b>	BDI4	Loss of pleasure	0.62	0.974	0.655	0.842
	BDI5	Guilty feelings	0.38	0.801	0.639	0.845
	BDI6	Punishment feeling	0.38	0.800	0.661	0.841
	BDI16	Changes in sleep	0.75	1.038	0.684	0.838
	BDI17	Irritability	0.38	0.846	0.657	0.841
	BDI20	Tiredness	0.57	0.914	0.677	0.837
<b>3) Negative Affective</b>	BDI8	Self-criticalness	0.77	1.057	0.529	0.668
	BDI10	Crying	0.83	1.220	0.497	0.682
	BDI11	Agitation	1.03	1.182	0.497	0.681
	BDI12	Loss of interest	0.91	0.896	0.462	0.696
	BDI21	Interest in sex	0.97	1.057	0.480	0.687
<b>4) Negative Attitude</b>	BDI1	Sadness	0.53	0.799	0.324	0.831
	BDI2	Pessimism	0.30	0.701	0.648	0.672
	BDI7	Self-dislike	0.38	0.846	0.723	0.615
	BDI9	Suicidal thoughts	0.37	0.790	0.610	0.685

The sub-scale Negative Cognition & Nutrition is comprised of six items: BDI3 (Past Failure), BDI13 (Indecisiveness), BDI14 (Worthlessness), BDI15 (Loss of energy), BDI18 (Changes in appetite), BDI19 (Concentration). The sub-scale Cognitive-behavioral & Performance Difficulties also consist of six items: BDI4 (Loss of pleasure), BDI5 (Guilty feelings), BDI6 (Punishment feeling), BDI16 (Changes in sleep), BDI17 (Irritability), BDI20 (Tiredness). The sub-scale Negative Affective is composed of five items: BDI8 (Self-criticalness), BDI10(Crying), BDI11(Agitation), BDI12 (Loss of interest), and BDI21 (Interest in sex). The fourth sub-scale Negative Attitude has four constituents: BDI1 (Sadness), BDI2 (Pessimism), BDI7 (Self-dislike), BDI9 (Suicidal thoughts).

Table 3 provides insights into the distribution, correlation, and reliability of each item within its respective subscale in the Beck Depression Inventory. The corrected item-total correlation indicates the strength and direction of the relationship between each item and the total score for its subscale. Cronbach's Alpha gives a measure of internal consistency, and the values after deleting an item indicate how much that item contributes to the overall reliability of the subscale.

### **3.3. Summarizing 21-Item BDI into Four Dimensions**

Factor analysis condensed the original 21 BDI items into four factors (table 2) initially classified as factor 1, factor 2, factor 3, and factor 4. The factor 1 is named as negative cognition & nutrition (Subramaniam et al., 2009). The factor 2 is named as cognitive-behavioral (Rodriguez-Gomez, Dávila-Martínez, & Collazo-Rodríguez, 2006) and performance difficulties (Osman et al., 1997). Factor 3 is named as negative affective (Subramaniam et al., 2009). Fourth factor is named as negative attitude (Rodriguez-Gomez et al., 2006). The total variance explained by these four factors is about 59.42%.

Negative Cognition & Nutrition (Factor 1): This factor comprises items associated with negative thoughts and cognitive aspects, such as past failures, indecisiveness, worthlessness,

loss of energy, changes in appetite, and concentration difficulties. These items collectively represent a cluster of depressive symptoms linked to negative thinking patterns and nutritional changes. This factor explains a substantial amount of variance, with a total of 40.861% accounted for by the items loading on it. This indicates that a significant portion of the variability in these items can be attributed to this underlying factor.

Cognitive-behavioral & Performance Difficulties (Factor 2): This factor includes items reflecting cognitive and behavioral challenges, such as loss of pleasure, guilty feelings, punishment feelings, changes in sleep, irritability, and tiredness. These items represent difficulties in cognitive and behavioral functioning associated with depression. The Cognitive-behavioral & Performance Difficulties factor explains 7.523% of the total variance. While a smaller percentage compared to the first factor, it still captures a significant portion of the variability in the symptoms associated with cognitive-behavioral and performance-related challenges.

