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The impact of chronic low back pain on older adults: A comparative study of patients and controls

Thomas E. Rudy [a,b,c,*], Debra K. Weiner [a,b,d], Susan J. Lieber [a], Jill Slaboda [e], J. Robert Boston [f]

[a] *Department of Anesthesiology,* [b] *Department of Psychiatry,* [c] *Department of Biostatistics,* [d] *Department of Medicine,* [e] *Department of Bioengineering,* [f] *Department of Electrical Engineering, Pain Evaluation and Treatment Institute and University of Pittsburgh, Pittsburgh, PA, USA*

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Abstract

Chronic low back pain (CLBP) is one of the most common, poorly understood, and potentially disabling chronic pain conditions from which older adults suffer. Many older adults remain quite functional despite CLBP, and because age-related comorbidities often exist independently of pain (e.g., medical illnesses, sleep disturbance, mobility difficulty), the unique impact of CLBP is unknown. We conducted this research to identify the multidimensional factors that distinguish independent community dwelling older adults with CLBP from those that are pain-free. Three hundred twenty cognitively intact participants (162 with $\geqslant$moderate pain for $\geqslant$3 months, and 158 pain-free) underwent comprehensive assessment of pain severity, medical comorbidity (illnesses, body mass index, medications), severity of degenerative disc and facet disease, lumbar flexion, psychological constructs (self-efficacy, mood, overall mental health), and self-reported as well as performance-based physical function. Significant differences were ascertained for all 22 measures. Discriminant function analysis revealed that eight measures uniquely maximized the separation between the two groups (self-reported function with the Functional Status Index and the SF-36, performance-based function with repetitive trunk rotation and functional reach, mood with the Geriatric Depression Scale, comorbidity with the Cumulative Illness Rating Scale and BMI, and severity of degenerative disc disease). These results should help to guide investigators that perform studies of CLBP in older adults and practitioners that want an easily adaptable battery for use in clinical settings.

Keywords: Chronic low back pain; Older adults; Disability; Functional performance

1. Introduction

Chronic pain is a common symptom reported by an estimated 50% of community dwelling older adults that has the potential to threaten their functional independence and ultimately lead to rising health care costs (Helme and Gibson, 1999). Recently, researchers found that the prevalence of pain in various body regions declines with age; however, the degree of pain interference with daily life increases with age (Thomas et al., 2004). Chronic low back pain (CLBP) is one of the most disabling and therapeutically challenging pain conditions afflicting older adults, yet there is a limited body of research dedicated to defining its impact on function (Hartvigsen et al., 2003). In contrast, there has been extensive research conducted on working-aged adults with CLBP in part due to the costs associated with

* Corresponding author. Address: University of Pittsburgh, Pain Evaluation and Treatment Institute, 5750 Centre Ave., Pittsburgh, PA 15206, USA. Tel.: +1 412 665 8053; fax: +1 412 665 8067.
E-mail address: rudyte@anes.upmc.edu (T.E. Rudy).

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work-related disability. The generalizability of these findings or their relevance to the older adult population is unknown. Consequently, studies are emerging to examine the impact of CLBP on everyday functioning of elders.

Weiner et al. examined concurrent validity of pain measurement in elders with CLBP and found a modestly strong correlation between self-reported pain and disability and pain behaviors observed during the performance of axial specific ADL tasks (Weiner et al., 1996). More recently, a study of community dwellers revealed that back pain was most often associated with difficulty in standing in one place, pushing or pulling a large object, and walking a half-mile (Edmond and Felson, 2003). Similarly, low back pain in older women has been linked to reported difficulty but not an inability to perform basic and instrumental ADLs (Leveille et al., 1999). Weiner et al. (2003) found low back pain was associated with lower extremity pain and self-reported difficulty in performing important functional tasks, but not with observed function.

Although these studies have begun to shed light on the functional consequences and disability related to low back pain, the multidimensional consequences of CLBP in older adults remain unknown. The purpose of this study was to measure the magnitude of the effect of CLBP on physical and psychosocial functioning in older adults. Specifically, we examined the factors most affected by pain in the biomedical, psychosocial, and self-reported and performance-based functional domains. We hypothesized that compared with an age and gender matched pain-free control group, older adult subjects with CLBP would demonstrate: (1) significantly more disrupted psychosocial function, (2) more self-reported disability, and (3) lower scores on performance-based measures of physical capacity.

2. Methods

2.1. Subjects

Subjects were 320 English-speaking community dwelling older adults (age 65–84) with CLBP, defined as pain of at least moderate intensity (measured with the pain thermometer, Roland and Morris, 1983), every day or almost every day, for at least the past 3 months (mean pain duration = 14.2 years, $n = 162$), or they were pain-free ($n = 158$). Pain-free was defined as no pain or pain occurring less than once per week of little intensity as measured with the pain thermometer. All subjects were cognitively intact and signed informed consent, approved by the University of Pittsburgh Biomedical Institutional Review Board, prior to their participation. Subjects were recruited via newspaper advertisements and tear-off fliers placed in the community and in primary care clinics. They were screened in two phases, first over the telephone ($n = 2007$), then on site by one of the investigators (DW) with a structured history and physical examination ($n = 610$). Exclusion criteria included cognitive impairment (Folstein Mini-Mental State Examination [MMSE] <21 adjusted for age and education), severe visual or hearing impairment, acute illness or pain, and medical conditions that could make the lifting task (see below) potentially unsafe (e.g., postural instability, severe cardiac or respiratory disease). Subjects were paid up to $150, $50 for each of the three testing or examination sessions they attended.

