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Evaluation of the reliability, validity, and predictive validity of the subscales of the Perceived Stress Scale in older adults

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Abstract

Background—The Perceived Stress Scale (PSS) is made up of two subscales but is typically used as a single summary measure. However, research has shown that the two subscales may have differential properties in older adults.

Objective—To evaluate the internal consistency, test-retest reliability, and the concurrent and predictive validity for development of aMCI of the positively-worded (PSS-PW) and negatively-worded (PSS-NW) subscale scores of the PSS in older adults.

Methods—We recruited community residing older adults free of dementia from the Einstein Aging Study. Reliability of the PSS-PW and PSS-NW was assessed using Cronbach's alpha for internal consistency and intraclass correlation for one year test-retest reliability. Concurrent validity was evaluated by examining the relationship between the PSS subscales and depression, anxiety, neuroticism, and positive and negative affect. Predictive validity was assessed using multivariate Cox regression analyses to examine the relationship between baseline PSS-PW and PSS-NW score and subsequent onset of aMCI.

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Results—Both PSS-PW and PSS-NW showed adequate internal consistency and retest reliabilities. Both the PSS-PW and PSS-NW were associated with depression, neuroticism, and negative affect. The PSS-NW was uniquely associated with anxiety while the PSS-PW was uniquely associated with positive affect. Only the PSS-PW was associated with a statistically significant increased risk of incident aMCI (HR=1.27; 95% CI: 1.06–1.51 for every 5 point increase in PSS-PW).

Conclusions—Evaluating the separate effects of the two PSS subscales may reveal more information than simply using a single summation score. Future research should investigate the PSS-PW and PSS-NW as separate subscales.

Keywords

adult; cohort study; dementia; reproducibility of results; psychological stress; cognitive dysfunction

Introduction

Perceived stress occurs when environmental demands exceed an individual's ability to cope with them [1]. One of the most frequently used measures of perceived stress is Cohen's Perceived Stress Scale (PSS) [2]. High scores on the PSS have been associated with a variety of adverse outcomes including but not limited to cognitive decline [3], depression [4], pain [5] and poor wound healing [6]. The PSS a 14-item questionnaire that evaluates perceived stress over the last four weeks and is made up of seven positively worded questions (PSS-PW) and seven negatively worded questions (PSS-NW). An example of a negative item is "How often have you felt nervous and stressed?" and an example of a positive item is "How often have you felt that things were going your way?" Studies have found a two factor structure with Cronbach alphas ranging from 0.75 to 0.91 [1,7,8,9].

Even though a two factor solution has been consistently found in the literature, the total PSS score is used in the vast majority of studies to evaluate perceived stress in both younger and older adults [1,3,7,9,10]. Though many studies reporting modest correlations between the PSS subscales, very few have evaluated the subscales of the PSS separately [11,12,13,14,15]. Studies assessing the 14-item PSS (PSS-14) in younger adults found these subscales to be moderately correlated with each other (correlations range from −0.26 to −0.54) [11,16,18].

In older adults, correlations between the two subscales are not as strong (correlations range from −0.08 to −0.28) [10,18], suggesting they may capture different information in older adults. Older adults may respond to stress and perceive stress differently from younger adults. Some studies suggest that older adults report fewer stressful events than younger adults [19,20]. Older adults use different coping mechanisms than their younger counterparts and possibly perceive their environment as less secure [21]. While the concurrent validity of the total PSS has been established [2,10], the concurrent validity of the PSS subscales has not been adequately investigated. In this study, we investigate whether one or both PSS subscales measure stress by examining their relationship with other measures that have been correlated with stress (anxiety, neuroticism, depression, and positive and negative affect).

Additionally, stress is an important area of study because stress has been linked to cognitive decline in older adults [3]. Dementia is a major cause of morbidity and mortality in older adults [22] and amnestic Mild Cognitive Impairment (aMCI) is a transition state between normal cognition and dementia [23]. Individuals with aMCI develop dementia at an increased rate (10–15% per year) [24]. Therefore it is important to help clarify the role of stress in the development of aMCI. In a prior study, higher PSS scores were associated with an increased risk of developing aMCI [3]. However, the subscales of the PSS were not tested. We found that baseline PSS-PW score, but not baseline total PSS score nor PSS-NW score, was significantly associated with the development of dementia in a population of older adults with aMCI [25]. However, the ability of the two PSS subscales to predict incident aMCI is unknown.

