Revista Brasileira de Psiquiatria. 2013;35:416–431

doi:10.1590/1516-4446-2012-1048

REVIEW ARTICLE

Psychometric properties of the Beck Depression Inventory-II: a comprehensive review

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Objective: To review the psychometric properties of the Beck Depression Inventory-II (BDI-II) as a self-report measure of depression in a variety of settings and populations.
Methods: Relevant studies of the BDI-II were retrieved through a search of electronic databases, a hand search, and contact with authors. Retained studies (k = 118) were allocated into three groups: non-clinical, psychiatric/institutionalized, and medical samples.
Results: The internal consistency was described as around 0.9 and the retest reliability ranged from 0.73 to 0.96. The correlation between BDI-II and the Beck Depression Inventory (BDI-I) was high and substantial overlap with measures of depression and anxiety was reported. The criterion-based validity showed good sensitivity and specificity for detecting depression in comparison to the adopted gold standard. However, the cutoff score to screen for depression varied according to the type of sample. Factor analysis showed a robust dimension of general depression composed by two constructs: cognitive-affective and somatic-vegetative.
Conclusions: The BDI-II is a relevant psychometric instrument, showing high reliability, capacity to discriminate between depressed and non-depressed subjects, and improved concurrent, content, and structural validity. Based on available psychometric evidence, the BDI-II can be viewed as a cost-effective questionnaire for measuring the severity of depression, with broad applicability for research and clinical practice worldwide.

Keywords: Psychometric scale; depression; reliability; validity; classical testing theory; item response theory

Introduction

Depression is projected to become a globally prevalent disorder[1,2] with a huge burden to the population.[3] Among the available self-assessment instruments, the 21-item Beck Depression Inventory (BDI) is one of the most popular measures of depressive symptoms worldwide.[4] First proposed by Beck et al.,[5] this instrument has been used in more than 7,000 studies so far. The theoretical assumption of the original BDI relied upon the belief that negativistic distorted cognitions would be the core characteristic of depression.[6]

The BDI has undergone two major revisions: in 1978 as the BDI-IA[7] and in 1996 as the Beck Depression Inventory-II (BDI-II).[8] The updated BDI-II taps psychological and somatic manifestations of 2-week major depressive episodes, as operationalized in the DSM-IV.[9] This version was modified to reword and replace some items. Four items of the BDI-IA that proved less sensitive for identification of typical symptoms of severe depression – weight loss, distorted body image, somatic preoccupation, and inability to work – were dropped and replaced by agitation, worthlessness, difficulty concentrating, and energy loss to assess a distinctive degree of intensity of depression. In addition, the items on appetite and sleep change were amended to evaluate the increase and decrease of these depression-related behaviors. Unlike the original version, the BDI-II does not reflect any particular theory of depression.

Despite widespread use in both non-clinical and clinical studies for more than 15 years after its publication, to the best of our knowledge, no relevant summary of the performance of this version has been conducted. In addition, the last decade has seen major progress in psychometric theories that were not fully developed at the time the BDI was reformulated. Within this context, we carried out a search of articles dealing with the psychometric properties of the BDI-II. This review is not intended to be a systematic review or meta-analysis, but a synopsis of the subject matter addressing the feasibility of using BDI-II in different population samples. Whenever possible, psychometric advantages and criticisms are underscored, discussing recommendations for use in a variety of settings.

Methods

Both investigators, with previous experience in psychometric instruments, searched MEDLINE and PsycINFO

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Submitted Nov 09 2012, accepted Feb 13 2013.

databases. The following MeSH terms were used to filter relevant studies: psychometrics and depression. We restricted the search to articles containing the BDI and published between the time periods of January 1st, 1996 and October 10th, 2012. The following non-psychometric article types were left out: clinical trials, editorials, letters, meta-analyses, practice guidelines, randomized controlled trials, and case reports. There was no language or age range restriction.

All retained articles were read for exclusion of additional criteria: non-psychometric studies; other versions of the BDI; small samples (fewer than 30 participants[10]), unless the study addressed a very important problem, such as between-version comparison or content analysis. Secondary analyses of previously reported datasets were excluded. Summary analysis of the complete sample was preferable when multiple analyses were available (such as separate reports by gender, ethnicity, or depressed vs. non-depressed groups).

The reference sections of review articles[11-13] and book chapters[4,14,15] that were not retrieved in the computer search were examined to identify potential studies for inclusion. Additional efforts to locate relevant studies included contacting authors in the field and a hand search of the reference lists of retained articles.

Results and discussion

Overview

The MeSH search strategy detailed above yielded 2,611 articles. Filtering these studies using BDI resulted in 253 articles, 198 of which matched the time period of interest. The exclusion of non-psychometric study types narrowed the sample to 178 articles. Among those retained from the electronic database plus hand search, 60 did not meet the inclusion criteria: 33 articles did not present relevant psychometric data; 18 used the BDI-I; five used the BDI-Fast Screen; and four presented a small sample. The final list resulted in 118 articles dedicated to investigate psychometric performance of the BDI-II.

For the sake of comparison between similar investigations, the studies were grouped by sample recruitment source as: non-clinical (k = 47); psychiatric/institutionalized (k = 37); or medical samples (k = 34). Typically, non-clinical studies were conducted in student analogue depression samples (average age, 18-23 years), which are referred to in this study as student studies to describe university-recruited samples (k = 29) and adolescent studies to describe school-based underage respondents (k = 8). Psychiatric samples were stratified as inpatient, outpatient, or institutionalized. Medical samples were grouped according to the disease and recruitment setting. The instrument was applied to over 60,000 respondents.

The English version of the BDI-II has been translated into 17 languages, and is used in Europe, the Middle East, Asia, and Latin America (Table 1). Although the English version prevailed among the studies (65%), the increasing number of language versions suggests international acceptance of the instrument.

Table 1 shows that the mean score ranged from 5.1 to 38.4. In general, psychiatric samples presented the highest mean scores, medical samples intermediate, and non-clinical samples the lowest means. Since sample standardization is not demographically representative of the population and little evidence has been provided regarding the gender and culture fairness of the items and total score, the original authors recommended development of local norms.

Reliability

Twenty-nine of the 118 retrieved articles (25%) did not report reliability coefficients, indicating that the assumption of test score reliability generally has not prevailed in clinical practice regarding application of the BDI. In comparison to the internal consistency of the previous versions of the BDI (average Cronbach's alpha coefficient around 0.85),[8] most studies on BDI-II reported an average alpha coefficient around 0.9, ranging from 0.83 to 0.96 (Table 1). Probably, the replacement of particular items has improved the homogeneity of the scale. Its ability to assess different types of depression, e.g., atypical depression, is superior to that of the BDI-IA, as symptoms of increased and decreased appetite and sleep were included in the BDI-II items. However, superior reliability does not necessarily indicate improvement of the clinical validity of the scale.

Retest reliability (Pearson's r) showed relative stability through re-application of the BDI-II, with good to excellent coefficients (range, 0.73 to 0.96),[17,29,33,59,127] with a mean re-application interval of 2 weeks (range, 1 week to 6 months) for the majority of studies (82%). However, two remarks should be taken into account when interpreting these coefficients: 1) as true changes in depressive symptoms can occur without any intervention, while a high correlation is more likely after a short time, a longer interval could explain a smaller correlation; 2) there is no available retest information for patient samples, whether psychiatric or medical. The observed retest coefficients were similar to the values found by the authors of the BDI-II with clinical and non-clinical populations,[8] 0.92 and 0.93 respectively for an average time interval of 7 days between application and the re-application of the scale. A reliability generalization analysis showed an average coefficient around 0.65 for the previous version of the BDI.[128] Comparison of the retest coefficients of the BDI-I and BDI-II could only be considered definitive if the time intervals of the studies were similar.

