Persistent Pain Biases Item Response on the Geriatric Depression Scale (GDS): Preliminary Evidence for Validity of the GDS-PAIN

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Abstract

Objective—Differential item functioning (DIF) assesses the consistency of items on a metric across clinical samples in relation to the attribute being measured. We hypothesized that in older adults with persistent pain, items of the Geriatric Depression Scale (GDS) would evidence DIF based on presence or intensity of pain.

Design—Unidimensionality was determined by factor and item analyses. DIF was tested using Rasch Modeling. We then evaluated the psychometric properties of a revised GDS (GDS-PAIN), comprised of items that did not evidence DIF.

Patient and Settings—A total of 677 community dwelling older adults (age 65–91) participating in observational or treatment studies of low back or knee pain who endorsed at least moderate pain for at least 3 months. A total of 201 pain-free controls were included in the analysis.

Results—Ten of the 30 items displayed significant DIF. These items were: 1) dropping activities and interests; 2) bothered by persistent thoughts; 3) often get fidgety and restless; 4) prefer to stay home; 5) do not feel full of energy; 6) do not enjoy getting up in the morning; 7) mind is not as clear as it was, 8) feel life is empty; 9) feel more problems with memory; and 10) do not find life very exciting. The modified GDS-PAIN scale did not adversely affect the psychometric properties of the scale.

Conclusions—The performance of the GDS is affected by pain. When unstable items are removed, the revised GDS (GDS-PAIN) appears to be psychometrically stable and maintains both internal consistency and similar correlation values with a measure of pain as the original scale.

Keywords

Depression; Geriatric; Chronic Pain; Measurement

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Introduction

Depression is common in patients with persistent pain [1]. Rates of depression in mixed age patients with persistent pain are reported to be between 30% and 54% [2]. The co-occurrence of depression within medical populations, such as patients with persistent pain conditions, is associated with increased medical symptom reporting [3,4], worsened functional impairment [5], and increased mortality [6]. Older adults currently constitute more than 12% of the United States' population. In community-dwelling older adults, the prevalence of pain experienced every day for at least 3–6 months has been estimated to occur at rates of up to 50% [7]. Other studies have estimated that up to 70–85% of people aged 65 and older experience a significant health problem that predisposes them to persistent pain [8,9].

Distinguishing major depression from the symptoms of persistent pain can be challenging in older adults. In addition to the emotional and cognitive symptoms, clues to depression in older adults include the presence of somatic symptoms such as chronic fatigue, disturbed sleep, gastrointestinal disturbance [10,11], and anxiety [12]. These symptoms often are present in persistent pain patients, and may make accurate diagnosis and treatment planning challenging.

Measures of depression that were created for and validated in nonpain samples may perform differently when used with persistent pain patients. This may be especially true for older adults because of the effect persistent pain and other somatic complaints have on depression symptom reporting. In addition to somatic complaints, older adults with persistent pain may also express elevated fears about the future (i.e., not getting pain relief), feel helpless and hopeless about their situation [13,14], evidence impaired cognitive functioning [15-17], and report decreased self-esteem [18,19] and social isolation [20]. Like the somatic complaints of persistent pain, these symptoms overlap with depression.

Differential item functioning (DIF) provides an assessment of the consistency of items on a metric across different clinical samples in relation to the underlying attribute being measured [21,22]. DIF analysis can help to determine if test questions are appropriate for use in various clinical groups. Applying DIF is especially useful when evaluating an assessment tool that taps symptoms common to more than one condition, such as persistent pain and depression. This need for an understanding of how an individual's clinical state interacts with the measurement process is critical for purposes of case identification, diagnosis, and treatment planning.

We hypothesized that in a sample of older adults with persistent pain, certain items of the Geriatric Depression Scale (GDS) [23] would show evidence of DIF. We predicted that both the 1) presence of persistent pain and 2) intensity of pain would differentially affect the function of a group of items on the GDS.

Methods

Subjects

Subjects were 677 English-speaking community dwelling older adults (age 65–91). Pain was measured with the pain thermometer [24,25] and had to be of at least moderate intensity, more days than not, for at least 3 months of duration. The average length of time subjects were in pain was 12.8 years (N = 476). Subjects who were free of pain also were included in the analysis (N = 201). Pain-free status was defined as no pain or pain occurring less than once per week of little intensity as measured with the pain thermometer.

All subjects received a comprehensive medical, pain, and psychosocial evaluation as part of their participation in either: 1) a research study evaluating psychosocial and functional differences between older adults with and without chronic low back pain (N = 374) [26]; 2) a

clinical trial evaluating the efficacy of percutaneous electrical nerve stimulation (PENS) for low back pain in older adults (N = 215) [27]; or 3) a clinical trial evaluating the efficacy of periosteal electroacupuncture (osteopuncture) for knee pain in older adults (N = 88). All assessments were completed before any testing or treatment procedures were begun.

All subjects were cognitively intact, as determined by screening with the Mini Mental State Examination score [28] (mean = 28.5, SD = 1.5). Prior to their participation subjects signed informed consent, which was approved by the University of Pittsburgh Institutional Review Board. Subjects were recruited via newspaper and radio advertisements and fliers placed in senior centers and primary care clinics.

Screening occurred in two phases. The first phase occurred over the telephone (N = 2997), which was followed up on-site by one of the investigators (D.K.W.) with a structured history and physical examination (N = 1025). Exclusion criteria included cognitive impairment (Mini Mental State Examination [MMSE] < 24 adjusted for age and education), severe visual or hearing impairment, and acute illness or pain. The majority of subjects with pain reported the lower back as their primary pain site (73%), followed by knee pain (18%).

Subject demographics are shown in Table 1. The pain-free and persistent pain subjects were not significantly different with respect to age, gender, educational level, ethnicity, or marital status. However, compared with pain-free subjects, the pain subjects were found to have a significantly higher number of medical comorbidities as measured by the Cumulative Illness Rating Scale (CIRS) [29], and modestly lower MMSE scores. The GDS scores were significantly higher for the pain subjects (mean = 5.3, SD = 5.4) compared with the pain-free subjects (mean = 1.9, SD = 2.6).