In this study, we will evaluate the reliability of the PSS-PW and PSS-NW and test their validity. The concurrent validity was evaluated by examining the relationship of PSS-PW and PSS-NW with depression, anxiety, neuroticism, and positive and negative affect. Predictive validity for evaluating cognitive decline will be established by assessing the role of the PSS-PW and PSS-NW in predicting the development of aMCI.

Methods

Participants

Participants were enrolled in the Einstein Aging Study, which enrolled of adults over the age of 70 in a prospective longitudinal observational study. Further information regarding the EAS, including detailed study design and methods can be found elsewhere [26]. Participants were systematically recruited by sampling New York City voter registration and Medicare lists for Bronx County, New York. Eligibility criteria included that the participants be non-institutionalized, ambulatory, English speaking residents of the Bronx, New York. Exclusion criteria included visual or auditory impairments or psychiatric symptoms that would interfere with their ability to complete study assessments.

Study Design

In-person evaluations were completed by trained research assistants at our clinical research center in Bronx County, NY. These evaluations were administered at baseline and then subsequently at 12-month intervals. Informed consent was obtained at the first visit. Further information regarding the details of the EAS demographic, psychosocial, neurological, and neuropsychological assessments can be found elsewhere [26]. The PSS was added to the EAS battery in 2006 and was since been administered at annual evaluations. Other papers using this data have been published [3,5,10]. EAS participants received no monetary compensation, however, they were given lunch as compensation for their time. The above study protocol was approved by the local institutional review board.

Outcome Measures

aMCI—aMCI was diagnosed using criteria developed by Peterson et al [27]. The three key features are: no current diagnosis of dementia, subjective memory complaints, and objective memory complaints. The last of these criteria was assessed using the immediate Free Recall

score from the Free and Cued Selective Reminding test [28] or immediate recall on the Logical Memory I Test [29].

The Free and Cued Selective Reminding test (FCSRT) is a neuropsychological test of verbal memory [28]. In this test, sixteen drawings of commonly recognizable objects are shown to the participants who are asked to name them. The free recall score is calculated by tallying the number of items recalled without prompting in 3 separate trials. Scores range from 0–48 with higher numbers indicating better memory. A cut score of 24 was 1.5 standard deviations below the mean and was found to identify persons with aMCI who developed new onset dementia at an elevated rate [30].

The Logical Memory I subtest from the Wechsler Memory Scale [29] was also utilized to measure verbal memory. Participants are read two short stories and then asked to immediately recall as many details as possible. Individuals receive a score ranging from 0–50.

Dementia—Dementia was diagnosed at case conference attended by a neurologist and neuropsychologist. The diagnosis was made according to the standardized clinical criterial in the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM IV) [31]. A comprehensive review of cognitive test results, relevant neurological signs and symptoms, and functional status informed the diagnosis. The lattermost criteria was assessed based on self or informant report, clinical evaluation, and questionnaires. A detailed description of this process can be found elsewhere [26].

Primary Predictor: Perceived Stress—The 14 item PSS [2] is an assessment of perceived stress that was administered at baseline and at every subsequent 12 month visit. Each item was rated on a five point Likert-type scale that ranged from 0 (never) to 4 (very often) assessing stress over the last month. Six out of the fourteen items of PSS-14 are negatively worded (Items 1, 2, 3, 8, 11, 14) and seven are positively worded (Items 4, 5, 6, 7, 9, 10, 13). Item 12 was considered neither positively nor negatively worded because it did not load well onto either factor and was excluded in this study [10]. This validation study was performed using older adults from the EAS.

Total scores (PSS-TOT) are calculated after reversing the scores of the positively worded items and then summing all items. PSS-TOT scores included item 12 and scores ranged from 0–56 with higher scores corresponding to more perceived stress. The positively worded subscale (PSS-PW) score was determined after reversing the scores of the positively worded items and then summing all scores; PSS-PW scores ranged from 0 to 28 with high scores indicating more stress and less endorsement of positively worded statements. The negatively worded subscale (PSS-NW) score was calculated by summing the score for the negatively worded items. PSS-NW scores ranged from 0 to 24. Item 12 was excluded from both the PSS-PW and PSS-NW scores. Good internal consistency was found for the PSS-PW (α = 0.84) and adequate for the PSS-NW (α = 0.78) [10].

