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The Factor Structure of the Brief Symptom Inventory-18 (BSI-18) in Parkinson Disease Patients

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Abstract

Objective—Psychological distress is common among Parkinson disease (PD) patients. Screening tools, such as the Brief Symptom Inventory-18 (BSI-18), help clinicians to identify and manage PD patients with psychiatric symptoms. The objective of this study is to test the factor structure of the BSI-18 in PD patients.

Methods—Analysis was conducted on PD patients who had initial visits at a movement disorders center from 2004-2015. Univariate analysis was used to describe the distribution of socio-demographic and clinical characteristics. The BSI-18 was used to determine the prevalence of clinically significant psychological distress. Confirmatory factor analyses (CFA) treating BSI-18 items as ordered categorical data were conducted. Five competing models were tested. Multiple fit indices, parsimony, and past theory were used to select the final model.

Results—In the study sample (n=1,067), 18.7%, 22.5%, 15.4%, and 15.0% of patients had BSI-18 T-scores indicative of clinically significant global psychological distress, somatization, depression, and anxiety, respectively. Of the competing models, the final model chosen was the second-order three-factor structure with somatization, depression, and anxiety loaded on psychological distress.

Conclusion—The original proposed factor structure of the BSI-18 was validated in this patient population. Consequently, this study confirms the construct validity of the BSI-18 for screening of psychological distress in PD patients. Findings highlight somatization as a particularly important component of psychological distress in PD patients.

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Keywords

BSI-18; Factor Analysis; Parkinson disease

Introduction

Parkinson disease (PD) is the second most prevalent neurodegenerative disorder behind Alzheimer's disease [1]. Individuals with PD have impaired dopamine production due to progressive injury and loss of substantia nigra neurons in the brain [2]. Patients manifest with motor symptoms including bradykinesia, tremor, rigidity, and postural instability [2]. However, non-motor symptoms, including psychiatric problems, are also common in PD [2]. PD patients report higher levels of psychological distress than age matched controls [3]. Depression and anxiety may be both primary to the disease pathology and a secondary response to progressive disability [4].

Monitoring psychological distress is important in patient management, especially because symptoms such as depression are associated with greater disability in PD patients [5]. However, non-motor symptoms often go unrecognized and untreated [5,6]. One study demonstrated that neurologists correctly identified only 35% and 42% of PD patients with significant symptoms of depression or anxiety, respectively [6]. Consequently, screening tools are important to identify and manage psychiatric symptoms in PD.

One instrument used to screen for psychiatric symptoms is the Brief Symptom Inventory-18 (BSI-18) [7]. The BSI-18 was developed by Derogatis [7] to assess psychological distress. The BSI-18 is a condensed version of the more extensive Symptoms Checklist-90-Revised (SCL-90-R) [8] and the Brief Symptom Inventory (BSI) [9]. The SCL-90-R and BSI capture nine components of psychological distress, compared to the BSI-18, which only captures three—somatization, depression, and anxiety [7]. Several studies have found high correlations of the BSI-18 with its parent measures—the BSI and the SCL-90-R [10]. With respect to construct validity, the BSI-18 has a significant, moderate to strong correlation ($r = 0.38-0.82$) with other psychological assessment instruments, namely the Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), and Minnesota Multiphasic Personality Inventory-2, in patients with psychiatric disorders diagnosed via the Structured Clinical Interview for DSM-IV (SCID) [11].

The factor structure of the BSI-18 was determined by a principal components analysis (PCA) using data from employees from an American corporation [7]. The PCA demonstrated a second-order structure where questionnaire items loaded on three distinct factors: somatization, anxiety or depression; these factors subsequently loaded on an overarching psychological distress factor [7]. Many other studies have examined the construct validity of the BSI-18 using PCA, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and item response theory [10-21]. Studies have been conducted in diverse samples of patients, community-dwelling volunteers, students, and prisoners; studies have also been conducted among subjects with a wide range of ages [10-21]. Patient populations studied include those with temporomandibular disorders, cancer, psychiatric disorders, and drug abuse disorders [10,11,13-15,20]. These studies confirmed the original

second-order factor structure [16,18,20] or suggested alternative models, including a one-factor structure [12,15,17,19], a three-factor structure [13,14,18,21], a three-factor structure with suicidal ideation as a separate item [10], and a four-factor structure [11]. Although not supported, several studies also tested a second-order four-factor structure [16,18,20].