Procedures

Depressed mood was assessed with the GDS [30], a brief self-report questionnaire both developed and normed for use with older adults. Patients are asked to respond yes or no to 30 questions about their mood state on the day of testing. The GDS has been shown to have excellent reliability and validity [31]. The alpha coefficient is 0.94, test–retest reliability 1 week apart is 0.85, and correlations with structured depression interviews are high (e.g., 0.83 with the Hamilton Rating Scale for Depression [30,32]).

Pain intensity was measured with the McGill Pain Questionnaire Short Form (MPQ-SF) [33] that has been validated in community dwelling older adults with chronic low back pain [34, 35].

The CIRS and MMSE were completed by one of the investigators (D.K.W.). The CIRS is a well-validated measure of comorbidity and was completed based on data that were collected during the structured history and physical examination. The MMSE [28] is a method widely used to screen for cognitive impairment, and it has been validated and normed for use in older adults [36].

Data Analyses

A requirement when applying item response theory (IRT) methods to data is that the items measure a dominant trait. For example, the items must be unidimensional enough to allow for the unbiased scaling of individuals on a common latent trait. We used three common approaches to evaluate whether the 30 items of the GDS are essentially unidimensional. These were: 1) internal consistency reliability; 2) item–scale correlations; and 3) factor analysis, which evaluated the size of eigenvalues via a scree plot to determine if most of the variance was accounted for by the first factor. IRT item parameters and model fit were evaluated with WINSTEPS [37], using a one-parameter IRT model. WINSTEPS is a psychometric computer

program that implements Rasch analysis, a method for obtaining objective, fundamental, linear measures from stochastic observations of ordered category responses. The software is very flexible and calculates item weights, processes a variety of rating scale formats, investigates dimensionality with principal components analysis of residuals, and analyzes item, person, and category model misfit. Item fit was assessed by examining the infit mean square statistic. The infit mean square statistic has an expected value of 1.0. If the infit mean square lies between 0.6 and 1.4 the item was considered to have a good fit [38]. Any item with an infit value <0.6 denotes "over-fit," which indicates a poorly discriminating item that makes little contribution to the overall scale scores. An infit value >1.4 denotes an item with unexpected variation and does not fit the Rasch model, which is an undesirable characteristic for forming a well-calibrated unidimensional scale. Assuring item fit is a necessary first step before testing for DIF.

After unidimensionality and item fit to the Rasch model were determined, DIF was tested in two ways. First, the GDS item calibrations were compared between respondents who were pain free and those respondents with persistent pain. A second set of DIF analyses for the GDS items were computed for those with lower pain scores on the MPQ-SF vs those with higher MPQ-SF scores. The WINSTEPS program was used for item equating and to test for the invariance of item estimates. The null hypothesis in DIF is that two parameter estimates for an item, estimated from separate samples, are the same, except for measurement error. A t-test was used to test for significant DIF. A *P* value of less than 0.05, two-tailed, was considered significant.

Results

Evaluating Unidimensionality

Table 2 displays the point–biserial correlations for the 30 GDS items. These correlations are between each item and the total score, with that particular item deleted from the total score. As can be seen, all 30 GDS items were reasonably high and ranged from 0.30 to 0.66, with an average point–biserial correlation of 0.47. The Cronbach alpha (KR-20) reliability index for the 30 GDS items was 0.90, suggesting high internal consistency. Finally, the scree plot of the eigenvalues from the factor analysis of the 30-item GDS indicated that the majority of the variance was accounted for by the first factor (Figure 1). Taken together, these results provide converging evidence that the GDS items are essentially unidimensional.

Evaluating Item Fit to the Rasch Rating Scale Model

The GDS ratings from all 677 subjects were tested for their goodness-of-fit to the Rasch Rating Scale Model. Table 2 presents the resulting item parameters, their standard error of estimate, and the infit statistic. Using our infit criteria of between 0.6 and 1.4, all 30 GDS items were found to fit the Rasch model. Analogous to the beta weights that result from regression analysis but using nonlinear estimation methods, the Rasch analysis of data produces a parameter for each item in a scale, referred to as a difficulty parameter. These are listed in column 2 of Table 2 and labeled as Measure Parameter. For our present purposes, the item Measure Parameter represents the point on the latent depression dimension, measured in logits, where the probability of a positive response to that particular GDS item is 0.50. Thus, this parameter is a location parameter with respect to the measurement scale. Consistency was maintained among the items in terms of how they were asked. For example, "hopeful about the future" was rephrased as "not hopeful about the future." Likewise, "think it is wonderful to be alive now" has been changed to "do not think it is wonderful to be alive now." This adjustment allowed the Measure Parameter of all the items, both positively and negatively worded, to be evaluated along a similar metric.

Those items with a relatively high negative Measure Parameter, such as items #21 (do not feel full of energy; measure value = −2.29) and #30 (mind is not as clear as it used to be; measure value = −2.25), indicate items with less informational value. Those items with relatively high positive measures, such as items #7 (not in good spirits most of the time; measure value = 1.42) and #22 (feel situation is hopeless; measure value = 1.81), suggest greater informational value. A good measurement scale should provide measures with adequate coverage or sensitivity over the full range of the latent construct of interest. For this analysis, a full range of GDS items, including lower, middle, and higher item parameters, were needed to adequately address the full range of depression. We stated that the higher positive items were most informative because endorsing these items is predictive of the respondent more likely endorsing many of the items with a lower parameter value. Our Rasch analysis of the GDS indicates that the items in this scale indeed provide sufficient coverage over the full range of the latent depression scale, as indicated by the wide spread of item measure estimates (Table 2).

DIF Analyses Related to the Presence of Pain

Our first set of DIF analyses tested whether Rasch scale parameter estimates for the 30 GDS items were equivalent (within random estimation error) for subjects without pain and those subjects with persistent pain. These results are presented in Table 3. As can be seen, seven of the 30 items were found to display significant DIF, indicating these items function differently in deriving depression scores on the GDS based on an individual's pain status. These items were: 1) dropping activities and interests; 2) bothered by thoughts cannot get out of head; 3) often get fidgety and restless; 4) prefer to stay at home; 5) do not feel full of energy; 6) do not enjoy getting up in the morning; and 7) mind is not as clear as it used to be.