To address the potential source of this retest effect, Longwell & Truax[129] randomly assigned non-clinical participants (n=237) without intervention to complete the BDI-II at weekly, monthly, or bimonthly intervals. Scores were found to significantly decrease for the weekly administration group only, indicating that lower retest scores could be the result of a measurement effect and the frequency of administration. Re-application of the BDI-II in healthcare settings might be problematic, since lower scores, or true change in severity of depression,

Table 1 Studies using the BDI-II by language version, sample size, target sample, gender distribution, mean (SD) score, and reliability (alpha and Pearson's r)

Author, year	Language	n	Sample	%F	Mean score (SD)	Alpha	Pearson's r
Non-clinical samples (47)							
Beck, 1996[8]	English	120	Student	44	12.6 (9.9)	0.93	0.93
Aasen, 2001[16]	Norwegian	303	Student	70	7.1 (6.0)	0.86	0.77
		875	Adult	59	8.1 (7.5)	0.91	
Al-Musawi, 2001[17]	Arabic	200	Student	63	13.4 (6.7)	0.84	0.75
Al-Turkait & Ohaeri, 2010[18]	Arabic	624	Student	71	15.5 (8.5)	0.83	
Aratake, 2007[19]	Japanese	399	Worker	33	12.3 (8.3)	0.90	
Arnarson, 2008[20]	Icelandic	1,206	Student	72	8.8 (7.8)	0.91	0.89
Byrne, 2004[21]	Chinese	1,460	Adolescent	53	NR	0.91-0.94	0.74
Campos & Gonçalves, 2011[22]	Portuguese	538	Student	60	8.9 (7.9)	0.90	
		200	Adult	50	NR	0.91	
Canel-Çinarbas, 2011[23]	Turkish	340	Student 1	46	14.9 (9.2)	0.88	
	English	487	Student 2	55	10.1 (7.7)	0.90	
Carmody, 2005[24]	English	502	Student	54	12.8 (9.1)	0.92	
Coelho, 2002[25]	Portuguese	775	Adolescent	60	10.3 (8.4)	0.89	
Cunningham, 2008[26]	English	971	Adolescent	51	12.9 (10.3)	NR	
Dozois, 1998[27]	English	1,022	Student	67	9.1 (7.6)	0.91	
Gary & Yarandi, 2004[28]	English	206	Rural Women	100	8.7 (7.8)	0.91	
Ghassemzadeh, 2005[29]	Persian	125	Student	50	9.8 (8.0)	0.87	0.73
Glickmann, 2004[30]	English	546	Student	57	11.3 (9.7)	0.92	
Gorenstein, 2011[31]	Portuguese	3,410	Student 1	71	10.9 (8.2)	0.88	
		60	Student 2	52	NR	NR	0.89
		1,417	Adolescent	60	11.7 (9.3)	0.89	
		301	Elderly	61	10.4 (10.1)	0.89	
		182	Adult	56	9.9 (10.7)	0.93	
Holländare, 2008[32]	Swedish	71	Student/Teacher	30	7.3-9.4 (7.4-11.1)	0.94-0.95	
Kapci, 2008[33]	Turkish	362	Worker	61	14.1 (9.7)* 15.0 (9.2)†	0.90	0.94
Kneipp, 2009[34]	English	308	Low-income women	100	17.1 (12.0)‡ 18.5 (11.8)‡	0.94	
Kogan, 2004[35]	English	114	Elderly	62	6.6 (5.4)	NR	
Kojima, 2002[36]	Japanese	766	Worker	42	8.9 (6.5)	0.87	
Kühner, 2007[37]	German	89	Adult 1	51	7.7 (7.5)	0.89	0.78
		118	Adult 2	61	7.7 (7.5)		
		108	Student	61	7.7 (7.5)		0.78
Lipps, 2007[38]	English	690	Student	77	9.8 (8.6)* 11.7 (9.3)†	0.90	
Lipps, 2010[39]	English	278	Adolescent	52	13.0-23.0 (2.9-23.9)	0.90	
Magán, 2008[40]	Spanish	249	Adult	53	NR	NR	
Osman, 1997[41]	English	230	Student	68	9.4 (6.4)* 11.9 (8.7)†	0.90	
Osman, 2008[42]	English	414	Adolescent	49	12.5 (10.5)	0.92	
Pallensen, 2006[43]	Norwegian	304	Student	44	NR	NR	
		879	Adult	58			
Roberts, 2012[44]	Welsh	115	Student	82	5.1 (5.9)	0.90	
Rodríguez-Gómez, 2006[45]	Spanish	410	Elderly	77	7.9 (7.6)	0.89	
Sanz, 2003[46]	Spanish	590	Student	78	9.2 (7.5)	0.89	
Sanz, 2003[47]	Spanish	470	Adult	53	9.4 (7.7)	0.87	
Sashidharan, 2012[48]	English	278	Student	75	9.4 (3.6)	0.91	
Segal, 2008[49]	English	229	Student	64	9.1 (8.5)	0.92	
		147	Elderly	58	7.7 (6.4)	0.86	
Shean & Baldwin, 2008[50]	English	395	Student	48	5.5 (4.2)§ 14.8 (6.6)‖	0.86	
Sprinkle, 2002[51]	English	137	Student 1	58	10.5 (7.7)§ 27.6 (9.8)‖	NR	
		46	Student 2	61	15.8 (10.4)¶ 13.8 (9.6)**	0.91 0.93	0.96
Steer & Clark, 1997[52]	English	160	Student	67	11.9 (8.1)	0.89	
Storch, 2004[53]	English	414	Student	73	11.1 (8.2)	0.90	
Treviño, 2007[54]	English	196	Hispanic couples	50	9.7 (9.7)	NR	
Uslu, 2008[55]	Turkish	512	Adolescent	55	11.0-13.8 (8.2-10.6)* 13.8-15.0 (8.6-9.7)†	0.90	0.89
Vanheule, 2008[56]	Dutch	695	Adult	50	7.0 (7.0)	NR	
Whisman, 2000[57]	English	576	Student	58	8.4 (7.2)	0.89	
Whisman, 2012[58††]	English	7,369	Student	65	9.3 (8.1)	0.90	
Wiebe & Penley, 2005[59]	English	539	Student 1	59	NR	0.89	0.73
	Spanish	355	Student 2	59	NR	0.91	0.86
			Bilingual subsample (n=254)	59	11.5 (9.2)‡‡ 9.8 (9.3)§§ 11.7 (7.4)§§ 10.3 (9.0)‡‡	NR	0.76
Wu, 2010[60]	Chinese	997	Student	60	13.0 (8.4)	0.88	
Wu & Huang, 2012[61]	Chinese	827	Adolescent	50	12.2 (8.7)	NR	