Independent Covariates

Demographics—Gender, race, and years of education were self-reported at the first visit. Age was calculated from self-reported birth date.

Depression—Depressive symptoms were assessed with the Geriatric Depression Scale (GDS) [32]. The GDS is a 15-item scale which elicits responses of either “yes” or “no” for how the participant felt over the past week with scores ranging from 0–15. Higher scores indicate greater depressive symptomatology, with a score of 6 or greater being classified as having depressive symptoms [33]. A cut off score of 6 was found to have high sensitivity (0.97) and specificity (0.96) in a study of Japanese older adults. Overall, the GDS has good reliability (α=0.80) [34] and was associated with depression defined by DSM-IV and International Classification of Diseases [33]. Our analyses utilized baseline GDS scores.

Beck Anxiety Inventory—The Beck Anxiety Inventory (BAI) [35] is used to measure anxiety. It is a 21-item scale with scores ranging from 0 to 63, where higher scores indicate more anxiety symptoms over the past month. The BAI has demonstrated good reliability (α = 0.88) and correlates well with other measures of anxiety [36].

NEO Personality Inventory Revised—The NEO Personality Inventory Revised (NEO-PI-R) used to assess neuroticism, extroversion, openness to experience, agreeableness, and conscientiousness [37]. It is a 60-item questionnaire with 12 questions pertaining to each of the five personality traits. Every item is answered based on a Likert scale of five options that range from “totally disagree” to “totally agree”. Each personality dimension has a range of 0 to 48 points based on participant responses. The NEO-PI-R has adequate reliability (α ranging from 0.70 to 0.90) and showed correlations with their respective Personality Assessment Inventory validity scales [38].

Positive and Negative Affect Schedule—The Positive and Negative Affect Schedule (PANAS) measures mood or general affect [39]. It consists of 10 questions that assess positive affect traits, such as interested, excited, and enthusiastic, and 10 negative affect traits, such as distressed, upset, and irritable. Scores for both positive and negative affect range from 10 to 50. These scales have good reliability (α = 0.89 for positive affect and α = 0.85 for negative affect) and correlate with depression and anxiety as predicted by the tripartite theory [40].

Blessed Information Memory Concentration Test—The Blessed Information Memory Concentration Test (BIMC) evaluated global cognitive status [41] . BIMC scores range from 0–33. Higher scores indicate greater global cognitive impairment. The BIMC has been demonstrated to be valid (α=0.92) [42] and has also been shown to correlate well with clinical dementia and the presence of plaques in the cerebral gray matter [43].

Data analysis

The PSS-PW and PSS-NW scales were assessed with regard to their internal consistency, one year test-retest reliability, concurrent validity, and predictive validity. Cronbach’s alpha was employed to assess their internal consistency. One year test-retest reliability was

assessed using the intraclass correlation. Concurrent validity was determined using Spearman's correlations to evaluate the relationships between PSS-PW and PSS-NW scales and depression, anxiety, neuroticism, and PANAS. Finally, predictive validity was measured by determining if baseline PSS-PW and PSS-NW scores differentially predict the development of aMCI.

Kaplan-Meier survival curves were fit to visualize the distributions of time to development of aMCI. For this purpose, the subjects were subdivided into two groups for each subscale score. "High" and "low", with high corresponding to the upper half of the PSS subscales and low representing the lower half of the PSS subscales. The statistical significance between these groups was evaluated using the logrank test.

Cox proportional hazard models were used to examine the association between PSS-PW and PSS-NW and the development of aMCI. Years of follow-up served as the time scale and were calculated beginning with the participant's baseline visit to either the final follow-up examination, incidence of aMCI, or death, whichever occurred earliest. The proportional hazards assumption was tested using sums of weighted residuals. Cox models were used to estimate the magnitude of the association of incident aMCI as a function of PSS score, gender, age, education, BIMC score, and GDS score. For these analyses, three models were employed: Model 1 used PSS-PW as the predictor of interest; Model 2 used PSS-NW; Model 3 used both PSS-PW and PSS-NW as predictors. All analyses were conducted in Stata, version 12 (College Station, Texas).