DIF Analyses Related to Pain Severity

Our second set of DIF analyses tested whether Rasch scale parameter estimates for the 30 GDS items were equivalent for subjects with lower vs higher levels of pain severity. A median split on the MPQ-SF (median = 10.0) was used to classify subjects with persistent pain as having lower pain severity (below the median) or higher pain severity (above the median). The results of these DIF analyses are presented in Table 4. As displayed in Table 4, seven of the 30 items were found to display significant DIF, indicating these items function differently in deriving depression scores on the GDS based on an individual's level of pain severity. These items were: 1) dropped activities and interests; 2) feel life is empty; 3) bothered by thoughts cannot get out of head; 4) often get fidgety and restless; 5) prefer to stay at home; 6) feel more problems with memory than most; and 7) do not find life very exciting.

Testing a GDS Scale Unbiased by Pain

Inspection of the results presented in Tables 3 and 4 indicated that a total of 10 GDS items displayed significant DIF (there were four items that displayed significant DIF for both the presence of pain and pain severity). The 10 DIF items were eliminated and a new revised GDS scale comprised of the remaining 20 items was created and evaluated to determine if its psychometric properties were similar to the full 30-item scale. As expected, the full and revised GDS scales (GDS-PAIN) were highly correlated, $r = 0.96$. The correlations between the MPQ-SF and GDS-PAIN and full GDS scale were very similar, $r = 0.32$ and $r = 0.34$, respectively. The GDS-PAIN scale had a Cronbach alpha of 0.87, compared with a Cronbach alpha value of 0.89 for the full scale. Rudy et al. [26] found a significant difference on the full GDS scale between older adults with and without chronic low back pain, with an effect size of 0.83 (i.e., large) between these two groups. Using the GDS-PAIN scale, this significant difference remained, and the effect size was found to be very similar (0.80).

An important psychometric question not addressed by the above analyses is what happens to the diagnostic sensitivity of the GDS when the GDS-PAIN scale is used instead of the full

scale. To evaluate this we used a cutoff score of 10 on the GDS to indicate depression [39]. As the GDS-PAIN scale contained only 20 items, we rescaled the raw scores to have the same range as the full GDS scale (int(((30*GDS-PAIN)/20) + 0.5)). The results of this analysis are presented in Table 5. These two scales resulted in significantly different classification results ($\chi^2(1) = 444.1$, $P < 0.0001$). Using the full scale and a cutoff score of 10 resulted in 86 or 12.7% of this sample being classified as depressed. However, 27 of these 86 subjects (31.4%) were not classified as depressed when the GDS-PAIN scale was used. Overall, the number of depressed subjects dropped to 59 or 8.7% when the GDS-PAIN scale was used.

Discussion

Our findings support the aims of this analysis that were to 1) evaluate if the presence of pain, regardless of its intensity, created DIF in at least some of the depression items of the GDS and 2) describe if, as pain severity increased, DIF would be more widespread, perhaps because of the increased life disruption and disability that has been shown to be correlated with pain intensity [40-43]. Specifically, several items appear to behave differently as a result of the presence or severity of pain. When these items that displayed DIF are removed, the revised GDS (GDS-PAIN) appears to be psychometrically stable and maintains both internal consistency and similar correlation values with a measure of pain as the original scale. Four of the 10 items (40%) were biased by both presence *and* severity of pain. The clinical salience of our findings is supported as both of these characteristics of pain (presence and severity) resulted in overlapping differential item bias.

The 10 items removed from the GDS include 1) dropping many activities and interests; 2) bothered by thoughts cannot get out of head; 3) often get fidgety and restless; 4) prefer to stay at home; 5) do not feel full of energy; 6) do not enjoy getting up in the morning; 7) mind is not as clear as it used to be; 8) feel life is empty; 9) feel more problems with memory than most; and 10) do not find life very exciting. These items can be grouped into preliminary groups, which we have labeled 1) low energy/isolation; 2) anxious; and 3) cognitive. Table 6 lists the items which comprise each of these groups.

None of the items that functioned differently because of either the presence or intensity of pain dealt explicitly with depressed mood, anhedonia, or hopelessness. Indeed, the six items that were grouped as low energy/isolation (which are most closely related to depression) perhaps reflect a fatigue, sense of feeling "slowed down," and decreased "zest" for life that may be independent of depression. This is apparent in the 1) dropping activities and interests; 2) feeling life is empty and not exciting; 3) preferring to stay at home; 4) lacking energy; and 5) not enjoying getting up in the morning. A recent article by Parmelee et al. [44] supports these findings, in particular dropping activities and interests, and suggests that having and retaining favorite pastimes are associated with reduced levels of depression and should be considered when evaluating the effects of pain upon quality of life.

One explanation for these potentially linked items is that pain is exhausting for older adults. While they might not be depressed (evidenced by the low GDS scores for the group as a whole), they might be fatigued by their persistent pain. It has been reported that fatigue (defined as tiredness in daily activities) among nondisabled older adults is a risk factor for subsequent disability [45]. This finding is supported by other work reported by Wijeratne et al. who used exploratory factor analysis to determine the structure underlying the responses of 10,662 ambulatory primary care patients, aged 60 years and over, who completed the 34-item SPHERE (Somatic and Psychological HEalth REport) questionnaire of somatic and psychological symptoms [46]. They derived a clinically interpretable four-factor solution consisting of mood, cognitive, musculoskeletal, and fatigue symptoms. An explanation why the item "do not enjoy getting up in the morning" showed evidence of DIF is because for many patients with persistent

pain, in particular osteoarthritis and fibromyalgia, morning stiffness is a prominent complaint. Thus, morning may be a time of worse pain.

Another potential explanation is that these items represent a latent variable known as learned helplessness [47]. Learned helplessness occurs when individuals come to expect that either negative outcomes will occur or positive outcomes will not occur and simultaneously feel a lack of control over the occurrence of these outcomes [48]. Perhaps these items tap a loss of pleasure seeking (e.g., going out with friends, spending time on hobbies) that is negatively affected by the presence of pain, which is independent of depression in older adults.