Importantly, no studies have examined the factor structure of the BSI-18 in PD patients. Furthermore, at least one patient-reported measure in PD (36-Item Short Form Health Survey) did not follow the factor structure shown in other samples [22]. This discrepancy further supports the need for conducting a CFA of the BSI-18 in PD. The primary aim of this study is to investigate the factor structure of the BSI-18 in PD patients to determine if the BSI-18 is a valid screening tool in PD.

Methods

Study Sample

Patients selected for this cross-sectional study received care at the University of Maryland Parkinson Disease and Movement Disorders Center. For study inclusion, patients must have been seen at the Center between April 2004, when collection of the BSI-18 was initiated, and September 2015. Patients must be diagnosed with idiopathic PD by one of the Center's movement disorders specialists. Per the University of Maryland's Institutional Review Board, the patient must consent to have their data included in the Center's ongoing PD and Movement Disorders research database.

Data Collection

At each clinical visit to the Center, patients complete several patient-reported instruments. Patients complete the questionnaires themselves, with the assistance of a caregiver, or the caregiver may complete the questionnaires for the patient. Patients typically complete questionnaires prior to the clinical encounter. Patient responses are recorded in the database along with demographic and physician assessment data.

Variables

BSI-18—The BSI-18 consists of 18 items with responses on a five-point Likert scale [7]. Patients are asked to report how much a given problem distressed or bothered them during the past week (0 = not at all, 1 = a little bit, 2 = moderately, 3 = quite a bit, 4 = extremely) [7]. Upon completion of the BSI-18, three sub-scale scores were calculated: somatization, depression, and anxiety [7]. Additionally, an overall global psychological distress score was calculated [7]. The overall global and sub-scale scores were then normalized and converted to gender-specific T-scores. Higher T-scores indicate more psychological distress with T-scores ≥ 63 indicative of clinically significant psychological distress [7].

Because the BSI-18 is newer than its parent measures, the SCL-90-R and the BSI, it has undergone less psychometric testing. When developed, some measures of reliability and validity were based on testing done on the parent measures [23]. The original psychometric properties of the BSI-18 reported by Derogatis [7] showed acceptable internal consistency with Cronbach's alphas of 0.89, 0.74, 0.84, and 0.79 for the global, somatization, depression,

and anxiety scales, respectively. With respect to validity, the BSI-18 also demonstrated correlations of over 0.90 with the various sub-scale and global SCL-90-R scores [7]. The criterion validity of the BSI-18 is more uncertain with studies finding inconsistent sensitivity and specificity [10,16]. Additional studies examined the reliability of the BSI-18. The majority obtained Cronbach's alpha values showing acceptable, good, or excellent internal consistency for both the overall psychological distress score as well as the three sub-scale scores (somatization, depression, and anxiety) [10-13,16,19,21,24-27]. Test-retest reliability has been less explored. However, Pearson-product moment correlations were greater than 0.6 for all sub-components and global scores in two studies [11,26]. No data are available on inter-rater and intra-rater reliability.

Covariates—Demographic variables collected included age, sex, race, and education level. PD severity was assessed by the neurologist performing a neurologic examination with completion of the Hoehn and Yahr (HY) stage (range = 0 to 5, higher stage = more severe) [28] and Unified Parkinson's Disease Rating Scale (UPDRS) total score (range = 0 to 147, higher score = more severe) [29]. Additional clinical characteristics of interest included medical comorbidity, assessed with the Cumulative Illness Rating Scale-Geriatric (CIRS-G) [30]. Patients rated the current level of problem (none, mild, moderate, severe/disabling, incapacitating) they experienced with 14 chronic condition categories. The CIRS-G score reported was the number of categories where the individual endorsed a mild or greater severity. Cognition was assessed with the Mini-Mental State Examination (MMSE) [31]. MMSE scores range from 0 to 30 with scores less than 24 suggestive of cognitive impairment.

