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Confirmatory Factor Analysis of the Beck Depression Inventory-II in Patients with Advanced Cancer: A Theory-Driven Approach

Kristen G. Tobias,

Department of Psychology, Fordham University

Jonathan Lehrfeld,

Department of Psychology, Fordham University

Barry Rosenfeld,

Department of Psychology, Fordham University

Hayley Pessin, and

Department of Psychiatry and Behavioral Sciences, Memorial Sloan Kettering Cancer Center

William Breitbart

Department of Psychiatry and Behavioral Sciences, Memorial Sloan Kettering Cancer Center

Abstract

Objective—The diagnosis and treatment of depression is complicated by the presence of a serious medical illness, such as cancer. The role of inflammation in the pathophysiology of depression remains unknown; however, the symptom cluster of sickness behavior is more clearly related to inflammation. Symptoms clusters may provide the specificity needed to improve treatment outcomes. The purpose of this study is to use confirmatory factor analysis to examine the construct of sickness behavior in patients with advanced cancer using the Beck Depression Inventory-II (BDI-II).

Methods—Patients ($N = 167$) were recruited from chemotherapy clinics and the Department of Psychiatry at Memorial Sloan Kettering Cancer Center. Symptoms were a priori delineated using the factor labels sickness behavior and negative affectivity (2-factor model) and affective, cognitive, and sickness behavior (3-factor model). These data were also fit a more traditional model using affective, cognitive, and somatic factors.

Results—The mean total BDI-II score was 14.74 ($SD = 8.52$; range 1 to 46). Fit statistics for all models were good, but the novel 3-factor model with sickness behavior provided the best fit: $\chi^2(186) = 273.624$, $p < .001$; RMSEA = .053; CFI = .949.

Significance of the results—Both the 2- and 3-factor models provide support for the unique construct of sickness behavior in patients with advanced cancer. High factor correlations with the BDI-II and other measures of distress were observed, which raises questions about theoretically distinct, but related constructs.

Keywords

Cancer; depression; sickness behavior; symptom clusters; Beck Depression Inventory-II

Introduction

Patients with cancer frequently face a wide range of symptoms that result in considerable distress. However, the etiological complexity of these symptoms often complicates the assessment and treatment of distress. Symptoms that fall under the rubric of depression constitute an important component of overall distress, with incidence rates for a current depressive episode across diagnoses ranging from 8% to 24% (Krebber et al., 2014). The adverse effects of depression in cancer are well-established (Raison & Miller, 2003), ranging from poorer quality of life to lower survival rates (Pinquart & Duberstein, 2010).

A recent study observed that rates of depression in patients with advanced cancer ($N=969$) ranged from 13.7% to 45.3%, depending on the diagnostic criteria applied (Lie et al., 2015), which underscores the diversity in clinical presentations and measurement challenges in this population. In multivariate analyses that accounted for variables known to affect inflammation (e.g., age and gender), elevated levels of C-reactive protein (CRP) were significantly associated with depression when using an inclusive diagnostic approach (i.e., including somatic symptoms such as sleep problems, fatigue, weight loss/appetite change, and psychomotor retardation or agitation), but not an exclusive approach (i.e., omitting these somatic symptoms when establishing a diagnosis of depression). In this sample, anhedonia, difficulty sleeping, fatigue, and poor appetite were the most prevalent symptoms endorsed on the Patient Health Questionnaire-9 (Spitzer, Kroenke, & Williams, 1999), a measure that includes the nine symptoms that constitute a DSM-5 diagnosis of depression (American Psychiatric Association, 2013).

The experience of depression in patients with advanced cancer, both in terms of pathophysiology and symptom manifestation, is not well understood. Identification of symptom clusters are recognized as a research priority that may provide the specificity needed to improve treatment outcomes (Miaskowski, Dodd, & Lee, 2004). Symptom clusters are conceptualized as co-occurring signs and symptoms that are related in some meaningful way, such as a common etiology. “Sickness behavior” is theorized to be a symptom cluster associated with inflammation, indicated by high levels of circulating pro-inflammatory cytokines and other acute-phase proteins (e.g., CRP) (Dantzer & Kelley, 2007). From an evolutionary perspective, sickness behavior represents an adaptive response to illness that promotes recuperation (Hart, 1988). Symptoms of sickness behavior typically include anhedonia, fatigue, decreased appetite, and low libido, among others (Raison & Miller, 2003). Major depressive disorder (MDD) and sickness behavior share overlapping symptoms, yet their relationship is unclear, and is further complicated by the presence of a medical illness such as cancer, which can cause many of the same symptoms.