The differential functioning of cognitive items builds upon work with older adults by our group that reported the effect of pain on both memory and executive functioning [16,17]. The presence or severity of pain differentially affected the following two items related to cognition: 1) feel more problems with memory than most; and 2) mind not as clear as it used to be. In earlier studies we reported that pain severity was associated with decreased performance on a test of number–letter switching, indicating a relationship between pain and mental flexibility [17]. We also reported that older adults with chronic low back pain demonstrated impaired neuropsychological performance as compared with pain-free older adults. Further, pain severity was inversely correlated with neuro-psychological performance [16].

While the sample in this report had relatively low scores on the GDS, suggesting minimal depression, it has been reported that approximately 45% of patients with depression in old age exhibit cognitive impairments in two or more cognitive domains. These impairments are most commonly characterized by deficits in information-processing speed, executive functioning, and visuospatial construction [49-51]. These reports of cognitive dysfunction, however, are often incidental findings in patients identified as having Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)-defined major depressive disorder. As the subjects in this report have on average mild depression scores yet still reported subjective cognitive changes, perhaps the behavior of these subjective descriptions of cognition may be more affected by the presence of pain than depression.

The anxiety items that exhibited differential item functioning, feeling fidgety and restless and bothered by thoughts cannot get out of head, are similar to symptoms of generalized anxiety disorder (GAD). Older adults with GAD report more restlessness, irritability, fatigue, and muscle tension relative to those without GAD. Wetherell and colleagues found that older adults with GAD reported greater worry, worry more days than not, worry about a greater range of topics (e.g., family, finance, personal health, social/interpersonal matters), and had more difficulty controlling their worry compared with a group of seniors with subsyndromal anxiety and asymptomatic controls [52]. It is known that GAD is a frequent cotraveler with depression [53,54]. However, in the presence of pain, these anxiety items perform differently and do not appear to contribute to a precise assessment of depressive symptoms.

These analyses are limited by several factors. First, our sample had relatively low scores on the GDS. Although this may reflect recruitment bias (i.e., more depressed individuals may not have responded to flyers or other advertisement), we feel the relatively low rates of depression is consistent with reports that older adults living with persistent pain may have lower rates of affective illness than mixed age samples [16,17,55]. Nonetheless, the fact that 10 unique items showed evidence of DIF supports the need for improved mood assessments for older persistent pain patients. Additionally, using a case–control design to evaluate DIF, that is, comparing two extreme groups (one with the condition, one control), does not necessarily ensure that the condition of interest (in our application, pain) is completely responsible for significant DIF. Other potential confounders to the observed DIF are the differences between the pain and control groups in terms of medical comorbidities and MMSE scores. Of note, while the MMSE

mean scores were statistically significant between the two groups, this difference of less than 0.5 was not clinically significant. It is unavoidable to find differences in level of medical comorbidity between pain patients and normal controls. For example, individuals with pain are often less physically active, which results in weight gain, hypertension, hypercholesterolemia, and diabetes. As comorbid medical burden may also affect some of the items that evidenced DIF, future work with more medically burdened controls is warranted.

Our work adds to the substantial literature examining the complex relationship between depression and persistent pain [56-63]. In addition to describing how both conditions are risk factors for each other and are mutually exacerbating, a common theme in this research area has been how to best distinguish depression among patients with persistent pain [58]. In our comparison of the revised GDS (GDS-PAIN) with the full scale, the psychometric properties appeared to be stable and provide preliminary support that the GDS-PAIN scale that removes items biased by pain does not appear to adversely affect the psychometric properties of the scale. Although the GDS-PAIN scale appears to be more specific in its screening for depression, future work should compare structured clinical interviews for depression, such as the Structured Clinical Interview for Axis I DSM-IV Disorders [64], with the GDS-PAIN to ascertain its diagnostic precision. Future comparisons of older patients with comorbid depression and persistent pain of the GDS-PAIN with other measures of depression severity such as the Hamilton Rating Scale for Depression [32] and the Montgomery Asberg Rating Scale for Depression [65] will also further support its validity and specificity.

According to the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) [66], for authors of a new or adapted measure to recommend it over relevant existing instruments, it is incumbent to demonstrate whether a newly developed measure has incremental advantages, including decreased participant burden or increased reliability or validity. Given 1) the sound psychometric properties of the GDS-PAIN; 2) the fact that it is shorter by 10 items; and 3) the apparently improved specificity for assessing depression when used in older adults with persistent pain, we feel it warrants further testing.

Acknowledgments

References

1. Campbell LC, Clauw DJ, Keefe FJ. Persistent pain and depression: A biopsychosocial perspective. Biol Psychiatry 2003;54(3):399–409. [PubMed: 12893114]

2. Banks S, Kerns RD. Explaining high rates of depression in chronic pain: A diathesis-stress framework. Psychol Bull 1996;119:95–110.

3. Katon W, Sullivan M, Walker E. Medical symptoms without identified pathology. Ann Intern Med 2001;134:917–25. [PubMed: 11346329]

4. Katon W, Sullivan MD. Depression and chronic medical illness. J Clin Psychiatry 1990;51(suppl):3–11. discussion 2–4. [PubMed: 2189874]

5. Wells KB, Stewart A, Hays RD, et al. The functioning and well-being of depressed patients. Results from the medical outcomes study [See comment]. JAMA 1989;262(7):914–9. [PubMed: 2754791]

6. Penninx BW, Geerlings SW, Deeg DJ, et al. Minor and major depression and the risk of death in older persons [See comment]. Arch Gen Psychiatry 1999;56(10):889–95. [PubMed: 10530630]

7. Helme RD, Gibson SJ. The epidemiology of pain in elderly people. Clin Geriatr Med 2001;17(3):417–31. [PubMed: 11459713]

8. Ross MM, Crook J. Elderly recipients of home nursing services: Pain, disability and functional competence. J Adv Nurs 1998;27(6):1117–26. [PubMed: 9663861]

9. Mobily P, Herr K, Clark M, Wallace R. An epidemiologic analysis of pain in the elderly: The Iowa 65 + Rural Health Study. J Aging Health 1994;6:139–54.