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Table 1 Continued

Author, year	Language	n	Sample	%F	Mean score (SD)	Alpha	Pearson's r
Psychiatric/institutionalized samples (37)							
Beck, 1996[8]	English	500	Adult outpatients	63	22.5 (12.8)	0.92	
Bedi, 2001[62]	English	390	Women outpatients	100	29.6 (11.9)[§]	0.83-0.87	
Besier, 2008[63]	German	111	Adolescent outpatients	62	14.4 (10.8)[§] 24.3 (12.2)[‖]	0.92	
Brouwer, 2012[64]	Dutch	1,530	Adult outpatients	62	20.1 (10.8)	0.90	
Brown, 2012[65]	English	111	Chronic fatigue outpatients	83	17.7 (9.1)	0.89	
Buckley, 2001[66]	English	416	Substance user inpatients	0	22.1 (11.5)	0.91	
Cole, 2003[67]	English	101	Psychiatric inpatients	55	17.5 (12.3)	0.95	
Delisle, 2012[68]	English	1,498	Psychiatric outpatients	68	27.5 (11.5)* 29.8 (12.0)[†]	NR	
Dolle, 2012[69]	German	88	Adolescent outpatients	58	10.5 (8.9)[§] 31.6 (9.6)[‖]	0.94	
Dum, 2008[70]	English	108	Substance user outpatients	52	19.2 (13.6)	0.95	
Hepner, 2009[71]	English	240	Substance user inpatients	37	14.9 (11.0)	0.91	
Hiroe, 2005[72]	Japanese	85	Adult patients	59	11.2-42.2 (NR)	NR	
Joe, 2008[73]	English	133	Suicide attempt outpatients	62	30.6 (14.4)	0.94	
Johnson, 2006[74]	English	598	Drug user outpatients	24	15.8 (10.8)	0.92	
Kapci, 2008[33]	Turkish	176	Adult outpatients	69	28.2 (12.6)* 30.4 (11.4)[†]	0.89	
Krefetz, 2002[75]	English	100	Adolescent inpatients	56	24.7 (12.5)	0.92	
Krefetz, 2003[76]	English	240	Adolescent outpatients	60	23.9 (11.9)	0.89	
Kühner, 2007[37]	German	13	Acute depressed inpatients	69	33.1 (9.4)	0.84	0.47
Kühner, 2007[37]	German	23	Non-remitted depressed inpatients	57	33.1 (9.4)	0.84	0.47
Kühner, 2007[37]	German	52	Previously depressed patients	48	10.5 (8.8)	0.90	0.47
Kumar, 2002[77]	English	100	Adolescent inpatients	55	22.8 (15.8)	0.94	
Kung, 2012[78]	English	625	Adult depressed in/outpatients	NR	31.0 (13.1)	NR	
Lindsay & Skene, 2007[79]	English	108	Patients with intellectual disability	26	14.1 (NR)	0.90	
O'Hara, 1998[80]	English	152	Student outpatients	70	15.3 (11.0)	NR	
Osman, 2004[42]	English	13	Adolescent inpatients	46	NR	NR	
		408	Adolescent inpatients	50	13.4-22.5 (10.7-14.5)	0.93	
			(319 adolescent inpatients)	50		NR	
Osman, 2008[81]	English	167	Adolescent inpatients	60	23.1 (11.4)	0.90	
Palmer & Binks, 2008[82]	English	117	Institutionalized male offenders	0	17.4 (11.2)	0.90	
Perris & Gilbody, 2009[83]	English	256	Institutionalized prisoners	47	NR	NR	
		394		100	NR	NR	
Quilty, 2010[84]	English	425	Adult outpatients	67	29.9 (8.8)	NR	
Roberts, 2012[44]	Welsh	37	Depression patients	60	38.4 (11.9)	0.96	
Sanz, 2005[85]	Spanish	305	Adult outpatients	75	22.1 (11.5)	0.89	
Seignourel, 2008[86]	English	582	Substance user outpatients	55	20.6 (11.8)	0.93	
Steer, 1998[87]	English	210	Adolescent outpatients	50	18.2 (12.7)	0.92	
Steer, 1999[88]	English	210	Depressed outpatients	50	28.6 (11.8)	0.90	
Steer, 2000[89]	English	130	Geriatric inpatients	62	24.6 (12.8)	0.89	
Uslu, 2008[55]	Turkish	166	Adolescent outpatients	68	24.7 (10.3)* 31.7 (13.3)[†]	0.90	
Van Noorden, 2012[90]	Dutch	1,489	Adult outpatients	62	31.0 (9.6)	NR	
Vanheule, 2008[56]	Dutch	404	Adult outpatients	71	26.0 (12.0)	NR	
VanVoorhis & Blumentritt, 2007[91]	English	131	Institutionalized adolescents	28	13.7-20.9 (11.1-13.4)	0.90	
Medical samples (34)							
Arnarson, 2008[20]	Icelandic	248	Adult – Primary care	82	21.3 (12.2)	0.93	
Arnau, 2001[92]	English	333	Adult – Primary care	69	8.7 (9.4)	0.94	
Bunevicius, 2012[93]	Lithuanian	522	Adult – Hospital	28	11.0 (8.2)	0.85	
Carney, 2009[94]	English	140	Insomnia – Hospital	74	14.1 (10.2)	0.91	
Carvalho Bos, 2009[95]	Portuguese	331	Pregnancy – Primary care	100	NR	0.88	
		354	Postpartum – Primary care	100		0.89	
Chilcot, 2011[96]	English	460	Renal disease – Hospital	35	11.9 (8.3)	NR	
Chung, 2010[97]	Chinese	62	Heart disease – Hospital	31	18.2 (7.9)	NR	
Corbière, 2011[98]	French	206	Chronic pain – Hospital	53	17.2 (11.5)	0.84	
del Pino Pérez, 2012[99]	Spanish	205	Coronary patients – Hospital	26	9.2 (7.6)	NR	
Di Benedetto, 2006[100]	English	81	Acute coronary syndrome – Hospital	19	NR	> 0.90	
Dutton, 2004/Grothe, 2005[101,102]	English	220	Adult – Primary care	52	12.6 (10.4)	0.90	
Frasure-Smith & Lespérance, 2008[103]	English/French	804	Coronary patients – Hospital	19	NR	0.90	
Hamid, 2004[104]	Arabic	493	Adult – Primary care	100	13.0 (8.1)	NR	
Harris & D'Eon, 2008[105]	English	481	Chronic pain – Hospital	58	26.9 (11.7)	0.92	
Hayden, 2012[106]	English	83	Bariatric surgery – Hospital	71	13.4 (9.1)	0.89	
Jamroz-Wisniewska, 2007[107]	Polish	104	Multiple sclerosis – Hospital	74	14.4 (9.2)	NR	
Jones, 2005[108]	English	174	Epilepsy – Hospital	66	NR	0.94	
Kirsch-Darrow, 2011[109]	English	161	Parkinson disease – Hospital	31	9.5 (7.2)	0.89	
Lopez, 2012[110]	English	345	Chronic pain – Hospital	0	23.0 (12.2)	0.93	
Low & Hubley, 2007[111]	English	119	Coronary patients – Hospital	25	8.0 (7.1)	0.89	
Mahmud, 2004[112]	Malay	61	Postpartum – Primary care I	100	4.4 (5.5)	0.89	
		354	Postpartum – Primary care II		6.2 (6.4)		

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Table 1 Continued

Author, year	Language	n	Sample	%F	Mean score (SD)	Alpha	Pearson's r
Ooms, 2011[113]	Dutch	136	Tinnitus – Hospital	35	11.3 (9.5)	NR	
Patterson, 2011[114]	English	671	Hepatitis C – Hospital	3	16.2 (12.2)	0.84-0.91	
Penley, 2003[115]	English/ Spanish	122	Hemodialysis – Hospital	41	15.0 (12.5)	0.92	
Poole, 2006, 2009[116,117]	English	1,227	Chronic pain – Hospital	62	24.4 (11.7)	0.92	
Rampling, 2012[118]	English	266	Epilepsy – Hospital	59	NR	0.94	
Siegert, 2009[119]	English	353	Neurorehabilitation – Hospital	40	13.6 (10.1)	0.89	
Su, 2007[120]	Chinese	185	Pregnant – Hospital	100	7.0 (5.0)[§] 17.0 (10.2)[‖]	NR	
Thombs, 2008[121]	English/French	477	Myocardial infarction – Hospital	17	9.2 (7.9)	NR	
Tully, 2011[122]	English	226	Cardiac surgery – Hospital	17	8.6 (6.2)[¶¶] 9.1 (6.4)[**]	0.85 0.87	
Turner, 2012[123]	English	72	Stroke – Primary care	47	13.4 (12.9)	0.94	
Viljoen, 2003[124]	English	127	Adult – Primary care	63	NR	NR	
Warmenhoven, 2012[125]	Dutch	46	Cancer – Hospital	43	14.7 (9.9)	NR	
Williams, 2012[126]	English	229	Parkinson disease – Primary care	33	6.5 (5.2)[§] 14.7 (7.4)[‖]	0.90	