Results

Baseline demographics

663 participants of the EAS were cognitively normal at the time they first completed the PSS. The mean age at baseline was 79.2 years (SD = 5.3). 65.0% of the sample were women and 64.9% were white. Sample demographics are presented in Table 1. Of this sample, 100 participants (15.1%) went on to develop incident aMCI.

Internal consistency reliability analysis

The internal consistency reliability coefficients as measured by Cronbach's alpha were 0.85 for the PSS-PW and 0.83for the PSS-NW. The overall PSS had an alpha of 0.83. We also used intraclass correlation to measure longitudinal stability over one year. The PSS-PW had an intraclass correlation of 0.49 (95% CI: 0.45–0.53). The PSS-NW had an intraclass correlation of 0.55 (95% CI: 0.51–0.59). The overall PSS had an ICC of 0.62 (95% CI: 0.58–0.65).

Construct validity

To assess the external validity of the PSS-PW and PSS-NW subscales, we investigated the correlation between these subscales and other demographic and psychological measures (Table 2). The PSS-PW and PSS-NW were correlated with each other ($r = 0.25$, $p < 0.001$). We found that higher PSS-PW scores significantly correlated with increased age ($r = 0.21$), fewer years of education ($r = -0.18$), higher GDS score ($r = 0.29$), more neuroticism on the

NEO-PI-R (r = 0.51), lower positive affect (r = −0.37) and higher negative affect (r = 0.14), and higher BIMC scores (r = 0.13). However, the magnitude of the associations were weak for PANAS negative and BIMC scores. Higher PSS-NW scores were significantly associated with increased GDS scores (r = 0.29), higher BAI (r = 0.32), more neuroticism (r = 0.58), higher negative affect (r = 0.54), and higher BIMC scores (r = 0.10), though the magnitude of the associations were weak for BIMC score. The overall PSS was significantly associated with all the demographic and neuropsychological measures except years of education.

Predictive Validity

Kaplan-Meier curves were generated to visualize the difference in the distributions of the time to incident aMCI between the high PSS-PW and low PSS-PW groups and high PSS-NW and low PSS-NW groups (Figure 1). The higher PSS-PW group had a shorter time to aMCI onset ($p < 0.001$) compared to those with lower PSS-PW scores. There was no difference in the time to aMCI onset between those with high PSS-NW scores and those with low PSS-NW scores (p=0.660).

Adjusted relationship of stress with incident aMCI

To determine if PSS-PW and PSS-NW were independently related to an increased risk of developing aMCI after adjusting for potential confounders, we fit a series of proportional hazard models (Table 3). In all models, we controlled for baseline demographics (age, sex, race, and education) and potential confounders (depressive symptoms and baseline cognitive status). In Model 1 the predictor of interest was PSS-PW, in Model 2 it was PSS-NW, and in Model 3 both PSS-PW and PSS-NW were included in the same model.

In Model 1, significant predictors of time to aMCI included PSS-PW (HR=1.27; 95% CI: 1.06–1.52; p=0.009 for a 5 point change in PSS-PW) (range 0–28), increased age (HR=1.07; 95% CI:1.03–1.12; p<0.001), and higher BIMC score (HR=1.12; 95% CI:1.01–1.25; p=0.033). In Model 2, PSS-NW (HR=0.97; 95% CI:0.77–1.22; p=0.768 for a 5 point change in PSS-NW) (range 0–24) was not associated with time to aMCI; older age (HR=1.08; 95% CI:1.04–1.12; p<0.001) and higher BIMC scores (HR=1.13; 95% CI:1.02–1.26; p=0.023) predicted time to aMCI. In Model 3, we added PSS-NW to Model 1; this did not affect the association of PSS-PW with increased risk for aMCI (HR=1.27; 95% CI:1.06–1.52; p=0.009 for a 5 point change in PSS-PW). Older age (HR=1.07; 95% CI:1.03–1.11; p<0.001) and higher BIMC score (HR=1.13; 95% CI:1.01–1.26; p=0.029) were also significantly associated with aMCI. High PSS-NW was not significantly associated with aMCI in any model. These analyses were repeated using PSS-PW and PSS-NW dichotomized at the mean and the results were similar (results not shown). Again, the PSS-PW (HR = 1.65, p = 0.022 for the equivalent of Model 1, HR = 1.67, p = 0.020 for the equivalent of Model 3) significantly predicted the incident aMCI and the PSS-NW (HR = 0.98, p = 0.939 for the equivalent of Model 2, HR = 0.91, p = 0.676 for the equivalent of Model 3) did not.