Analytic Plan

All data for analysis were drawn from the PD and Movement Disorders research database. The original validation of the BSI-18 did not address sensitivity to change, and, to date, only one study found that the BSI-18 has good sensitivity to change [7,11]. Consequently, this analysis was limited to patient data from one point in time—initial visits to the Center. Patients only needed to complete at least one item of the BSI-18 questionnaire for inclusion in the analysis.

Univariate analysis was used to describe the distribution of patient socio-demographic and clinical characteristics, including BSI-18 T-scores, for the study sample. All univariate analysis was conducted using SAS version 9.2 (SAS Institute, Inc., Cary NC). Missing data analysis and BSI-18 distributional diagnostics were completed with SAS version 9.2 and Mplus version 7.31 (Muthén & Muthén, Los Angeles CA).

CFAs were conducted using Mplus version 7.31 (Muthén & Muthén, 2012). Raw BSI-18 item scores were used for the CFA. Based on past PCA, EFA, CFA, and item response theory studies conducted with the BSI-18, five separate competing models were considered. The first model was a one-factor model with all items loading on global psychological distress [12,15,17,19]. The second model was a first-order model with items loading on one of three factors: somatization, anxiety, or depression [13,14,18,21]. The third model was equivalent to model two; however, all first-order factors loaded on psychological distress to

create a second-order model [16,18,20]. Model four was a single-order, four-factor model with anxiety split into two factors—general anxiety and panic [11]. Model five was a second-order model with the four factors (somatization, anxiety-general anxiety, anxiety-panic, and depression) loading on psychological distress [16,18,20]. Although one past study suggested a three-factor model with suicide as a separate item [10], this model was not tested as it was based on a PCA, which may be a less ideal analytic strategy to explore factor structures [32].

Based on the right skew of all BSI-18 items (Table 1), extreme kurtosis of some items, and past precedent to correct for the non-normal distribution of BSI-18 items, all model fit comparisons were conducted treating the BSI-18 items as ordered categorical [16,19-21]. Because the data were treated as ordered categorical, all model parameters were estimated using the weighted least square mean-and-variance adjusted (WLSMV) estimator [32,33]. In conjunction with the WLSMV estimator, missing data were handled with pairwise deletion [34] and only standardized estimates were interpreted [35].

Selection of the final model was based on several criteria including best fit, parsimony, and theoretical operationalization. Fit was assessed with multiple indices including the model chi-square (χ^2_M) exact-fit test, Root Mean Square Error of Approximation (RMSEA), Bentler Comparative Fit Index (CFI), and Tucker-Lewis Fit Index (TLI). Thresholds for assessing goodness of fit were $p > 0.05$ (χ^2_M), 0.06 (RMSEA), 0.95 (CFI), and 0.95 (TLI) [33,36,37]. A DIFFTEST was also used to compare improvement in fit between nested models [35]. If model fits were poor, modification indices were requested and modifications were considered if suggestions were deemed theoretically appropriate.

Results

Overall, 75.6% of PD patients seen at the Center consented to participate in the research database during the study time frame, for a total of 1,394 patients. Of these patients, 327 (23.5%) did not complete any BSI-18 items at their initial patient visit and were excluded from analysis, resulting in a total analytic sample of 1,067 patients; 996 patients completed all items on the BSI-18 while the rest had various items missing with no single item missing for more than 15 patients (Table 1).

Univariate Analysis

Table 2 details patient demographic, clinical characteristics, and BSI-18 T-scores. The mean patient age for the full sample was 65.3 years ($SD=10.9$). The majority of patients were white (91.4%) males (61.8%) with some post-high school education (71.1%). Patients had a mean HY stage of 2.3 ($SD=0.90$), consistent with mild to moderate disease [38] and a mean UPDRS total score of 40.6 ($SD=20.0$). The average CIRS-G score was 3.0 ($SD=1.82$), indicating patients experienced problems with an average of three chronic conditions; the average MMSE scores was 28.3 ($SD=2.69$), which is above the threshold for cognitive impairment.