10. Kim Y, Pilkonis PA, Frank E, Thase ME, Reynolds CF. Differential functioning of the Beck depression inventory in late-life patients: Use of item response theory. Psychol Aging 2002;17(3): 379–91. [PubMed: 12243380]

11. Talley J. Geriatric depression: Avoiding the pitfalls of primary care. Geriatrics 1987;42(4):53–60. [PubMed: 3557133]

12. Casten RJ, Parmelee PA, Kleban MH, Lawton MP, Katz IR. The relationships among anxiety, depression, and pain in a geriatric institutionalized sample. Pain 1995;61(2):271–6. [PubMed: 7659437]

13. Varma VK, Chaturvedi SK, Malhotra A, Chari P. Psychiatric symptoms in patients with non-organic chronic intractable pain. Indian J Med Res 1991;94:60–3. [PubMed: 2071186]

14. Koleck M, Mazaux JM, Rascle N, Bruchon-Schweitzer M. Psycho-social factors and coping strategies as predictors of chronic evolution and quality of life in patients with low back pain: A prospective study. Eur J Pain 2006;10(1):1–11. [PubMed: 16291293]

15. Roth RS, Geisser ME, Theisen-Goodvich M, Dixon PJ. Cognitive complaints are associated with depression, fatigue, female sex, and pain catastrophizing in patients with chronic pain. Arch Phys Med Rehabil 2005;86(6):1147–54. [PubMed: 15954053]

16. Weiner DK, Rudy TE, Morrow L, Slaboda J, Lieber S. The relationship between pain, neuropsychological performance, and physical function in community-dwelling older adults with chronic low back pain. Pain Med 2006;7(1):60–70. [PubMed: 16533199]

17. Karp JF, Reynolds CF, Butters MA, et al. The relationship between pain and mental flexibility in older adult pain clinic patients. Pain Med 2006;7(5):444–52. [PubMed: 17014605]

18. Gold DT. The clinical impact of vertebral fractures: Quality of life in women with osteoporosis. Bone 1996;18(3 suppl):185S–9S. [PubMed: 8777086]

19. Krol B, Sanderman R, Suurmeijer T, et al. Disease characteristics, level of self-esteem and psychological well-being in rheumatoid arthritis patients. Scand J Rheumatol 1994;23(1):8–12. [PubMed: 8108671]

20. Barkin RL, Barkin SJ, Barkin DS. Perception, assessment, treatment, and management of pain in the elderly. Clin Geriatr Med 2005;21(3):465–90. [PubMed: 15911202]

21. Holland, P.; Wainer, H. Differential Item Functioning. Hillsdale: Lawrence Erlbaum Associates; 1993.

22. Camilli, G.; Shepard, L. Methods for Identifying Biased Test Items. Thousand Oaks, CA: Sage; 1994.

23. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of a geriatric depression screening scale: A preliminary report. J Psychiatr Res 1982;17(1):37–49. [PubMed: 7183759]

24. Herr KA, Garand L. Assessment and measurement of pain in older adults. Clin Geriatr Med 2001;17 (3):457–78. [PubMed: 11459715]

25. Taylor LJ, Harris J, Epps CD, Herr K. Psychometric evaluation of selected pain intensity scales for use with cognitively impaired and cognitively intact older adults. Rehabil Nurs 2005;30(2):55–61. [PubMed: 15789697]

26. Rudy TE, Weiner DK, Lieber SJ, Slaboda J, Boston JR. The impact of chronic low back pain on older adults: A comparative study of patients and controls. Pain 2007;131:293–301. [PubMed: 17317008]

27. Weiner DK, Rudy TE, Glick RM, et al. Efficacy of percutaneous electrical nerve stimulation for the treatment of chronic low back pain in older adults. J Am Geriatr Soc 2003;51(5):599–608. [PubMed: 12752833]

28. Folstein M, Folstein, McHugh PR. Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98. [PubMed: 1202204]

29. Linn BS, Linn MW, Gurel L. Cumulative illness rating scale. J Am Geriatr Soc 1968;16(5):622–6. [PubMed: 5646906]

30. Yesavage JA, Brink TL, Rose TL, et al. Development and validation of a geriatric depression screening scale: A preliminary report. J Psychiatr Res 1983;17(1):37–49. [PubMed: 7183759]

31. Burke WJ, Roccaforte WH, Wengel SP, Conley DM, Potter JF. The reliability and validity of the geriatric depression rating scale administered by telephone. J Am Geriatr Soc 1995;43(6):674–9. [PubMed: 7775729]

32. Hamilton M. A rating scale for depression. J Neurol Neurosurg Psychiatry 1960;23:56–62. [PubMed: 14399272]

33. Melzack R. The short-form McGill Pain Questionnaire. Pain 1987;30(2):191–7. [PubMed: 3670870]

34. Weiner D, Pieper C, McConnell E, Martinez S, Keefe F. Pain measurement in elders with chronic low back pain: Traditional and alternative approaches. Pain 1996;67(2–3):461–7. [PubMed: 8951942]

35. Gagliese L, Melzack R. Chronic pain in elderly people. Pain 1997;70(1):3–14. [PubMed: 9106804]

36. Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the mini-mental state examination by age and educational level [See comment]. JAMA 1993;269(18):2386–91. [PubMed: 8479064]

37. Linacre, J.; Wright, B. WINSTEPS: Multiple-Choice, Rating Scale, and Partial Credit Rasch Analysis (Computer Software). Chicago, IL: Mesa Press; 2002.

38. Bond, T.; Fox, C. Applying the Rasch Model: Fundamental Measurement in the Human Sciences. Mahwah, NJ: Lawrence Erlbaum; 2001.