BDI-II = Beck Depression Inventory-II; NR = not reported; SD = standard deviation.
* Men, † women, ‡ half-random sample, § non-depressed, ‖ depressed, ¶ first administration, ** second administration, †† sample included some of the dataset from previous reports, ‡‡ English, §§ Spanish, ‖‖ preoperative, ¶¶ postoperative.

can be obtained even without intervention and might be attributable to the measurement process. The measurement error due to time length as captured by the retest estimate is probably larger than the error due to item heterogeneity and content as captured by cross-sectional internal consistency.[128]

On the other hand, Hiroe et al.[72] investigated sensitivity to change by anchoring the BDI-II against the Clinical Global Impression-Change (CGI-I) subscale 2 weeks after first consultation of 40 patients with major depression. The instrument was able to distinguish between all grades of depression severity. Since changes in score could also be the result of a measurement effect, clinicians should be careful when making important treatment decisions based solely on information from the BDI-II.

Item characteristics

The true score of a given scale, as well as its reliability, is the result of a set of scores that are susceptible to the influence of individual item errors.[130] Further analysis of item characteristics might overcome this measurement effect.

In comparison with its previous version, the item characteristics of the BDI-II have been changed in terms of item endorsement rate, content coverage, and homogeneity. Most investigations of non-clinical samples reported item scores in the low end of the possible range (0-3), resulting in a skewed distribution of item scores. Typically, non-clinical participants tended to report an average item score below 1.[31,131] Furthermore, the mean item score does not exceed 2 in most clinical samples. In the case of extreme scores, endorsement bias might push the distribution of the results upward. Some researchers have criticized the possibility of malingered or deceitful ratings by the respondents due to the self-report nature of the scale.[75,83,86] The potential fakability of the inventory should be kept in mind during the interpretation of the test.

The item suicidal thoughts had the lowest endorsement rate; however, the substantial correlation still provides evidence of its contribution to the measured construct. Similarly, loss of sexual interest displayed the worst item-total correlation, although it remained significantly related to the whole construct under consideration.[8,31] Conversely, somatic items such as change in sleeping pattern and in appetite also presented low scores for non-clinical samples. The hypothesis of gender differences in somatic symptoms[132] was not supported by Delisle et al.,[68] who showed that the experience and reporting of somatic symptoms could explain merely a small portion of discrepancy in depressed patients. Testing the hypothesis of whether individual baseline depressive symptoms in the interest-activity domain would predict outcome, the items pessimism and loss of energy were found to be independent predictors of both remission and response in the treatment setting.[90] The effects of new items and wording revisions on the psychometric performance of the scale have not been fully assessed, and sample type should be taken into account when interpreting scores.

Because the selected items and content of the BDI-II were modified in accordance with symptoms defined in the DSM-IV as specific to a subtype of depression, it is reasonable to expect a more stringent degree of homogeneity. Beck[8] reported a median item-total scale correlation of 0.59 for the BDI-II in a sample of college students (n=120). Acceptable item-total scale correlations ($r_{it} \geqslant 0.5$)[10] were described for 17 out of 21 items. Nonetheless, this correlation can vary across studies. For the Arabic version, substantial item-total correlation was described for 10 items among Islamic students,[131] whereas adequate item-total correlation of the Portuguese version in Brazilian samples was reported for 15 items.[31] Factors such as language version, type of sample, age range, educational level, and severity of depression might affect the difficulty of item endorsement.[133] Insight into which items should be assigned to a scale can improve its performance through item-level analysis.

Item response theory and Rasch analysis

Most validation studies of the BDI-II were analyzed on the grounds of classic test theory (CTT), assuming a true score for each respondent and disregarding the measurement error. In other words, two individuals with the same total score may differ in terms of the relative severity and frequency of symptoms. In CTT, most test performances are computed as a whole rather than at the item level. Error is often assumed to be normally distributed and uncorrelated with the true score. Although the statistics produced are usually generalized to similar respondents taking a similar test, the results should only apply to those individuals taking that test. As a psychometric breakthrough to these limitations, latent trait models based on item response theory (IRT) aim to look beyond the CTT: at the underlying traits that are producing the test performance. The results of an IRT-based test can provide sample-free measurement and are measured at the item level in terms of difficulty and discrimination. This method is being increasingly used in the empirical construction and evaluation of modern psychometric instruments.

A sound rating scale should measure a single psychopathological construct (i.e., an illness or syndrome) and be composed of items that adequately cover a constellation of symptoms that are associated with the syndrome. According to IRT, a given scale and its constituent items may have good reliability estimates but still fail to meet IRT criteria of unidimensionality.[134] Efforts to analyze individual items and to identify a single dimension of depression severity can benefit from several IRT models, e.g., Rasch analysis. This method assesses the extent to which empirical data correspond to an ideal dimension, by identifying a unidimensional set of items from a rating scale, and evaluates how adequately these items measure the full range of clinical severity.

Use of the IRT is particularly pressing in studies investigating clinical change in depressive syndromes. Items that are insensitive to change will underestimate the strength of actual treatment effects. In contrast, a true treatment effect can be weakened if patients are falsely identified as not having changed, thus leading to spurious claims of ineffectiveness of the therapeutic intervention. If only items measuring mild depression were used to compose a depression scale, it would be very difficult to discriminate between moderate and severe cases of depression with this instrument, since high scores on all items would characterize both states.

The magnitude to which a severity score actually measures depression is related to a unidimensional syndrome. When depression is heterogeneous, the interpretation of a single summed score is unclear. For example, if items assessing psychological and physical symptoms were only loosely related, a single score would not distinguish between two potentially different groups of depressed patients – with primarily psychological or with primarily vegetative symptoms. Any effects of an intervention targeting only one of these aspects would be harder to detect.

Subsequently, a subset of BDI-II items that would measure a single dimension of depression across a wide range of severity can be sensitive at mild, moderate, or severe levels. IRT analysis can improve the scale items in a psychometrically stronger fashion. When disturbed thresholds are identified, item rescoring may be necessary. One expects diverse item ratings at different levels of severity, with zeroes more frequent at mild levels of overall depression and higher item scores more common with more severe presentations of depression. Moreover, whereas most items on the BDI-II are sensitive to the level of depression severity, many items may present response options that can be considered awkward, at the very least.