The study sample had an average global psychological distress T-score of 53.4. T-scores were the highest for somatization (54.6) and lowest for depression (50.8) (Table 2). BSI-18

global psychological distress, somatization, depression, and anxiety T-scores were at the clinical threshold of 63 or above for 18.7% (n=181), 22.5% (n=217), 15.4% (n=149), and 15.0% (n=160) of patients, respectively (Table 2) [7].

CFA

Table 3 displays the comparison of fit statistics for all competing models. The one factor model did not reach fit thresholds for the χ^2_M exact-fit test, RMSEA, CFI, or TLI. The first-order, three-factor model and its equivalent second-order three-factor model, resulted in improved fit, compared to the one-factor model; all fit thresholds were met, except for the χ^2_M exact-fit test. Both the first-order and second-order four-factor model resulted in a small, additional improvement in fit in RMSEA, TLI, and CFI, compared to the three-factor models. However, the χ^2_M exact-fit test p-value was still less than 0.05. When using a DIFFTEST to compare the χ^2_M between the two second-order models, the four-factor model resulted in a significant improvement in fit, compared to the three-factor model ($\chi^2=52.306$, $df=1$, $p<0.0001$). Modification indices obtained were ignored because suggested model changes lacked a theoretical basis.

The final model chosen was the second-order three-factor model. This model provided substantial improvement in fit, compared to the one-factor model. The second-order three-factor model was also chosen for parsimony given the trivial improvement in fit for most fit indices seen in the four-factor models. With respect to the first-order three-factor model, somatization and depression had a correlation of 0.713, somatization and anxiety had a correlation of 0.793, and depression and anxiety had a correlation of 0.847. Correlations greater than or equal to 0.80 suggest poor discriminant validity between factors [39]. The potential lack of discriminant validity between the three factors in the first-order model suggested a second-order model where somatization, depression, and anxiety are derived from the same higher order factor, global psychological distress, may be more appropriate.

Table 4 displays the standardized and unstandardized parameter estimates, standard errors, and p-values for the selected second-order three-factor model. All loadings were statistically significant. The weakest standardized item loading was “pains in chest” on the somatization factor (estimate=0.52, SE=0.04), and the strongest was “blue” on the depression factor (estimate=0.89, SE=0.01). The loadings of the three factors onto global psychological distress were 0.82 (SE=0.02) for somatization, 0.87 (SE=0.02) for depression, and 0.97 (SE=0.02) for anxiety.

Sensitivity Analysis

Despite the general good fit of the final CFA structure selected, the model still had a significant χ^2_M exact-fit test. This test is thought to be overly sensitive to sample size—tests can be significant despite minor discrepancies when the sample size is large [32,35]. However, it is still worth discussing possible areas of misfit, such as sample heterogeneity [32]. Importantly, modification indices did not suggest adding error covariances to the model as a way to improve model fit.

In this sample of patients seeking care at the Movement Disorders Center, a small number (n=40) had cognitive impairment; however, cognitive status was unavailable for 36

individuals due to a missing MMSE score [40]. The majority of patients (n=634) self-completed all questionnaires, 293 had co-completed questionnaires, three had proxy completed questionnaires, and 137 did not record who completed the questionnaires. The co-completer was most often the patient's spouse. PD patients with dementia or mild cognitive impairment report higher levels of neuropsychiatric problems than those without cognitive impairment [41]. Questionnaires completed by caregivers or caregivers and patients together show worse health-related quality of life than questionnaires completed by patients alone [42,43]. Consequently, a sensitivity analysis was conducted with a second, restricted sample (n=406) that included only patients who were cognitively intact (MMSE 24) and who completed all questionnaires without assistance [44].