Discussion

In this study, we tested the internal consistency, one year retest stability, concurrent validity, and predictive validity of evaluating the PSS as separate subscale scores in older adults. The

PSS-PW (α = 0.85) and PSS-NW (α = 0.83) showed good internal consistency reliability in older adults. Both subscales correlated with depressive symptoms, neuroticism, negative affect, and baseline cognitive status. Only the PSS-PW correlated with positive affect; only the PSS-NW correlated with anxiety. Finally, the PSS-PW, but not the PSS-NW, significantly predicted incident aMCI (HR=1.27; 95% CI:1.06–1.52; p=0.009 for a 5 point change in PSS-PW) after adjusting for age, sex, white race, years of education, depressive symptoms, and baseline cognitive status. These results were robust and were significant when viewing the PSS-PW as both a continuous and dichotomous variable.

Previous studies validating the PSS-14 in a variety of populations, including older adults, have found a two factor solution [2,10,16]. Despite this, very few evaluate the PSS-PW and PSS-NW separately from the total PSS score. Previous research has found Cronbach's alphas for the PSS-PW ranging from 0.72–0.83 [11,16,17]. Cronbach's alphas for PSS-NW range from 0.80–0.86 [11,16,17], very similar to the present. To our knowledge, no study has correlated the separate subscales of the PSS with other measures of stress and affect. The overall PSS scale has been associated with neuroticism, depression, positive and negative affect, and anxiety in previous studies [4,10]. Both the PSS-PW and PSS-NW were associated with depressive symptoms and neuroticism. Studies have found that stress is associated with both of these things [4,44]. This suggests that both subscales are measuring stress.

The results of our test of the clinical validity of the PSS-PW and PSS-NW is consistent with the literature. We have previously found that the PSS-PW, but not PSS-NW, predicted incident dementia in an older population with aMCI [25]. Katz et al found that the overall PSS predicted incident aMCI using the EAS sample [3].

The current study adds to a growing literature suggesting that evaluating the PSS positively and negatively worded items as separate subscales has both psychometric and clinical advantages. Hewitt et al [11] writes that the PSS-NW resembles general distress, since most of the negatively worded items refer to emotions such as nervousness, anger, or being upset. Only one item asked about feeling a loss of control. On the other hand, the PSS-PW items generally reflect a perception of being able to cope. Taylor found that the two subscales correlated differently to the Perceived Helplessness Subscale in men and women [45]. Finally, a dental study found that the PSS-PW, but not PSS-NW, differentially predicted tooth loss [12]. This adds to our findings that the PSS-PW and PSS-NW have different properties and suggests that it is more appropriate to view the two subscales separately instead of as a total summation score.

It is possible that the two PSS subscales measure different constructs particularly in older adults. We found that only the PSS-PW correlated with PANAS positive affect and that the correlation was relatively large (r = −0.37). The PSS-NW correlated much more strongly with PANAS negative affect (r = 0.54 for PSS-NW vs r = 0.14 for PSS-PW). It is possible that a lack of positive affect is associated with different types of stress and coping mechanisms than those associated with large amounts of negative affect. Another explanation for these results is that these associations are due to the wording of the questions. Both the PSS-PW and PANAS positive affect are made up of positively worded

items and both the PSS-NW and PANAS negative affect are made up of negatively worded items. While this is certainly a possibility, it wouldn't explain the differential predictive validity of the two subscales.

A study evaluating the PSS in cancer patients [15] suggest that positively worded items tap into positive emotions, feelings of confidence, and ability to handle stressors. The authors of this paper suggest that the PSS-PW may measure coping while the PSS-NW measures the severity of a stressor. This is consistent within the framework of Lazarus's transactional model of stress [1]: stress occurs due to an imbalance between the demands of a stressor and the resources of the individual to deal with the stressor. Therefore, stress has two components: the perceived demands of the stressor and perceived coping ability. It is possible that the PSS-PW measures the ability to cope with stress while the PSS-NW measures an individual's perceived distress. In the current paper, we chose to label the subscales as PSS-PW and PSS-NW to avoid premature characterization of the construct measured by each subscale. Future research should determine the construct validity of the PSS subscales by comparing them to measures of coping mechanisms, stress appraisal, and coping appraisal.