Seigert et al.[119] examined each BDI-II item for differential item functioning in a neurological sample (n=315). Three items (changes in sleeping pattern, changes in appetite, and loss of interest in sex) were removed in an iterative fashion after identification of misfit to model expectations. Possibly, these items measure different dimensions. In the real world, the likelihood of receiving a rating of 1 on the insomnia item was essentially the same regardless of the overall severity of depression, but the likelihood of receiving a rating of 3 on sad mood was very low even when overall depression was severe. These findings suggest that the rating scheme was not ideal for many BDI-II items, decreasing its capacity to detect change. Additional applications of this type of technique include detection of translation or equivalence problems between language versions at the item level.[23]

Measurement invariance is a prerequisite for considering the equivalence of the scale across versions, as well as for using it to make valid and interpretable comparisons of the severity of depression among different groups. Applying the IRT-related item functioning analysis, Hambrick et al.[135] compared response patterns of African American and Asian American undergraduates to those of white counterparts on measures of depression, social anxiety, and worry. While the response patterns of African American participants were roughly equivalent to those of their white counterparts, there were substantial differences in measures of worry and social anxiety. Using a mixed item response model incorporating both latent class and Rasch analysis, Wu & Huang[136] showed that person heterogeneity (e.g., different response usage and styles) of a student sample could reflect two latent classes without compromising scale construct validity. These investigations are examples of how the family of IRT techniques can address several psychometric questions at the item level, beyond the summed score of CTT.

Concurrent and discriminant validity

Table 2 displays studies that report a comparison of the BDI-II with scales measuring depression, anxiety, and miscellaneous constructs as criterion, determined at essentially the same time to check for concurrent validity. The convergent validity between the BDI-I and the BDI-II was high, with Pearson's product-moment correlation

Table 2 Concurrent and discriminant validity of the Beck Depression Inventory-II with measures of depression, anxiety, and other miscellaneous constructs*

Construct/Concurrent instrument	r	Study
Depression measure		
BDI-I - Beck Depression Inventory – I	0.82-0.94	27,33,137
CES-D - Center for Epidemiologic Studies of Depression	0.66-0.86	20,22,36,38,40,49,50,98
HRSD - Revised Hamilton Rating Scale for Depression	0.66-0.75	73,111,137
MADRS - Montgomery-Åsberg Depression Rating Scale	0.68-0.75	31,37
SCL-90-D - Symptom Check List – Depression	0.57-0.84	16,18
Z-SRDS - Zung Self-Rating Depression Scale	0.71	16
PHQ-9 - Patient Health Questionnaire (PRIME-MD)	0.74-0.88	37,70,71,78,123
EPDS - Edinburgh Postnatal Depression Scale	0.72-0.74	111
HADS-D - Hospital Anxiety and Depression Scale – Depression	0.71-0.77	20,89,123
DASS-D - Depression Anxiety Stress Scales – Depression	0.77	41
GDS - Geriatric Depression Scale	0.76	110
Anxiety measure		
BAI - Beck Anxiety Inventory	0.56-0.69	16,20,26,33,37,40-43,52,137
HARS - Revised Hamilton Anxiety Rating Scale	0.47-0.66	31,137
STAI - State-Trait Anxiety Inventory	0.37-0.83	17,43,53,99,105
SCL-90-A - Symptom Check List – Anxiety	0.48-0.57	18
MASQ - Mood Anxiety Symptom Questionnaire	0.46-0.71	41
PSWQ - Penn State Worry Questionnaire	0.56-0.61	20,43
HADS-A - Hospital Anxiety and Depression Scale-Anxiety	0.61-0.66	20,44,102
DASS-A - Depression Anxiety Stress Scales – Anxiety	0.44	41
MOCI - Maudsley Obsessive Compulsive Inventory	0.45	43
Miscellanea		
K10 - Kessler's 10-item brief screening scale	0.63-0.93	31,123
SRQ-20 - Self-Report Questionnaire	0.67-0.89	31
DASS-S - Depression Anxiety Stress Scales – Stress	0.68	41
PSS - Perceived Stress Scale	0.67	49
SCL-90-P - Symptom Check List, Psychoticism scale	0.61	16
CISQ - Checklist of Individual Strength Questionnaire	0.66	19
BSI - Brief Symptom Inventory	0.67	33
SPWB - Short Psychological Well-Being Scale	0.65	49
WHOQOL - WHO Quality of Life	0.30-0.78	37
WHO-5 - WHO Wellbeing Index	0.49-.73	37
SSI - Scale for Suicide Ideation	0.37	8
SBQ-R - Suicidal Behaviors Questionnaire-Revised	0.51-0.60	42,81
BHS - Beck Hopelessness Scale	0.55-0.69	8,26,33,42,81,82
AUDIT - Alcohol Use Disorders Identification Test	0.17-0.33	70,71
DAST - Drug Abuse Screening Test	0.26	70
MPQ PRI - McGill Pain Questionnaire Pain Rating Index	0.32	105

r = Pearson's product-moment correlation. Negative correlation is omitted in the numerical value.
* A complete list of retrieved studies can be obtained from the authors upon request.

coefficients (r) ranging from 0.82 to 0.94.[27,33,137] The overlap of the construct measured by BDI-II with that of other widely used scales to assess depression, e.g., the Center for Epidemiologic Studies of Depression (CES-D), the Hamilton Depression Rating Scale (HAM-D), the Zung Self-Rating Depression Scale (SDS), the Montgomery-Åsberg Depression Rating Scale (MADRS), and the Geriatric Depression Scale (GDS), was also quite high, ranging from 0.66 to 0.86 (Table 2). Researchers and clinicians need to be aware of the different constructs covered by depression instruments, which, while supposedly measuring the same attribute, might be focused on different components of this mood condition. Although BDI-II was designed to be a non-theoretically driven instrument, its coverage seems to be broader than the intended DSM-IV description of major depression.

The convergent validity between the BDI-II and scales that assess anxiety – such as the Beck Anxiety Inventory (BAI), the Hamilton Anxiety Rating Scale (HAM-A), and the State-Trait Anxiety Inventory (STAI) – was also significant, with a wide range of correlation coefficients (0.37 to 0.83; rough estimate of 0.50). On the other hand, overlap between the BDI-II and scales that assess general psychopathology (e.g., K10 and Self-Report Questionnaire [SEQ]) was good to excellent.[31,123] These significant concurrent correlations are expected and might be linked to the underlying constructs and the characteristics of the instruments. This overlap between anxiety and depressive symptoms is indicative of symptomatic co-occurrence as well as of the high rate of comorbidity of these clinical syndromes. As depression is one of the broadest indicators of mental health, a high score on the BDI scale could be explained by many other disorders, physical illness, or social problems. In this respect, BDI should not be viewed as a specific indicator of depression. In practice, BDI-II scores can be mis-interpreted, leading the clinician to assume depression as a primary issue, when used without a thorough assessment.

Concerning discriminant validity, studies have indicated low correlation ($r < 0.4$) with instruments assessing alcohol and drug use[70,71] and chronic pain.[105] It is noteworthy that suicidal ideation, which is one of the core features of depression and an item on the BDI-II, correlated only poorly to moderately with the instrument.[8,81] More investigations should be conducted to document concurrent validity in comparison with well-known constructs.

Although the construction of the BDI-II adopted a non-theoretical strategy, the high concurrent validity between scales assessing depressive and anxiety states (and, to a lesser extent, the poor discriminant validity between BDI-II and other constructs) suggest the need for a theoretical model to elucidate the relationship, whether similarity or dissimilarity, between these disorders. In light of empirical structural evidence, Watson & Clark's contributions on a psychopathological construct named negative affect[138-140] advocated that the boundaries of mood and anxiety disorders might be collapsed together into an overarching class of emotional disorders and further decomposed into some meaningful subclasses of disorders.

Criterion-oriented validity

Based on the scores of 500 outpatients recruited from four clinics, the original authors of the instrument[8] proposed the following rules of thumb for score interpretation with different specifiers of severity: 0-13 to indicate minimal or no depression; 14-19, mild depression; 20-28, moderate depression; and 29-63, severe depression. For instance, the average BDI-II score in this patient sample with mood disorders was M=26.6. Mean scores for major depressive episode, recurrent depression, and dysthymia were, respectively, 28.1, 29.4, and 24.0.