In this restricted sample, patients were younger, more educated, had less severe PD, and were less likely to have clinically significant psychiatric problems than the original sample. An identical pattern was seen with respect to fit thresholds and improvement in fit. Similar to the original sample, the second-order three-factor model was chosen for the restricted sample. Compared to the original sample, there was a slight improvement in RMSEA and a slight worsening in the TLI and CFI for the restricted sample model. However, there was a drastic improvement in χ^2_M from $\chi^2=503.864$ (df=132, $p<0.0001$) in the original sample to $\chi^2=284.448$ (df=132, $p<0.0001$) in the restricted sample. Because patient-reported outcomes are affected by cognitive status and by proxy-reporting [41-43], the factor structure of the BSI-18 had better fit in the sensitivity analysis when applied to the more homogeneous sample of cognitively intact patients who completed questionnaires without assistance.

Discussion

In this study of PD patients, distress due to somatization, depression, and anxiety symptoms were quite common with mean T-scores in the 50's; 22.5%, 15.4%, and 15.0% of patients had T-scores above the clinically significant threshold for these three entities, respectively. Several studies have documented that the prevalence of psychiatric disorders in PD patients is much higher than the rates we found; for example, one PD study using the SCL-90-R found prevalences of somatization, depression, and anxiety symptoms of 56%, 47%, and 46%, respectively [45]. An additional study found 38% prevalence of depressive symptoms and 20% prevalence of anxiety symptoms among older PD patients with, on average, more advanced disease [41]. However, these two studies only looked at the prevalence of symptom endorsement, not necessarily high levels of symptom endorsement. Using validated thresholds from the BDI and BAI, one prior study from a comparable sample found clinically significant depressive symptoms among 36% of PD patients and clinically significant anxiety symptoms among 33% of patients [4]. More consistent with our study, a study conducted by Bugalho et al. [46] using the SCL-90-R in patients in the early stages of PD found that 24%, 13%, and 10% of patients had clinically significant somatization, depression, and anxiety, respectively. The Bugalho et al. [46] study sample was similar to our study sample and used the measure from which the BSI-18 is derived.

This study also demonstrated that the previously reported factor structure of the BSI-18 holds in a diverse population of PD patients at a tertiary care center [7]. The best model findings in this study are similar to those of Petkus et al. [16] in a study of older adults,

Recklitis et al. [18] in a study of childhood cancer survivors, and Wang et al. [20] in a study of adult, Chinese methamphetamine drug users. As in these other studies, the second-order three-factor model had a large improvement in fit, compared to the one-factor model. In addition, there was only slight improvement in the second-order four-factor model, compared to the second-order three factor model, which did not outweigh the loss of parsimony [16,18,20]. Although these other studies were conducted in different samples, the factor loadings are similar to those in this current study. One exception is that the item loadings for anxiety in PD in the current study are stronger than in older adults [16] and childhood cancer survivors [18], but weaker than in the Chinese sample [20]. Looking at the loadings for general psychological distress in PD, we found loadings in the full sample of 0.817 for somatization, 0.873 for depression, and 0.971 for anxiety. In the other studies, the somatization loading ranged from 0.79 to 0.98 [16,18,20], the depression loading ranged from 0.79 to 0.84 [16,18,20], and the anxiety loading ranged from 0.74 to 0.98 [16,18,20]; loadings were most similar between PD and older adults [16]; this finding is consistent with the older age distribution of the PD sample.

Somatization was more common than other psychiatric symptoms (depression and anxiety) in this patient population. However, somatization, although a distinct factor, highly correlates with depression ($r=0.713$) and anxiety ($r=0.793$). There is also a strong overlap of somatization with depression and anxiety in non-PD patients [47]. The National Institutes of Health have recently sponsored the development of new, self-reported health tools as part of the Patient Reported Outcomes Measurement Information System (NIH PROMIS®). Currently, the emotional distress measure of PROMIS® only includes anxiety, depression, and anger [48]. Although there is large overlap with somatization, it will be important to ensure, through validation studies, that the unique contributions of somatization to patient mental health, or psychological distress, are not lost with such newer tools.