The PSS has several advantages compared to other measures of stress in older adults. It is brief and has been validated in several populations and languages [7,16,45,46]. Also, the PSS assesses the appraisal of stress, whereas life event scales can only measure objective external circumstances such as loss of a spouse or loss of a job. This is of particular importance in older adults because they tend to have fewer activities that could cause stress than younger adults. In fact, it is the non-occurrence of positive events, rather than having many negative events, that most frequently cause stress in older adults [47]. Therefore, understanding the structure of the PSS in older adults is an important area for future research.

One limitation of our findings on predictive validity is the problem of reverse causality. It is possible that decreased cognitive function caused the increase in perceived stress. First, the baseline PSS was measured at least a year before the onset of aMCI. If cognitive impairment caused increased stress, adjustment for baseline cognitive status (i.e., BIMC) would substantially attenuate the effect of stress but it does not. This makes it unlikely that the reverse causality hypothesis is true.

Our study also has a number of strengths. The EAS is a community based, racially diverse, longitudinal study that consistently uses well established procedures for establishing cognitive status. The PSS is brief and has been psychometrically validated in the EAS population [10].

The PSS has commonly been used to evaluate the effectiveness of stress reduction interventions in a variety of populations [48,49,50,51]. Interventions designed to reduce stress include meditation, mindfulness based stress reduction, yoga, to name a few [48,49,50,51]. All of these studies have used total PSS scores as a primary outcome, but is possible that it would be better to measure perceived stress as PSS-PW and PSS-NW subscales instead of a total score. Future studies should examine the effectiveness of these

interventions in reducing PSS-PW. Furthermore, future studies should examine the differential effectiveness of interventions focused on increasing coping ability (eg. stress management training, cognitive behavioral therapy) and those focused on decreasing distress (eg. dialectic behavior therapy) on PSS subscales.

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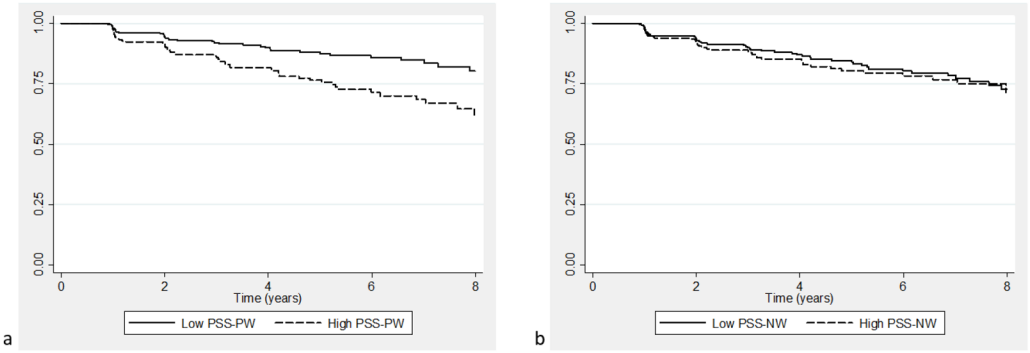

Figure 1. Cumulative probability of remaining free of aMCI

Cumulative probability of remaining free of aMCI in a.high PSS-PW and low PSS-PW, and b.high PSS-NW and low PSS-NW groups. (High is defined as the upper half of the sample and low is defined as the lower half of the sample)

Table 1

Baseline Characteristics of the study population (N = 663)

Variable		Status at Final Follow-up		P value
	Total N = (663)	Normal (N = 563)	aMCI (N = 100)	
Age	79.2 (5.3)	78.8 (5.1)	81.0 (5.7)	<**0.001**
% Female	65.0	64.3	69.0	0.364
Race				0.737
% White	64.9	65.2	63.0	
% Black	28.2	27.9	30.0	
% Other	6.9	6.9	7.0	
Education Years	14.3 (3.4)	14.4 (3.4)	13.9 (3.3)	0.144
GDS score	2.0 (2.1)	1.9 (2.0)	2.4 (2.5)	0.165
BIMC	1.8 (2.0)	1.7 (1.9)	2.0 (2.1)	0.101
Follow up time	3.8 (2.6)	3.9 (2.6)	3.2 (2.4)	**0.024**
PSS-14 Score	18.9 (7.8)	18.6 (7.8)	20.8 (7.6)	**0.008**
PSS-PW	9.4 (5.4)	9.0 (5.2)	11.5 (6.1)	<**0.001**
PSS-NW	7.0 (4.4)	7.0 (4.3)	7.2 (4.5)	0.704
BAI	4.0 (4.7)			
Neuroticism	20.7 (6.3)			
PANAS Positive	21.9 (7.7)			
PANAS Negative	7.1 (6.1)			