39. Brink T, Yesavage J, Lum O, et al. Screening tests for geriatric depression. Clin Gerontol 1982;1:37–44.

40. Gesztelyi G, Bereczki D. Determinants of disability in everyday activities differ in primary and cervicogenic headaches and in low back pain. Psychiatry Clin Neurosci 2006;60(3):271–6. [PubMed: 16732741]

41. Horng Y-S, Hwang Y-H, Wu H-C, et al. Predicting health-related quality of life in patients with low back pain. Spine 2005;30(5):551–5. [PubMed: 15738789]

42. Lichtenstein MJ, Dhanda R, Cornell JE, Escalante A, Hazuda HP. Disaggregating pain and its effect on physical functional limitations. J Gerontol A Biol Sci Med Sci 1998;53(5):M361–71. [PubMed: 9754142]

43. Reid MC, Guo Z, Towle VR, Kerns RD, Concato J. Pain-related disability among older male veterans receiving primary care. J Gerontol A Biol Sci Med Sci 2002;57(11):M727–32. [PubMed: 12403801]

44. Parmelee P, Harralson T, Smith L, Schumacher H. Necessary and discretionary activities in arthritis: Do they mediate the pain–depression relationship. Pain Med 2007;8(5):449–61. [PubMed: 17661863]

45. Avlund K, Rantanen T, Schroll M. Tiredness and subsequent disability in older adults: The role of walking limitations. J Gerontol A Biol Sci Med Sci 2006;61(11):1201–5. [PubMed: 17167163]

46. Wijeratne C, Hickie I, Davenport T. Is there an independent somatic symptom dimension in older people? J Psychosom Res 2006;61(2):197–204. [PubMed: 16880022]

47. Abramson LY, Metalsky GI, Alloy LB. Hopelessness depression: A theory-based subtype of depression. Psychol Rev 1989;96(2):358–72.

48. Smith TW, Peck JR, Ward JR. Helplessness and depression in rheumatoid arthritis. Health Psychol 1990;9(4):377–89. [PubMed: 2373064]

49. Butters MA, Bhalla RK, Mulsant BH, et al. Executive functioning, illness course, and relapse/recurrence in continuation and maintenance treatment of late-life depression: Is there a relationship? Am J Geriatr Psychiatry 2004;12(4):387–94. [PubMed: 15249276]

50. Elderkin-Thompson V, Kumar A, Bilker WB, et al. Neuropsychological deficits among patients with late-onset minor and major depression. Arch Clin Neuropsychol 2003;18(5):529–49. [PubMed: 14591448]

51. Lockwood KA, Alexopoulos GS, Kakuma T, Van Gorp WG. Subtypes of cognitive impairment in depressed older adults. Am J Geriatr Psychiatry 2000;8(3):201–8. [PubMed: 10910417]

52. Wetherell JL, Le Roux H, Gatz M. DSM-IV criteria for generalized anxiety disorder in older adults: Distinguishing the worried from the well. Psychol Aging 2003;18(3):622–7. [PubMed: 14518822]

53. Lenze EJ, Mulsant BH, Mohlman J, et al. Generalized anxiety disorder in late life: Lifetime course and comorbidity with major depressive disorder. Am J Geriatr Psychiatry 2005;13(1):77–80. [PubMed: 15653943]

54. DeLuca AK, Lenze EJ, Mulsant BH, et al. Comorbid anxiety disorder in late life depression: Association with memory decline over four years. Int J Geriatr Psychiatry 2005;20(9):848–54. [PubMed: 16116585]

55. Calabrese SK, Lyness JM, Sorensen S, Duberstein PR. Personality and the association of pain and depression. Am J Geriatr Psychiatry 2006;14(6):546–9. [PubMed: 16731724]

56. Romano JM, Turner JA. Chronic pain and depression: Does the evidence support a relationship? Psychol Bull 1985;97(1):18–34. [PubMed: 3983297]

57. Ranga Rama Krishnan K, France RD, Pelton SZ. Chronic pain and depression: I. classification of depression in chronic low back pain patients. Pain 1985;22(3):279–87. [PubMed: 3162135]

58. Wilson KG, Mikail SF, D'Eon JL, Minns JE. Alternative diagnostic criteria for major depressive disorder in patients with chronic pain. Pain 2001;91(3):227–34. [PubMed: 11275378]

59. Arnow BA, Hunkeler EM, Blasey CM, et al. Comorbid depression, chronic pain, and disability in primary care. Psychosom Med 2006;68(2):262–8. [PubMed: 16554392]

60. Giesecke T, Gracely RH, Williams DA, et al. The relationship between depression, clinical pain, and experimental pain in a chronic pain cohort. Arthritis Rheum 2005;52(5):1577–84. [PubMed: 15880832]

61. Schatzberg AF. The relationship of chronic pain and depression. J Clin Psychiatry 2004;65(suppl 12): 3–4.

62. Taylor R, Lovibond PF, Nicholas MK, Cayley C, Wilson PH. The utility of somatic items in the assessment of depression in patients with chronic pain: A comparison of the Zung self-rating depression scale and the depression anxiety stress scales in chronic pain and clinical and community samples. Clin J Pain 2005;21(1):91–100. [PubMed: 15599136]

63. Turner JA, Ersek M, Kemp C. Self-efficacy for managing pain is associated with disability, depression, and pain coping among retirement community residents with chronic pain. J Pain 2005;6 (7):471–9. [PubMed: 15993826]

64. Spitzer, R.; Gibbon, M.; Williams, J. Structured Clinical Interview for Axis I DSM-IV Disorders (SCID). Washington, DC: American Psychiatric Association Press; 1995.

65. Montgomery SA, Asberg M. A new depression scale designed to be sensitive to change. Br J Psychiatry 1979;134:382–9. [PubMed: 444788]

66. Turk DC, Dworkin RH, Burke LB, et al. Developing patient-reported outcome measures for pain clinical trials: IMMPACT recommendations. Pain 2006;125(3):208–15. [PubMed: 17069973]
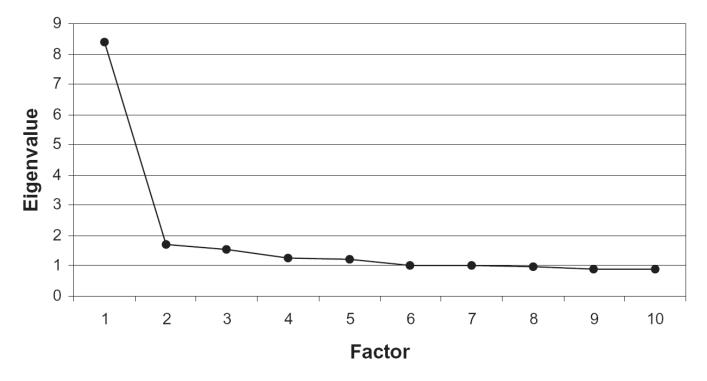
Figure 1.
Scree plot for factor analysis of the 30 Geriatric Depression Scale items (N = 677).