Although the instrument was originally designed to measure the severity of depression, existing evidence shows that the BDI-II can be recommended to screen for probable cases of major depression (Table 3). In general, studies reported a sensitivity of $\geqslant 0.70$. Sensitivity should be viewed as the most important indicator to minimize the chance of false-negative diagnosis of depressive disorders. Significant diagnostic accuracy, as expressed by the area under the receiver operating characteristics (ROC) curve, was around 75% and higher. Sources of

Table 3 Criterion validity and cutoff point of the Beck Depression Inventory-II to detect major depressive episode

Author	Cutoff	Sn	Sp	PPV	NPV	AUC	%MDD	Criterion
Non-clinical sample								
Dozois[27]	13	81	92	NR	NR	NR	NR	BDI-II > 12
Gorenstein[31]	10	70	87	84.3	77	82	33.5	SCID-I
Osman[81]	10	86.8	56.8	NR	NR	77	10.5	Clinical consensus
Sprinkle[51]	16	84	73	NR	NR	NR	64.0	SCID-I
Shean & Baldwin[50]	10	73.3	84.4	47.8	94.2	NR	17.9	DIS-IV
Psychiatric/institutionalized sample								
Dolle[69]	23	88	92	NR	NR	93	27	Kinder-DIPS
Kapci[33]	19	77	76	NR	NR	87	NR	Clinical
Krefetz[75]	24	74	70	NR	NR	78	NR	PRIME-MD
Kumar[77]	21	85	83	85	83	92	54	PRIME-MD
Perry & Gilbody[83]	21	65.9	67.9	NR	NR	74	32.6	SCOPE
	31*	80.0	60.4			75	14	
Seignourel[86]	25	73	75	45	91	82	21.3	SCID-I
Uslu[55]	20	77.4	76.8	63.4	84.6	86	NR	BDI-II > 12
Medical sample								
Arnarson[20]	20	82	75	NR	NR	87	42.1	MINI
Arnau[92]	18	94	92	54	99	96	23.2	PHQ
Bunevicius[93]	14	89	74	29	98	90	11	MINI
Carney[94]	17	81	79	NR	NR	83.8	NR	SCID-I
Dutton[102]	14	87.7	839	695	942	91	29.5	PRIME-MD
Frasure-Smith & Lespérance[103]	14	91.2	77.5	NR	NR	92	13.7	SCID-I
Jones[108]	11	96	80	48	99	94	17.2	MINI
	15	84	87	55	97	92		SCID-I
	11	95.7	78.3	42	99	94		MINI + SCID
Low & Hubley[111]	10	100	75	21	100	92	11.8	SCID-I
Rampling[118]	14	93.6	74	44	98	90	17.7	MDI (ICD-10)
	15	93.8	78.9	49.5	98	93	18	MDI (DSM-IV)
Turner[123]	11	92	71	NR	NR	89	18	SCID-I
Warmenhoven[125]	16	90	69	NR	NR	82	22	PRIME-MD
Williams[126]	7	95	60	62	94	85	34.1	SCID-I

AUC = area under the curve; DIS-IV = Diagnostic Interview Schedule-IV; Kinder-DIPS = Diagnostisches Interview bei psychischen Störungen im Kindes und Jugendalter; MDI = Major Depression Inventory; MINI: Mini International Neuropsychiatric Interview; NPV = negative predictive value; NR = not reported; PHQ = PRIME-MD Patient Health Questionnaire; PPV = positive predictive value; PRIME-MD = primary care evaluation of mental disorders; SCID-I = Structured Clinical Interview for DSM-IV Axis I Diagnosis; SCOPE: measure of vulnerability to suicide and self-harm behavior; Sn = sensitivity; Sp = specificity; %MDD = proportion of major depressive disorder in the sample.

* This investigation included incident cases of suicide.

variation may depend on the type of the sample (non-clinical or clinical), percentage of depressive subjects, and external gold-standard criterion for DSM-IV depression. As shown in Table 3, non-clinical samples displayed the lowest range of cutoff points (from 10 to 16) to detect major depression, medical samples had an intermediate cutoff (from 7 to 20), and psychiatric samples had the highest cutoff (from 19 to 31). However, caution is warranted when using the cutoff guidelines presented for criterion-referenced interpretation and regarding misuse of the BDI-II as a diagnostic instrument. While the reported thresholds are helpful indicators for detecting suspected cases that should be referred for additional clinical assessment, the validity of these findings is essentially limited by the arbitrary external criterion adopted for comparison. Regardless of sound criterion validity, most investigators were unanimous in recommending the BDI-II as a screening tool as the first phase of two-stage studies to prevent excessive cases of false-positive detection if the scale is used as a single tool.[50]

Some BDI-II items were associated with treatment response in a treatment setting.[90] In the regression model, the items pessimism and loss of energy emerged as predictors of response after 2 years. When both symptoms were endorsed at baseline, these items could predict a 61.1% chance of response, and absence of both symptoms predicted a 49.4% chance of response. Routine clinical assessment of these depressive symptoms can provide information about treatment progress as early as the initial assessment of the intake phase.

Content and construct validity

Besides test performance and criteria scores, the underlying trait or quality of a given test is a matter of the utmost importance for its validity.[141] Two relevant topics are the description of content validity and the latent construct assessed by the instrument.[142] While content coverage was established by ordinary deduction of the universe of items accepted to define the construct, structural or construct validity can be demonstrated by statistical methods, such as factor analyses. The development of a sound measurement instrument for large-scale use requires demonstration of the latent trait being measured, and of the types, categories, and behaviors that constitute an adequate representation of depression.

The content validity of the BDI-II appears to be adequate but narrower than that of its former version.[10,42] The BDI-I reflected six of the nine criteria for DSM-based depression,[143,144] while the BDI-II presented an improved performance on specificity to indicate DSM-based depression. Consequently, the sensitivity of the test to detect a broader concept of depression may have been affected.[27,50] The acceptance of the content universe as a qualitative representation of the trait to be measured is critical in this type of validity.[130] Although this DSM-based instrument for assessment of depression can allow reliable comparisons in an array of settings and facilitates tailoring of therapeutic interventions, this trend should not be viewed as the true representation of the construct of depression.[145]

Construct validity tests how well a given psychological measure relates to measures of theory-driven constructs. Therefore, construct validation refers to the simultaneous procedure of measurement and theory validation.[146,147] However, since the BDI-II was built on non-theoretical assumptions, investigators often choose factor analysis to account for variance in test performance and determine which psychological events make up test performance. Besides reducing the items to explain the structure of data covariance, factor analysis depicts the latent structure of a given test. This family of techniques can determine how and to what extent selected items cluster on one or more factors.[148] Table 4 lists 74 investigations reporting the factor structure of BDI-II, which represented around two-thirds of the retained studies, grouped by type of sample and specified strategy for factor extraction. Some investigators have adopted both exploratory and confirmatory strategies with different purposes, e.g., to identify problems with items reported to have non-significant factor loadings, or for cross-validation of data. The use of the state-of-art confirmatory approach is a trend in studies investigating the latent structure of BDI-II.

Using the means of exploratory factor analysis, Beck[8] reported a structure of two oblique factors, represented by the cognitive-affective and somatic-vegetative dimensions (between-factor correlation, r = 0.62 and 0.66 for student and outpatient samples respectively). A similar two-dimensional structure was obtained in non-clinical samples using a different language version of the BDI-II,[27,31,55] in psychiatric samples,[8,33,55,62,65,82,88,91] and in medical patients.[96,114,116,124] The between-factor correlation coefficients in the two-dimensional structure of the BDI-II were generally high (> 0.50, range 0.49-0.87) and could account for a large amount of common data variance. Meta-analysis of selected empirical studies on the factor structure of the BDI concluded that much of the data variability can be attributed to the common dimension of severity of depression and the other part to somatic symptoms.[12] However, some investigators also reached different results, with more than two dimensions and different item loadings.[21,45,70] These conflicting findings posited the existence of alternative structural models.