The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) is one of the most commonly used self-report measures to assess depressive symptom severity. The BDI-II consists of 21 items rated on a 4-point scale (0 to 3); total scores range from 0 to 63. The scale measures core and associated symptoms of depression, including the nine symptoms that comprise a diagnosis of MDD (American Psychiatric Association, 2013). Severity cutoff scores that distinguish minimal (0 to 13), mild (14 to 19), moderate (20 to 28), and severe (29 and greater) depression have been established (Beck, Steer, & Brown, 1996). The

factor structure of the BDI-II has varied across studies (Huang & Chen, 2015) and support has been observed for one- (Segal et al., 2008), two- (Steer et al., 1999), three- (Harris & D'Eon, 2008), and bi-factor (Brouwer, Meijer, & Zevalkink, 2013) models.

The polythetic diagnostic criteria for depression are generally recognized to include affective, cognitive, and somatic components, yet there is not consensus on the items that comprise each dimension, either statistically or conceptually. For example, some factor analytic research has indicated that the BDI-II "Crying" item loads onto a cognitive factor (Arnau, Meagher, Norris, & Bramson, 2001) whereas other studies include this item on an affective factor (Buckley, Parker, & Heggie, 2001). The demarcation of symptoms is even more complicated in patients with cancer. Crying or tearfulness may represent a normative response in the context of a life threatening illness, or might represent a symptom of depression. Similarly, fatigue may arise secondary to the cancer itself, as a side effect of chemotherapy, or as a symptom of depression. Research using the BDI-II in cancer samples has typically focused on its utility as a screening instrument (Vodermaier, Linden, & Siu, 2009) or indicator of treatment response (Brothers, Yang, Strunk, & Andersen, 2011; Hopko et al., 2011). To our knowledge, the factor structure of the BDI-II has not been examined in an advanced cancer sample and this study sought to fill this void in the literature. Given the discrepancies in factor composition observed in published research, this study applied a theory-driven model that incorporated the symptoms of sickness behavior as a factor.

Methods

Participants

Patients ($N=167$) were recruited from outpatient clinics at Memorial Sloan Kettering Cancer Center (MSKCC) as part of a psychotherapy research study. The study was approved by the MSKCC Institutional Review Board. Eligibility criteria included Stage IV cancer (or Stage III cancer with a poor prognosis), English-speaking, and age 18 years and older. Patients were excluded if they were unable to provide informed consent or had physical limitations that precluded participation in group psychotherapy. A minimum level of distress or depression was not required for entry into the study, although 14.4% ($n=24$) reported ongoing treatment for depression. The sample ranged in age from 27 to 91 years (mean=58.4 years old, $SD=11.31$) and was predominantly female ($n=125$, 75.4%). Participants were largely white ($n=131$, 78.4%), educated (mean=16.6 years of education; $SD=2.41$), and 49.1% of the sample was married ($n=82$).

Measures

In addition to the BDI-II, patients completed a number of scales including the Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1974), the Schedule of Attitudes Towards Hastened Death (SAHD; Rosenfeld et al., 1999), and the Hospital Anxiety Depression Scale, Anxiety subscale (HADS-A; Zigmond & Snaith, 1983). The BHS is a 20-item true/false self-report questionnaire that measures the severity of pessimistic cognitions. This scale has been shown to have good test-retest reliability ($r=.78$; $p < .001$) and internal consistency ($\alpha=.94$) in an advanced cancer sample (Mystakidou et al., 2008). The SAHD is a 20-item self-report questionnaire that measures desire for death in

medically ill patients. High internal consistency has been observed in patients with HIV/AIDS (Rosenfeld et al., 1999) and advanced cancer (Rosenfeld et al., 2000). This SAHD is recognized as the most frequently used measure to quantify the desire or wish for hastened death in patients with advanced cancer (Nissim, Gagliese, & Rodin, 2009). The HADS was developed to screen for the presence of clinically significant anxiety and depression in patients receiving medical care. It consists of 14 items that yield a total score, as well as depression (HADS-D; 7 items) and anxiety (HADS-A; 7 items) subscale scores. This measure is widely used in research with medically complicated samples because of its minimal reliance on potentially confounding somatic symptoms (e.g., sleep disturbance). In a review of 747 studies comprised of diverse samples, the HADS-A demonstrated adequate to strong reliability (α ranged from .68 to .93) (Bjelland, Dahl, Haug, & Neckelmann, 2002).