This study is subject to several limitations. The study was restricted to consenting patients who filled out the BSI-18. Selection bias may exist if those that consented and filled out the BSI-18 were inherently different than patients at the Center who did not fill out the form or did not consent to participate in the Center's database. Over 75% of patients consented to the database; furthermore, independent samples pooled t-tests and chi-square tests were used to determine if there were any significant differences in socio-demographics or clinical characteristics between those who enrolled and completed versus did not complete any of items of the BSI-18. The only significant difference between ($p<0.05$) the two groups was that non-completers were significantly more likely to be non-white. It is unclear what effect this differential completion by race would have on study results, especially given that the study has a fairly homogeneous sample. Generalizability may be limited as PD patients who seek care at a tertiary, specialty care center may not represent the larger population of PD patients. Despite these potential limitations, this study was able to examine the factor structure of the BSI-18 in a novel disease population of sufficient sample size.

Future studies should examine whether any differences exist in the CFA factor structure by PD sub-groups. Specifically, it may be important to determine whether any differences exist in the factor structure between males and females. Females with PD typically report greater psychiatric symptoms [45]. Recklitis et al. [18] found similar factor structures for male and

female childhood cancer survivors. However, studies in pediatric populations may not match those in an older adult population.

The literature on the sensitivity and specificity of the BSI-18 is inconsistent, which raises concerns about the validity of the instrument, separate from construct validity [10,16]. This concern is highlighted by the conflicting prevalence of clinically significant anxiety and depression found in studies using the BSI-18 or SCL-90-R versus the BAI and BDI [4,46]. Additionally, in PD, it can be difficult to separate psychological distress, including somatization, from disease symptomatology [45,47,49,50]. Due to the pathology of PD, patients often develop non-motor symptoms including sleep disorders, autonomic symptoms (e.g., orthostatic hypotension), and gastrointestinal symptoms (e.g., nausea) [51]. Several of these symptoms overlap with items on the BSI-18. In one study of PD patients, 33% reported dizziness and 9.4% reported nausea; in this study, 34% and 24% were at least a little bit bothered by dizziness and nausea, respectively [52]. Consequently, future studies should examine the sensitivity and specificity of the BSI-18 as a screening tool for psychiatric diagnoses among PD patients. Such studies can inform whether the T-score cutpoint used to indicate clinically significant psychological distress should be increased, due to symptom overlap, or lowered, as it is for cancer survivors [53].

Based on the results of this study, among PD patients, the BSI-18 questionnaire adheres to the anticipated factor structure developed by Derogatis [7]. This finding lends further support for the BSI-18 as an appropriate screening tool for psychiatric conditions in PD patients. This study also demonstrates that somatization is a particularly important component of psychological distress that is important to capture in PD patients.

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Highlights

- The factor structure of the BSI-18 was tested in Parkinson disease patients.
- Psychological distress due to somatization was the most prevalent.
- The originally proposed second-order three-factor structure was validated.

Table 1
Distribution of individual BSI-18 items for PD patients (n=1067)

Factor/Items	Mean	Variance	Median	IQR	Missing
Somatization					
Faintness	0.49	0.64	0.00	1.00	6
Chest pains	0.17	0.27	0.00	0.00	9
Nausea	0.35	0.55	0.00	0.00	8
Shortness of breath	0.32	0.47	0.00	0.00	12
Numb or tingling	0.90	1.18	1.00	1.00	15
Body weakness	1.33	1.41	1.00	2.00	8
Depression					
No Interest	0.68	0.89	0.00	1.00	12
Lonely	0.56	0.80	0.00	1.00	10
Blue	0.75	0.90	0.00	1.00	10
Worthlessness	0.47	0.72	0.00	1.00	10
Hopelessness	0.68	1.05	0.00	1.00	11
Suicidal thoughts	0.11	0.17	0.00	0.00	8
Anxiety					
^a Nervousness	1.12	1.22	1.00	2.00	8
^a Tense	1.04	1.06	1.00	2.00	10
^b Scared	0.29	0.54	0.00	0.00	9
^b Panic episodes	0.27	0.52	0.00	0.00	8
^a Restlessness	0.56	0.87	0.00	1.00	14
^b Fearful	0.52	0.76	0.00	1.00	10