The confirmatory strategy has been employed to compare the structure and model fit of previous studies in relation to the construct validity of the BDI-II. In general, a two-dimensional structure composed of a cognitive-affective and a somatic-vegetative factor can be replicated empirically across studies.[27,29,38,53,57,59] The stability of the obtained solutions seems to substantiate the proposal of the DSM-IV, where the cognitive-affective symptoms are central to making the diagnosis, supplemented by the vegetative-somatic symptoms in the assessment of depressive syndrome. Nevertheless, some studies have suggested that the structure of

Table 4 Construct validity of latent structure of the Beck Depression Inventory-II

Author	Sample	Method	Factor 1	Factor 2	Factor 3	Factor 4
Non-clinical sample (34)						
Beck[8]	Students	EFA	Cognitive-affective	Somatic-vegetative		
Aasen[16]	Students	CFA	Negative attitude	Performance difficulty	Somatic element	
	Adults		Negative attitude	Performance difficulty	Somatic element	
Al-Musawi[17]	Students	EFA	Cognitive-affective	Overt emotional upset	Somatic complaints	
		CFA	Cognitive-affective	Emotional distress	Somatic-vegetative	
Al-Turkait & Ohaeri[18]	Students	CFA	Cognitive-affective	Somatic	General depression (G)	
Arnarson[20]	Students	CFA	Depressive cognition	Depressive affect	Somatic-vegetative	
Byrne[21]	Students	EFA	Negative attitude	Performance difficulty	Somatic element	
		CFA	Negative attitude	Performance difficulty	Somatic element	(Depression)
Campos & Gonçalves[22]	Students	EFA	Cognitive-affective	Somatic		
	Adults	CFA	Cognitive-affective	Somatic		
Canel-Çinarbas[23]	Turkish students	CFA	Cognitive-affective	Somatic		
	U.S. students					
Carmody[24]	Students	CFA	Negative attitude	Performance difficulty	Somatic	
Dozois[27]	Students	EFA	Cognitive-affective	Somatic-vegetative		
		CFA	Cognitive-affective	Somatic-vegetative		
Gary & Yarandi[28]	Rural women	EFA	Cognitive	Somatic-affective		
Ghassemzadeh[29]	Students	CFA	Cognitive-affective	Somatic-vegetative		
Gorenstein[31]	College students	EFA	Cognitive-affective	Somatic-vegetative		
	Adolescents	EFA	Cognitive-affective	Somatic-vegetative		
	Elderly	EFA	Cognitive-affective	Somatic-vegetative		
Kapci[33]	Workers	EFA	Performance	Negative attitude		
		CFA	difficulty/Somatic			
Kneipp[34]	Low-income women	EFA	Cognitive-affective	Somatic		
		CFA	Cognitive-affective	Somatic	General depression (G)	
Kojima[36]	Workers	PCA	Somato-vegetative	Cognitive-affective		
		CFA	Somato-vegetative	Cognitive-affective		
Lipps[38]	Students	C-PCA	Cognitive-affective	Somatic-vegetative		
Osman[41]	Students	CFA	Negative attitude	Performance difficulty	Somato-vegetative	
Osman[42]	Adolescents	CFA	Somatic	Cognitive-affective	General depression (G)	
Roberts[44]	Students	EFA	Cognitive-affective	Somatic-vegetative	(Depression)	
Rodriguez-Gomes[45]	Elderly	PCA	Somatic	Cognitive-behavioral	Biological	Negative attitude
Sanz[46]	Students	EFA	Cognitive-affective	Somatic-motivational	General depression (G)	
Sanz[47]	Community	EFA	Cognitive-affective	Somatic-motivational	General depression (G)	
Segal[49]	Students	PCA	Depression			
	Elderly					
Steer & Clark[52]	Students	EFA	Cognitive-affective	Somatic-vegetative		
Storch[53]	Students	CFA	Cognitive-affective	Somatic-vegetative		
Uslu[55]	Adolescents	EFA	Cognitive	Somatic-affective		
Vanheule[56]	Community	CFA	Somatic-vegetative	Depressive affect	Depressive cognition	
Whisman[57]	Students	CFA	Cognitive-affective	Somatic-vegetative		
Whisman[58]	Students	CFA	Negative attitude	Performance difficulty	Somatic elements	(Depression)
Wiebe & Penley[59]	Students	CFA	Cognitive-affective	Somatic-vegetative		
Wu[60]	Students	CFA	Negative attitude	Performance difficulty	Somatic elements	
Wu & Huang[61]	Adolescents	CFA	Negative attitude	Performance difficulty	Somatic elements	
Psychiatric/institutionalized sample (24)						
Beck[8]	Outpatients	EFA	Cognitive-affective	Somatic-vegetative		
Bedi[62]	Depressed women	EFA	Somatic-affective	Cognitive		
Brouwer[64]	Outpatients	CFA	Affective	Cognitive	Somatic	General depression (G)
Brown[65]	Chronic fatigue	EFA	Cognitive	Somatic-affective		
Buckley[66]	Substance abusers	CFA	Cognitive	Affective	Somatic	
Cohen[149]	Outpatients	MDS	Disturbance	Arousal		
Cole[67]	Psychiatric inpatients	PCA	Cognitive-affective	Somatic-vegetative	(Depression)	
Dum[70]	Substance users	PCA	Somatic	Affective	Cognitive	
Hepner[71]	Substance users	CFA	Cognitive	Somatic		
Joe[73]	Suicide attempters	CFA	Somatic	Cognitive-affective	(Depression)	
Johnson[74]	Intravenous drug users	CFA	Cognitive	Affective	Somatic	
Kapci[33]	Outpatients	EFA	Somatic-affective	Cognitive		
		CFA				
Lindsay & Skene[79]	Intellectual disability	PCA	Emotion cognitions	Loss of function	Somatic changes	
Osman[42]	Adolescent outpatients	CFA	Cognitive	Somatic		
		EFA				
Palmer & Binks[82]	Male offenders	EFA	Cognitive-affective	Somatic		
Quilty[84]	Major depression	CFA	Cognitive	Somatic	General depression (G)	
Sanz[47]	Outpatients	EFA	Somatic-motivational	Cognitive	General depression (G)	
Seignourel[86]	Substance users	CFA	Cognitive	Affective	Somatic	
Steer[87]	Adolescent outpatients	EFA	Cognitive	Somatic-affective	Guilt/Punishment	(Depression)
Steer[88]	Depressed outpatients	EFA	Somatic-affective	Cognitive		
		CFA	Cognitive	Non-cognitive	(Depression)	
Steer[85]	Geriatric inpatients	EFA	Somatic-affective	Cognitive		
Uslu[55]	Adolescents	EFA	Somatic-affective	Cognitive		
Vanheule[56]	Outpatients	CFA	Somatic-vegetative	Depressive affect		
VanVoorhis & Blumentritt[91]	Mexican American adolescents	EFA	Cognitive-somatic	Affective		