Table 1

Subject demographic and clinical data

Variable	Group		
	Pain-Free	**Pain**	*P* **Value**
Sample size	201	476	—
Age			
Mean	73.6	73.4	0.64
SD	4.7	5.9	
Gender (%)			
Males	57	51	0.22
Females	43	49	
Education (in %)			
High school graduate (or less)	20.5	25.7	0.33
Some college (or trade school)	19.5	16.7	
College graduate	60.0	57.6	
Ethnicity (%)			
White	88.1	90.9	0.54
African American	9.7	7.6	
Other	2.2	1.5	
Marital status			
Single, never married	4.3	6.9	0.62
Separated/divorced	11.4	10.1	
Married	61.6	59.4	
Widowed	22.7	23.6	
Cumulative Illness Rating Scale			
Mean	6.5	9.2	<0.001
SD	2.9	4.3	
Folstein Mini Mental State Examination			
Mean	28.7	28.4	0.008
SD	1.3	1.6	
Geriatric Depression Scale total score			
Mean	1.9	5.3	<0.001
Median	1.0	3.0	
SD	2.6	5.4	
Range	0–19	0–29	
Duration of pain (in years)			—
Mean	—	12.8	
SD	—	14.1	

Table 2

Assessment of Rasch Rating Scale Model to Geriatric Depression Scale (GDS) items, total sample (N = 677)

GDS Item Number and Question	Measure Parameter	SE	Infit Statistic	Point–BiserialCorrelation
1 Basically unsatisfied with life *	0.00	0.14	0.83	0.53
2 Dropped activities and interests	−0.56	0.12	0.94	0.54
3 Feel life is empty	0.92	0.18	0.78	0.47
4 Often get bored	0.06	0.14	1.00	0.46
5 Not hopeful about the future *	0.44	0.15	1.07	0.40
6 Bothered by thoughts cannot get out of head	−0.26	0.13	1.07	0.45
7 Not in good spirits most of the time *	1.42	0.21	0.85	0.40
8 Afraid something bad is going to happen to you	0.98	0.18	1.00	0.38
9 Feel unhappy most of the time *	0.22	0.14	0.81	0.52
10 Often feel helpless	0.54	0.16	0.82	0.49
11 Often get fidgety and restless	−0.73	0.12	1.08	0.48
12 Prefer to stay at home	−1.09	0.11	1.20	0.45
13 Frequently worry about the future	−0.33	0.13	1.00	0.49
14 Feel more problems with memory than most	0.49	0.15	1.29	0.30
15 Do not think it is wonderful to be alive now *	1.05	0.18	0.97	0.38
16 Feel downhearted and blue	0.10	0.14	0.71	0.57
17 Feel pretty worthless the way you are now	1.08	0.18	0.89	0.43
18 Worry a lot about the past	1.19	0.19	0.88	0.41
19 Do not find life very exciting *	−1.71	0.10	1.02	0.57
20 Hard to get started on new projects	−1.39	0.11	0.99	0.57
21 Do not feel full of energy *	−2.29	0.10	0.85	0.66
22 Feel situation is hopeless	1.81	0.23	0.84	0.36
23 Think that most people are better off than you are	0.80	0.17	0.88	0.45
24 Frequently get upset over little things	−0.42	0.12	1.14	0.42
25 Frequently feel like crying	0.77	0.17	0.90	0.44
26 Have trouble concentrating	−0.16	0.13	1.09	0.45
27 Do not enjoy getting up in the morning *	−0.09	0.13	1.19	0.39
28 Prefer to avoid social occasions	−0.09	0.13	1.02	0.46

GDS Item Number and Question	Measure Parameter	SE	Infit Statistic	Point–Biserial Correlation
29 Is not easy to make decisions*	−0.53	0.12	1.09	0.46
30 Mind is not as clear as it used to be*	−2.25	0.10	1.32	0.46

*
Items have been rephrased using a negative valence to assure a consistent metric for the Measure Parameter.

Table 3

Differential item functioning assessment of Geriatric Depression Scale (GDS) items, no pain sample vs pain sample (N = 677)

		Measure Parameter (SE)			
GDS Item Number and Question		**No Pain**	**Pain**	***t* Value**	***P* Value**
1	Basically unsatisfied with life *	0.12 (0.37)	0.00 (0.15)	0.30	0.765
2	Dropped activities and interests	1.81 (0.73)	−0.76 (0.13)	3.47	0.001
3	Feel life is empty	1.81 (0.73)	0.85 (0.18)	1.28	0.203
4	Often get bored	0.12 (0.37)	0.07 (0.15)	0.13	0.896
5	Not hopeful about the future *	−0.12 (0.33)	0.57 (0.17)	−1.85	0.064
6	Bothered by thoughts cannot get out of head	−0.75 (0.27)	−0.12 (0.14)	−2.04	0.042
7	Not in good spirits most of the time *	3.75 (1.81)	1.30 (0.21)	1.34	0.182
8	Afraid something bad is going to happen to you	1.81 (0.73)	0.92 (0.19)	1.18	0.237
9	Feel unhappy most of the time *	0.60 (0.44)	0.18 (0.15)	0.89	0.374
10	Often feel helpless	0.80 (0.48)	0.51 (0.17)	0.57	0.566
11	Often get fidgety and restless	−0.01 (0.35)	−0.82 (0.13)	2.20	0.028
12	Prefer to stay at home	−1.51 (0.22)	−0.93 (0.12)	−2.29	0.022
13	Frequently worry about the future	−0.01 (0.35)	−0.36 (0.14)	0.94	0.347
14	Feel more problems with memory than most	0.26 (0.38)	0.54 (0.17)	−0.67	0.502
15	Do not think it is wonderful to be alive now *	0.60 (0.44)	1.14 (0.2)	−1.13	0.260
16	Feel downhearted and blue	1.05 (0.53)	0.00 (0.15)	1.92	0.055
17	Feel pretty worthless the way you are now	1.37 (0.6)	1.06 (0.19)	0.49	0.624
18	Worry a lot about the past	1.37 (0.6)	1.18 (0.2)	0.30	0.761
19	Do not find life very exciting *	−1.83 (0.2)	−1.62 (0.12)	−0.87	0.385
20	Hard to get started on new projects	−1.14 (0.24)	−1.41 (0.12)	1.01	0.313
21	Do not feel full of energy *	−1.61 (0.21)	−2.41 (0.11)	3.32	0.001
22	Feel situation is hopeless	1.81 (0.73)	1.82 (0.25)	−0.02	0.987
23	Think that most people are better off than you are	0.60 (0.44)	0.84 (0.18)	−0.52	0.605
24	Frequently get upset over little things	0.12 (0.37)	−0.49 (0.13)	1.56	0.119
25	Frequently feel like crying	0.42 (0.41)	0.85 (0.18)	−0.96	0.336
26	Have trouble concentrating	0.42 (0.41)	−0.22 (0.14)	1.49	0.137