Data Analysis

Descriptive statistics were used to characterize depressive symptoms. Each of the 21 symptoms on the BDI-II was *a priori* assigned to factors based on competing, theory-driven models. A 2-factor model (model 1 in Table 1) included factors thought to represent Sickness Behavior (BDI-II items: loss of pleasure, loss of interest, loss of energy, changes in sleeping pattern, changes in appetite, concentration difficulty, tiredness or fatigue, loss of interest in sex) and Negative Affectivity (i.e., symptoms of dysphoria not linked to sickness behavior). A novel 3-factor model (model 2 in Table 1) included Sickness Behavior (items listed above), but divided the Negative Affectivity into separate Affective₁ (i.e., mood-related symptoms), and Cognitive₁ factors (i.e., negative thoughts). A second, more traditional 3-factor model (model 3 in Table 1) included Affective₂, Cognitive₂, and Somatic factors. MPlus was used to fit factor models using unweighted least squares parameter estimates with standard errors and a mean- and variance-adjusted chi-square test statistic. Reliability and validity of the BDI-II factors were examined for the model(s) that demonstrated the best fit.

Results

The mean total BDI-II score was 14.74 ($SD = 8.52$; range 1 to 46). Using established cutoffs, approximately half of the sample reported minimal depression (52.1%, $n=87$), followed by mild (24.6%, $n=41$), moderate (16.8%, $n=28$) and severe depression (6.6%, $n=11$). When items were dichotomized as present or absent, the most prevalent symptoms were “loss of energy” (90%), “changes in sleeping pattern” (83%), “changes in appetite” (76%), “tiredness or fatigue” (94%), “loss of interest in sex” (74%), and “concentration difficulty” (70%).

Both the two-factor and the novel three-factor models were a good fit to the study data (Models 1 & 2 in Table 1). Results show support for the sickness behavior factor regardless of which factor structure was fit to the data. Standardized factor loadings were high, with the exception of two items (agitation and loss of interest in sex). These data were fit to another more traditional model (i.e., with Affective₂, Cognitive₂, and Somatic factors; Table 1) that has been supported in diverse samples (Buckley et al., 2001; Hall et al., 2013). Fit statistics

for this model (i.e., model 3) were good, but the novel 3-factor model with sickness behavior provided a slightly better fit (Table 2).

The internal consistency of the 21-item BDI-II was high (Cronbach's $\alpha = .90$). Reliability for factors included: sickness behavior (Cronbach's $\alpha = .82$), Affective₁ (Cronbach's $\alpha = .71$), and Cognitive₁ (Cronbach's $\alpha = .80$). All BDI-II factors scores were significantly correlated with depressive severity (i.e., BDI-II total score), hopelessness, desired for hastened death, and anxiety (Table 3).

Discussion

Shortcomings in the recognition and treatment of depression in cancer patients are well-established (McDaniel et al., 1995). In the present study, we examined the dimensions of the BDI-II using three theory-driven factor models. While this sample endorsed a mild level of depressive symptoms overall, individual participants ranged from minimal to severe. Consistent with existing literature, symptoms that are typically classified as somatic in nature (e.g., fatigue) were highly prevalent.

Symptom clusters are recognized as a research priority that may elucidate neurobiological underpinnings and thereby improve treatment outcomes. Both the 2- and 3-factor models applied in this study provide initial psychometric support for the unique construct of sickness behavior in patients with advanced cancer. This finding was observed in a sample that varied in terms of age, cancer diagnosis, and symptom burden (25% of which had moderate to severe depression). Support for a sickness behavior symptom cluster challenges the current conceptualization of depression, which posits vegetative/somatic symptoms as a distinct factor. Our novel factor structure provided a better fit to the data compared to a traditional factor model with affective, cognitive, and somatic factors. Results also suggest that the demarcation of factors (e.g., affective, cognitive) other than sickness behavior is less salient within a cancer sample.