Continued on next page

Table 4 Continued

Author	Sample	Method	Factor 1	Factor 2	Factor 3	Factor 4
Medical sample (16)						
Arnau[89]	Primary care	PCA	Somatic-affective	Cognitive	(Depression)	
Carvalho Bos[94]	Pregnancy	PCA	Cognitive-affective	Anxiety	Fatigue	
	Postpartum	PCA	Cognitive-affective	Somatic-anxiety	Guilt	
Chilcot[96]	Renal disease	EFA	Cognitive	Somatic		
		CFA	Cognitive	Somatic	General depression (G)	
Corbière[98]	Chronic pain	CFA	Cognitive	Affective	Somatic	
del Pino Pérez[97]	Coronary disease	EFA	Somatic-affective	Cognitive		
		CFA	Somatic-affective	Cognitive	(Depression)	
Grothe[101]	Medical outpatients	CFA	Cognitive	Somatic	(Depression)	
Harris & D'Eon[105]	Chronic pain	CFA	Negative attitude	Performance difficulty	Somatic	(Depression)
Kirsch-Darrow[108]	Parkinson's disease	CFA	Dysphoric mood	Loss of interest/pleasure	Somatic	
Lopez[109]	Chronic pain	EFA	Negative rumination	Somatic Complaint	Mood	
Mahmud[111]	Postpartum	PCA	Affective	Somatic	Cognitive	
Patterson[114]	Hepatitis C	EFA	Cognitive-affective	Somatic		
		CFA	Cognitive-affective	Somatic		
Penley[113]	Hemodialysis	CFA	Cognitive	Somatic-affective		
Poole[116]	Chronic pain	EFA	Negative cognitions	Behavior and activities		
		CFA				
Siegert[119]	Neurorehabilitation	PCA	Cognitive-affective	Somatic		
		CFA	Cognitive-affective	Somatic		
Thombs[121]	Myocardial infarction	CFA	Cognitive	Somatic	General depression (G)	
Tully[122]	Coronary revascularization	CFA	Cognitive	Affective	Somatic	
Viljoen[124]	Primary care	EFA	Somatic-affective	Cognitive		

C-PCA = confirmatory principal component analysis; CFA = confirmatory factor analysis; EFA = exploratory factor analysis; MDS = multidimensional scaling; PCA = principal component analysis; G = general factor of depression for bifactor model; Depression = higher-order general dimension of depression for hierarchical model.

BDI-II can be best described as three-dimensional, distributing the cognitive-affective dimension into two distinct factors.[17,20,41,56,66,98,122,136] Further analyses revealed that the BDI-II presents reasonable factorial invariance when assessing the severity of depressive symptoms; this covariance structure is equivalent across gender and ethnicity in American college students[58] and across gender in Taiwanese college students and adolescents.[60,61]

Sophisticated alternative structural analysis of the BDI-II was strengthened by two investigative breakthroughs: the hierarchical model and the bifactor model. The first group of strategies depicted a general depression dimension as a higher-order structure to explain the variance of lower-order dimensions.[21,58,67,73,87,101,105] Although still scant, the bifactor model (G) was able to identify a non-hierarchical general depression in addition to the traditional two-dimensional structure.[18,34,64,81,84,96,121] These investigations shared the view that much of the variance of the BDI-II items can be accounted for by a hierarchical higher order or a parallel dimension of depression, where much of the common variance can be explained by a general construct. Practitioners should be careful when interpreting subscale scores, which might be greatly related to the heterogeneous characteristics of depressive conditions.

Cross-cultural issues

With the BDI-II being such a popular measure adapted for use in several countries, information on cross-cultural comparability is still remarkably scarce. The cross-cultural equivalence between the versions of the BDI-II stands out as a topic of fervent academic interest: the symptomatology of depression in different culture/races or languages can be compared by testing the measurement variance of the instrument.[23,48,58,59,150] For example, large differential item functioning values were found for 12 BDI-II items between Turkish and U.S. students with same level of depression.[23] Besides suggesting an equivalence problem with the Turkish version, this study indicated that participants would respond in a different way to different language versions of the instrument. Likewise, the construct validity of the BDI-II (Table 4) also varies over existing language versions. Before a true cross-cultural difference can be acknowledged, more fine-grained analyses should be conducted to ascertain the sources of this dissimilarity.

Limitations

Before widespread adoption of the BDI-II as a standard measure of depression, the potential sources of its score variation should be examined. First, this review has attempted to minimize the file drawer bias by including psychometric articles published in journals, monographs, and book chapters. Explicit exclusion criteria were used to select high-quality investigations. Moreover, efforts were made to contact authors in the field to obtain primary psychometric data for the BDI-II. Unlike traditional experimental studies, psychometric analyses are more descriptive in nature, with both significant and non-significant studies being available. Therefore, the publication bias seems to affect the current review to a lesser degree than in experimental-type research.

The spectrum bias refers to the psychometric phenomenon of differential performance of a test in different settings, thus affecting the generalizability of the results. For example, the somatic factor can be the dominant dimension in patient samples[88] vs. depressive cognition

in non-clinical samples. On the other hand, the workup or verification bias arises when respondents with positive (or negative) diagnostic procedure results are preferentially referred to receive verification by the gold-standard procedure, producing considerable distortion in test accuracy. To the extent where these types of bias might occur, the investigators should consider the differential performance of the BDI-II when interpreting scores. Future revisions should include quantitative analysis to assess the sources of scale error.

The self-report nature of the BDI can affect its results according to social desirability, respondent educational attainment, and the gender effect of the condition.[130] The BDI is sometimes criticized for being too transparent to respondents and thus easily faked by those wishing to present themselves in a favorable or unfavorable light. Fortunately, this does not seem to be a pervasive problem, as the BDI-II tended to provide an accurate index of depressive manifestations in voluntary and anonymous participants, with good correlation with measures of negative psychological states such as anxiety or psychological distress. Furthermore, the non-theoretical approach of the construction of the BDI-II might introduce more problems than solutions for understanding the scale in terms of psychometric and clinical parameters. In summary, despite its robust psychometric characteristics, as widely reported in available studies, the generalizability of the BDI-II is not free of limitations.

Comments

Depression is a common psychological state in both non-clinical and clinical conditions. The predicted high occurrence of depressive disorders worldwide justifies the use of self-assessment scales to detect a consensus definition of depression. These instruments must be inexpensive and easy to administer, with good acceptance by users in the public health domain. The pressure for rapid evidence-based decisions in clinical practice and the explosion of information in the scientific literature indicate the need for an updated review to summarize the growing body of psychometric literature on self-report measures of depression, such as the BDI-II.

A good measure must supply clinicians with evidence that they find useful and relevant to the needs of their patients. Advantages of this well-investigated inventory are its high internal consistency, capacity to discriminate between depressed and non-depressed subjects, and improved content and structural validity. Consequently, investigators can benefit from this simple, short, reliable, and validated tool to design research in a variety of settings. The fact that the BDI-II is copyrighted and must be obtained from the publisher is the major obstacle against the recommendation of its widespread use as a standard second-generation self-report tool worldwide.

After more than 15 years using the BDI-II in hundreds of investigations and thousands of respondents, evidence of the validity of this authoritative scale is growing, but its use is not free of caveats. Bearing in mind that the stated purpose of the BDI-II was not to establish a diagnosis of major depressive episode, continuous investigations must examine its appropriateness in monitoring treatment efficacy and its comparability with observer-rated scales, such as the HAM-D or the MADRS. Besides comparing the cross-cultural equivalence and conducting item-level analysis to uncover the factors affecting the interpretation of this scale for measurement of depressive symptoms, future studies of the BDI-II should be mindful of theory-based strategies of validation.

Acknowledgements

Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) sponsors this article and Yuan-Pang Wang is the recipient of the grant (protocol no. 2008/11415-9). Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) sponsors Clarice Gorenstein.

Disclosure

The authors report no conflicts of interest.

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