IQR, Interquartile Range

^a General anxiety items

^b Panic items

Table 2
Parkinson disease patient demographics, clinical characteristics, and Brief Symptom Inventory-18 T-scores (n=1067)

Variable	Mean (SD)	n (%)
Demographics		
Age in years	65.3 (10.85)	
Sex (missing: 60)		
Male		598 (61.8)
Race (missing: 123)		
White		863 (91.4)
Black		39 (4.1)
Other or Refused		42 (4.4)
Education Level (missing: 146)		
High School or Below		266 (28.9)
College, Some College, or Trade School		352 (38.2)
Graduate Degree		303 (32.9)
Clinical Characteristics		
H&Y (missing: 137)	2.3 (0.90)	
UPDRS Total (missing: 162)	40.6 (20.0)	
CIRS-G count (missing: 167)	3.0 (1.82)	
MMSE (missing: 369)	28.3 (2.69)	
BSI-18 T-scores (missing: 101 ^a)		
Global Psychological Distress	53.4 (9.39)	
Somatization	54.6 (8.52)	
Depression	50.8 (9.71)	
Anxiety	52.1 (9.83)	
BSI-18 T-scores 63 (missing: 101 ^a)		
Global Psychological Distress		181 (18.74)
Somatization		217 (22.46)
Depression		149 (15.42)
Anxiety		160 (15.00)

H&Y, Hoehn and Yahr stage; UPDRS, Unified Parkinson's Disease Rating Scale; CIRS-G, Cumulative Illness Rating Scale-Geriatrics; MMSE, Mini-Mental State Examination, BSI-18 Brief Symptom Inventory

^aDue to insufficient items completed or missing sex data at time of calculation

Table 3
Comparison of fit for competing CFA models treating Brief Symptom Inventory-18 items as ordered categorical (n=1067)

Fit Indices	CFA Model			
	1-Factor	^a First-Order 3-Factor	^a Second-Order 3-Factor	First-Order 4-Factor Second-Order 4-Factor
χ^2_M	1,044.861	503.864	503.864	410.432 418.380
df	135	132	132	129 131
p-value	<0.0001	<0.0001	<0.0001	<0.0001 <0.0001
RMSEA	0.079	0.051	0.051	0.045 0.045
90% CI	0.075, 0.084	0.047, 0.056	0.047, 0.056	0.040, 0.050 0.041, 0.050
CFI	0.941	0.976	0.976	0.982 0.981
TLI	0.933	0.972	0.972	0.978 0.978

^aEquivalent models

Table 4
Standardized second-order three-factor CFA model parameter estimates (n=1067)

Factor/Items	Estimate	SE	p-value
Somatization			
Faintness	0.624	0.031	<0.01
Chest pains	0.523	0.044	<0.01
Nausea	0.625	0.034	<0.01
Shortness of breath	0.714	0.031	<0.01
Numb or tingling	0.549	0.030	<0.01
Body weakness	0.726	0.025	<0.01
Depression			
No Interest	0.772	0.018	<0.01
Lonely	0.815	0.016	<0.01
Blue	0.894	0.011	<0.01
Worthlessness	0.860	0.014	<0.01
Hopelessness	0.865	0.013	<0.01
Suicidal thoughts	0.701	0.038	<0.01
Anxiety			
^a Nervousness	0.718	0.020	<0.01
^a Tense	0.796	0.016	<0.01
^b Scared	0.850	0.019	<0.01
^b Panic episodes	0.853	0.019	<0.01
^a Restlessness	0.692	0.024	<0.01
^b Fearful	0.825	0.017	<0.01
Psychological Distress			
Somatization	0.817	0.022	<0.01
Depression	0.873	0.017	<0.01
Anxiety	0.971	0.016	<0.01

^aGeneral anxiety items

^bPanic items