Divergent validity among constructs (e.g., sickness behavior, hopelessness, depression) was not observed, which raises questions about the relationships of theoretically related, but distinct constructs. However, results are consistent with a theory of depression that proposes the symptoms of sickness behavior as primary, such that mood and cognitive symptoms are secondary and emerge as a result of feeling unwell (Charlton, 2000). In this model, the successful treatment of inflammation before syndromal depression could potentially prevent the emergence of additional symptoms.

Alternatively, moderate to strong correlations between sickness behavior and other constructs (e.g., anxiety, hopelessness, desire for hastened death) are potentially related to suffering that exists in bodily, mental, and spiritual (or existential) dimensions (Frankl, 1969). An existential disturbance is uniquely human in its focus on meaning and purpose, as opposed to a biological disturbance such as sickness behavior, which has been observed in both animals and humans (Shattuck & Muehlenbein, 2016). In this study, the SAHD is reasonably conceptualized as a proxy for existential distress by its assessment of desire for hastened death (e.g., failure to endorse the item, "Despite my illness, my life has purpose

and meaning.”). Patients with advanced cancer may have co-occurring biological (e.g., sickness behavior), psychological (e.g., anxiety), and existential domains of disturbance that affect cognition and behavior.

Disentanglement of the dimensions of suffering in medically ill patients may help to facilitate targeted interventions. A cross-sectional study precludes examination of the temporal dimension of symptom development that would help to parse these complex relationships. Further research is needed utilizing inflammatory biomarkers to better understand the complex relationship between sickness behavior and depressive symptomatology. Longitudinal research on symptom clusters that have statistical support and clinical relevance may optimally guide treatment in medically complicated populations.

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Table 1

Standardized factor loadings

Item	Model 1		Model 2		Model 3		
	SB	NA	SB	A ₁	C ₁	A ₂	C ₂ S
Sadness		.72		.71			.73
Pessimism		.53			.54		.55
Past failure		.68			.71		.70
Loss of pleasure	.78		.78			.70	
Guilt feelings		.63			.66		.64
Punishment feelings		.60			.62		.62
Self-dislike		.83			.86		.85
Self-criticalness		.66			.69		.68
Suicidal thoughts or wishes		.55		.55			.57
Crying		.65		.64		.62	
Agitation		.39		.39			.40
Loss of interest	.72		.72			.65	
Indecisiveness		.85		.84		.82	
Worthlessness		.86			.88		.88
Loss of energy	.70		.70				.70
Changes in sleeping pattern	.62		.62				.62
Irritability		.56		.55			.59
Changes in appetite	.60		.60				.59
Concentration difficulty	.86		.86				.86
Tiredness or fatigue	.65		.65				.65
Loss of interest in sex	.47		.47				.46

Note: SB = sickness behavior, NA = negative affectivity, A₁ = affective1, C₁ = cognitive1, A₂ = affective2, C₂ = cognitive2, S = somatic

Table 2

Fit Statistics

	χ^2	Df	p	RMSEA	CFI
SB 2-Factor Model 1	278.129	188	<.001	.054	.947
SB 3-Factor Model 2	273.624	186	<.001	.053	.949
3-Factor Model 3	285.758	186	<.001	.057	.942

Note: χ^2 = chi square, RMSEA = root mean square error of approximation, CFI = comparative fit index SB = Sickness Behavior.

Table 3

Factor Correlations with Models 1 & 2

	BHS	SAHD	HADS-A
BDI Total	.68 **	.53 **	.69 **
Sickness Behavior	.61 **	.47 **	.51 **
Negative Affectivity	.66 **	.53 **	.70 **
Affective ₁	.56 **	.49 **	.70 **
Cognitive ₁	.68 **	.47 **	.64 **

**
p<.01

Note: BHS = Beck Hopelessness Scale, SAHD = Schedule of Attitudes towards Hastened Death, HADS-A = Hospital Anxiety and Depression Scale, Anxiety subscale