Negative Affective (Factor 3): This factor comprises items related to negative affective experiences, such as self-criticalness, crying, agitation, loss of interest, and reduced interest in sex. These items reflect the emotional and affective aspects of depression. The Negative Affective factor accounts for 5.669% of the total variance, highlighting the emotional and affective components of depressive symptoms.

Negative Attitude (Factor 4): This factor includes items such as sadness, pessimism, self-dislike, and suicidal thoughts. These items collectively represent a cluster of depressive symptoms associated with negative attitudes. The Negative Attitude factor explains 5.373% of the total variance. It provides insight into the cognitive and attitudinal aspects of depression.

Collectively, these four factors provide a structured understanding of the diverse manifestations of depressive symptoms, each capturing distinct aspects of the experience. The addition of the fourth factor, Negative Attitude, contributes to a more comprehensive and nuanced view of the underlying constructs assessed by the Beck Depression Inventory (BDI). The factors collectively explain a significant portion of the variability in depressive symptoms, offering valuable insights into the structure of depression as measured by the BDI.

### **3.4. Factorial Structure Analysis in Comparison with Multiple Cultures**

In comparing the selected studies concerning instrument, factor structure analysis method, Cronbach's alpha, explained variance, and identified factors distinct patterns and variations are evident across different research contexts.

Bernal, Bonilla, & Santiago (1995) in a study conducted in San Juan, Puerto Rico, had a sample size of 300 participants. Bonicatto (1998) research in La Plata, Argentina, included a larger sample of 608 participants. Bonilla, Bernal, Santos & Santos (2004) in a research study in Puerto Rico involved 351 participants. Rodríguez-Gómez JR, et al (2006) executed research in Puerto Rico focusing on 410 participants. Basker et al (2007) in a research carried out in India included 178 participants. Subramaniam, et al (2009) conducted research in Baltimore, USA, involving 145 participants. Khan et al (2015) performed research in Abbottabad, KPK, Pakistan by including 250 participants, but specific demographic details are not mentioned. The current study conducted in Bahawalpur, Pakistan, involved 160 participants.

To measure the factorial structure of the BDI, Bernal, Bonilla, & Santiago (1995) did not mention any specific method. Bonicatto (1998), Bonilla, Bernal, Santos & Santos (2004), Basker et al (2007), Subramaniam, et al (2009), and Khan et al (2015) used PCA (Principal Component Analysis) with Varimax Rotation. Rodríguez-Gómez JR, et al (2006) applied PCA (Principal Component Analysis) with Promax Rotation. The current study has also employed PCA with Varimax Rotation. Bonilla, & Santiago (1995), Bonicatto (1998), Bonilla, Bernal, Santos & Santos (2004), Rodríguez-Gómez JR, et al (2006), Basker et al (2007), Subramaniam, et al (2009), and Khan et al (2015) reported Cronbach's alpha of 0.89, 0.87, 0.88, 0.89, 0.96, 0.87, and 0.92 respectively. Current study has reported Cronbach's alpha of 0.92. The studies of Bonilla, & Santiago (1995), Bonicatto (1998), Bonilla, Bernal, Santos & Santos (2004), Rodríguez-Gómez JR, et al (2006), Basker et al (2007), and Subramaniam, et al (2009), reported respectively 49.40%, 36.1%, 49%, 52%, 30.5%, 60.63%, variance explained. Current study explained 59.42% variance by the components of the BDI.

**Table 4: Factor Analysis**

<i>BDI Item</i>	<i>BDI Item Name</i>	<i>Factor Loadings</i>	<i>Factors</i>	<i>Total Variance (%) Explained by Each Factor</i>	
				<i>Extraction Sums of Squared Loadings</i>	<i>Rotated Sums of Squared Loadings</i>
BDI3	Past Failure	<b>0.734</b>	<i>Negative Cognition &amp; Nutrition</i>	40.861	19.120
BDI13	Indecisiveness	<b>0.698</b>			
BDI14	Worthlessness	<b>0.666</b>			
BDI15	Loss of energy	<b>0.583</b>			
BDI18	Changes in appetite	<b>0.550</b>	<i>Cognitive-behavioral &amp; Performance Difficulties</i>	7.523	15.856
BDI19	Concentration	<b>0.539</b>			
BDI4	Loss of pleasure	<b>0.809</b>			
BDI5	Guilty feelings	<b>0.609</b>			
BDI6	Punishment feeling	<b>0.607</b>			
BDI16	Changes in sleep	<b>0.595</b>			
BDI17	Irritability	<b>0.547</b>			
BDI20	Tiredness	<b>0.524</b>	<i>Negative Affective</i>	5.669	12.620
BDI8	Self-criticalness	<b>0.751</b>			
BDI10	Crying	<b>0.672</b>			
BDI11	Agitation	<b>0.641</b>	<i>Negative Attitude</i>	5.373	11.829
BDI12	Loss of interest	<b>0.496</b>			
BDI21	Interest in sex	<b>0.449</b>			
BDI1	Sadness	<b>0.706</b>			
BDI2	Pessimism	<b>0.651</b>			
BDI7	Self-dislike	<b>0.639</b>			
BDI9	Suicidal thoughts	<b>0.542</b>			