GDS, Geriatric Depression Scale (range 0–15); BAI, Beck Anxiety Inventory (range 0–63) N = 246; Neuroticism trait of the NEO Personality Inventory Revised (range 0–48); PANAS, Positive and Negative Affect Schedule (range 10–50); BIMC, Blessed Information Memory Concentration; PSS-14, 14 question version of the Perceived Stress Scale (range 0–56); PSS-PW, positively worded factor score of PSS (range 0–28); PSS-NW, negatively worded factor score of PSS (range 0–24)

Continuous variables shown as mean(SD)

Table 2

Correlations of PSS-PW and PSS-NW

Variable	PSS-PW		PSS-NW		PSS total	
	Corr	P value	Corr	P value	Corr	P value
Age	**0.21**	**<0.001**	0.03	0.430	**0.17**	**<0.001**
Education Years	**−0.18**	**<0.001**	0.03	0.422	−0.06	0.083
GDS score	**0.29**	**<0.001**	**0.29**	**<0.001**	**0.43**	**<0.001**
BAI	0.10	0.265	**0.32**	**<0.001**	**0.31**	**<0.001**
Neuroticism	**0.51**	**<0.001**	**0.58**	**<0.001**	**0.44**	**<0.001**
PANAS Positive	**−0.37**	**<0.001**	−0.07	0.157	**−0.40**	**<0.001**
PANAS Negative	**0.14**	**0.003**	**0.54**	**<0.001**	**0.52**	**<0.001**
BIMC	**0.13**	**0.001**	**0.10**	**0.015**	**0.08**	**0.024**

GDS, Geriatric Depression Scale (range 0–15); BAI, Beck Anxiety Inventory (range 0–63) N = 246; Neuroticism trait of the NEO Personality Inventory Revised (range 0–48) ; PANAS, Positive and Negative Affect Schedule (range 10–50); BIMC, Blessed Information Memory Concentration; PSS-14, 14 question version of the Perceived Stress Scale (range 0–56); PSS-PW, positively worded factor score of PSS (range 0–28); PSS-NW, negatively worded factor score of PSS (range 0–24)

Table 3

Cox models comparing PSS-PW and PSS-NW to predict aMCI adjusting for demographics

	Model 1		Model 2		Model 3	
	HR (95% CI)	**P value**	**HR (95% CI)**	**P value**	**HR (95% CI)**	**P value**
PSS-PW	**1.27 (1.06–1.52)**	**0.009**			**1.27 (1.06–1.52)**	**0.009**
PSS-NW			0.97 (0.77–1.22)	0.768	0.95 (0.75–1.19)	0.638
Age	**1.07 (1.03–1.12)**	**<0.001**	**1.08 (1.04–1.12)**	**<0.001**	**1.07 (1.03–1.11)**	**<0.001**
Female	1.02 (0.65–1.58)	0.939	1.05 (0.67–1.64)	0.832	1.03 (0.66–1.61)	0.886
White race	0.87 (0.56–1.37)	0.547	0.92 (0.58–1.46)	0.727	0.89 (0.56–1.41)	0.617
Education (years)	1.00 (0.94–1.06)	0.958	0.98 (0.92–1.04)	0.551	1.00 (0.94–1.06)	0.999
GDS score	1.37 (0.70–2.66)	0.354	1.83 (0.94–3.56)	0.076	1.43 (0.72–2.83)	0.309
BIMC score	**1.12 (1.01–1.25)**	**0.033**	**1.13 (1.02–1.26)**	**0.023**	**1.13 (1.01–1.26)**	**0.029**

*aMCI, amnestic mild cognitive impairment; PSS, Perceived Stress Scale; PSS-PW, a 5 point change in the positively worded factor of the PSS (range 0–28); PSS-NW, a 5 point change in the negatively worded factor of the PSS (range 0–24); GDS, Geriatric Depression Scale (range 0–15); BIMC, Blessed Information Memory Concentration test (range 0–33)