Measure Parameter (SE)

GDS Item Number and Question	No Pain	Pain	t Value	P Value
27 Do not enjoy getting up in the morning *	−0.60 (0.28)	0.05 (0.15)	−2.00	0.046
28 Prefer to avoid social occasions	0.12 (0.37)	−0.10 (0.14)	0.57	0.569
29 Is not easy to make decisions *	−0.96 (0.25)	−0.40 (0.14)	−1.94	0.052
30 Mind is not as clear as it used to be *	−2.72 (0.18)	−1.98 (0.11)	−3.51	0.001

*
Items have been rephrased using a negative valence to assure a consistent metric for the Measure Parameter.

Table 4

Differential item functioning assessment of Geriatric Depression Scale (GDS) items, lower pain sample vs higher pain sample (N = 476)

GDS Item Number and Question	Measure Parameter (SE)			
	Lower Pain	Higher Pain	t Value	P Value
1 Basically unsatisfied with life *	0.25 (0.25)	−0.15 (0.19)	1.32	0.187
2 Dropped activities and interests	−0.40 (0.21)	−1.02 (0.17)	2.37	0.018
3 Feel life is empty	1.50 (0.38)	0.56 (0.22)	2.15	0.032
4 Often get bored	0.45 (0.26)	−0.15 (0.19)	1.87	0.062
5 Not hopeful about the future *	0.32 (0.25)	0.76 (0.23)	−1.31	0.191
6 Bothered by thoughts cannot get out of head	0.25 (0.25)	−0.36 (0.18)	2.01	0.046
7 Not in good spirits most of the time *	1.36 (0.36)	1.28 (0.26)	0.19	0.847
8 Afraid something bad is going to happen to you	0.75 (0.29)	1.03 (0.24)	−0.75	0.454
9 Feel unhappy most of the time *	0.38 (0.26)	0.06 (0.19)	0.98	0.326
10 Often feel helpless	0.52 (0.27)	0.52 (0.21)	−0.01	0.996
11 Often get fidgety and restless	−0.35 (0.21)	−1.16 (0.17)	3.05	0.002
12 Prefer to stay at home	−1.21 (0.17)	−0.67 (0.17)	−2.16	0.031
13 Frequently worry about the future	−0.26 (0.21)	−0.42 (0.18)	0.57	0.567
14 Feel more problems with memory than most	0.08 (0.23)	0.92 (0.23)	−2.52	0.012
15 Do not think it is wonderful to be alive now *	0.75 (0.29)	1.41 (0.27)	−1.70	0.090
16 Feel downhearted and blue	0.32 (0.25)	−0.19 (0.19)	1.62	0.106
17 Feel pretty worthless the way you are now	1.02 (0.32)	1.09 (0.24)	−0.17	0.867
18 Worry a lot about the past	1.65 (0.4)	0.97 (0.24)	1.45	0.146
19 Do not find life very exciting *	−1.89 (0.16)	−1.33 (0.16)	−2.44	0.015
20 Hard to get started on new projects	−1.50 (0.17)	−1.33 (0.16)	−0.73	0.468
21 Do not feel full of energy *	−2.29 (0.16)	−2.53 (0.16)	1.07	0.283
22 Feel situation is hopeless	2.27 (0.52)	1.64 (0.29)	1.06	0.291
23 Think that most people are better off than you are	1.11 (0.33)	0.71 (0.22)	1.01	0.314
24 Frequently get upset over little things	−0.63 (0.19)	−0.36 (0.18)	−1.04	0.300
25 Frequently feel like crying	1.02 (0.32)	0.76 (0.23)	0.68	0.500
26 Have trouble concentrating	−0.17 (0.22)	−0.26 (0.18)	0.30	0.762

GDS Item Number and Question	Measure Parameter (SE)			
	Lower Pain	Higher Pain	*t* Value	*P* Value
27 Do not enjoy getting up in the morning *	−0.26 (0.21)	0.30 (0.20)	−1.92	0.055
28 Prefer to avoid social occasions	−0.40 (0.21)	0.14 (0.20)	−1.88	0.061
29 Is not easy to make decisions *	−0.48 (0.20)	−0.33 (0.18)	−0.56	0.575
30 Mind is not as clear as it used to be *	−2.17 (0.16)	−1.77 (0.16)	−1.75	0.080

*
Items have been rephrased using a negative valence to assure a consistent metric for the Measure Parameter.

Table 5

Comparison of subjects classified as depressed (Geriatric Depression Scale [GDS] score ≥ 10) using the full GDS scale and the revised GDS (GDS-PAIN) (N = 677)

		GDS-PAIN Scale		
		Non-Depressed	**Depressed**	**Total**
Full GDS scale	Non-depressed	591 (87.3%)	0 (0.0%)	591 (87.3%)
	Depressed	27 (3.9%)	59 (8.7%)	86 (12.7%)
	Total	618 (91.2%)	59 (8.7%)	677

Table 6

Differential item functioning items removed from the revised Geriatric Depression Scale (GDS-PAIN)

Low Energy/Isolation	Anxiety	Cognitive
• Do not find life very exciting • Feel life is empty • Dropped activities and interests • Do not feel full of energy • Prefer to stay at home • Do not enjoy getting up in the morning	• Fidgety and restless • Bothered by thoughts cannot get out of head	• Feel more problems with memory than most • Mind not as clear as it used to be