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 8 iterations.

**Table 5: Factorial Structure Analysis in Comparison with Multiple Cultures**

<b>Study</b>	<b>Instrument</b>	<b>Factor Structure Analysis Method</b>	<b>Cronbach's alpha</b>	<b>Explained Variance</b>	<b>Identified Factors</b>
Bernal, Bonilla, & Santiago (1995)	BDI		0.89	49.40%	
Bonicatto (1998)	BDI	PCA (Varimax Rotation)	0.87	36.10%	Cognitive-Affective, Somatic
Bonilla, Bernal, Santos & Santos (2004)	BDI Spanish version	PCA (Varimax Rotation)	0.88	49%	Somatic, Sadness or Helplessness, Self-Esteem, Negative Thoughts
Rodríguez-Gómez JR, et al (2006)	BDI-II	PCA (Varimax Rotation)	0.89	52%	Negative Attitudes, Cognitive-Behavioral, Biological, Somatic
Basker et al (2007)	BDI translated in Tamil	PCA (Promax Rotation)	0.96	30.50%	Somatic Symptoms, Mood-Negative Cognitions
Subramaniam, et al (2009)	BDI	PCA (Varimax and Oblimin Rotation)	0.87	60.63%	Negative Cognition, Negative Affect, Nutrition, Negative Self-perception, Pessimism
Khan et al (2015)	BDI Urdu version	PCA (Varimax Rotation)	0.92	Not mentioned	Names are not mentioned
Current Study	BDI Urdu version	PCA (Varimax Rotation)	0.92	59.42%	Negative Cognition & Nutrition, Cognitive-behavioral & Performance Difficulties, Negative Affective, Negative Attitude

Bernal, Bonilla, & Santiago (1995) identified 4 factors. Bonicatto (1998) identified 2 factors: Cognitive-affective and Somatic. Bonilla, Bernal, Santos & Santos (2004) identified 4 factors: somatic, sadness or helplessness, self-esteem, and negative thoughts. Rodríguez-Gómez

JR, et al (2006) identified 4 factors: negative attitudes, cognitive-behavioral, biological, and somatic.

Basker et al (2007) identified 2 factors: somatic symptoms and mood-negative cognitions. Subramaniam, et al (2009) identified 5 factors: negative cognition, negative affect, nutrition, negative self-perception, and pessimism. In the study of Khan et al (2015) the factors are not mentioned. Current study identified 4 factors: negative cognition & nutrition, cognitive-behavioral & performance difficulties, negative affective, negative attitude.

These variations underscore the diversity in sample characteristics, reflecting the influence of cultural, geographical, and contextual factors on study populations.

#### 4. Conclusion

The findings, as stated by the authors of the study, lend credibility to the general reliability and internal consistency of the BDI, as well as verify the BDI sub-scales that were used in the research region. However, there is some evidence to show that the factorial structure of the BDI is not totally clear when it comes to certain home scenarios. The original 21 questions that comprised the BDI were narrowed down to four dimensions through the utilization of factor analysis, which provided evidence that this was, in fact, the state of affairs. The Beck Depression Inventory (BDI) has a factorial structure that can be adjusted, as well as a component makeup that can be altered. This indicates that environmental factors can have an impact on the manifestation of depression. According to the conclusions of the study, it is extremely important to refrain from drawing broad generalizations regarding the prevalence and severity of depression across a variety of populations. In this way, it is possible that efforts to create treatments for the illness that are sensitive to the various cultures that exist could be hampered.

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