Subject demographics are shown in Table 1. Pain-free and CLBP subjects were not significantly different with respect to age, gender, educational level, ethnicity, or current living situation. However, compared with pain-free subjects, CLBP subjects were found to have a significantly higher number of comorbidities (Cumulative Illness Rating Scale [CIRS]), and modestly lower Folstein scores.

2.2. Procedures

All subjects received a comprehensive assessment in four domains, biomedical, psychosocial, self-reported function, and performance-based function. The measures used for each of these domains are described below. It should be noted that although the examiners in this study were careful to follow standardized testing procedures, they were not masked to the clinical status of the subjects (i.e., CLBP vs. pain-free).

Table 1
Subject demographics

Variable	Group		
	Pain-free	CLBP	*P*-value
Sample size	158	162	–
Age			
Mean	73.5	73.6	0.87
SD	4.8	5.2	
Gender			
Males	94	83	0.16
Females	66	80	
Education (in %)			
High school graduate	17.3	25.2	0.14
Some college (or trade school)	19.9	22.5	
College graduate	62.8	52.3	
Ethnicity			
White	142	141	0.82
African American	15	18	
Hispanic	3	4	
Current living situation			
Live alone	54	48	0.17
Live with spouse	100	99	
Live with other family members	4	9	
Live with others (non-family)	2	7	
Modified Cumulative Illness Rating Scale			
Mean	2.3	2.9	<0.001
SD	1.5	1.8	
Folstein Mini-Mental State Examination			
Mean	28.7	28.3	0.01
SD	1.3	1.3	
Duration of pain (in yrs)			
Mean	–	14.2	–
SD		14.6	

2.2.1. Biomedical constructs and measures

Biomedical constructs were included for one of two reasons: (1) literature supporting a link between a particular construct and physical function (e.g., medical comorbidity, body mass index), or (2) regardless of supportive scientific literature, the common inclusion of a biomedical construct in disability determination (e.g., severity of radiographic pathology, spinal flexibility). The measures used to assess these constructs are described below.

1. *General Medical Comorbidity* was assessed in two ways. First, the *Cumulative Illness Rating Scale* (Linn et al., 1968), a well-validated measure of comorbidity, was completed based upon data collected during the structured history and physical examination. A comorbidity index was computed by counting the number of items for which moderate to severe pathology was reported (Parmelee et al., 1995). Second, the *number of medications*, both prescription and over-the-counter, was counted and expressed as a summed score.
2. *Body Mass Index (BMI)*. BMI was included as a potential predictor of group differences because it has been shown to be predictive of functional dependence in other populations (Landi et al., 1999), and was calculated using standard procedures.
3. *Radiographic Pathology*. Severity of degenerative lumbosacral pathology was scored using an established system (Weiner et al., 1994), with disc and facet involvement scored for each level (T12 through S1; 0 = no disease, 3 = severe disease). Disc and facet summary scores were then calculated.
4. *Back Range of Motion (lumbar flexion)* was measured because of its common inclusion in disability determination. The measure was assessed using a gravity goniometer (Burdett et al., 1986) and mean lumbar flexion over two trials was calculated.

2.2.2. Psychosocial constructs and measures

The lack of correlation between physical pathology and physical function has been demonstrated repeatedly in younger chronic pain patients (Witt et al., 1984; Vanharanta et al., 1989). A number of psychological factors have been found to play a key role in causing impaired function and disability in those with chronic low back pain. We assessed several psychosocial constructs that have previously been found to mediate or moderate the chronic pain–disability relationship (e.g., mood, self-efficacy) or because of their impairment in chronic pain patients (e.g., sleep). The constructs and their component measures are described below.

1. *Self-Efficacy* is a strong predictor of disability in chronic pain patients in general and in those with CLBP in particular (Grembowski et al., 1993; Clark, 1996). This construct was assessed in two ways. First, the *Chronic Pain Self-Efficacy Scale* was used. This is a 22-item questionnaire designed to measure the patient's confidence in performing activities of daily living (Anderson et al., 1995). Since 14 of the 22 self-efficacy items do not contain reference to pain, these items were completed by controls and were used to compare controls with CLBP subjects. This modified scale for controls had an internal consistency index of 0.85 (Cronbach's alpha) compared with 0.87 for the full scale for CLBP subjects, thus this modification did not appear to adversely impact the psychometric properties of this scale. Second, *Task-specific Self-Efficacy* was evaluated by having participants rate their perceived ability to complete the static and dynamic lifting tasks (described below). Ratings ranged from 0 = very uncertain to 100 = very certain. A summed score was computed. Coefficient alpha was 0.92 for the 10 self-efficacy ratings that comprised this scale.
2. *Mood* was assessed with the *Geriatric Depression Scale*, a brief questionnaire developed and normed for older adults. Patients are asked to respond yes or no to 30 questions in reference to how they felt on the day of testing. This is a widely used scale with older adults and has been shown to have excellent reliability and validity (Yesavage et al., 1983). The alpha coefficient is 0.94, test–retest reliability one week apart is 0.85, and correlations with structured depression interviews are high (e.g., 0.83 with the Hamilton Rating Scale for Depression).
3. *Mental/emotional health* was evaluated with the *SF-36*, a well-established instrument that examines the participant's health over the past four weeks in eight different outcome dimensions: energy/fatigue, general health perception, mental health, bodily pain, physical functioning, role limitation due to physical problems and social functioning. Two higher-order scales have been developed to combine these eight primary dimensions of health, a physical functioning and role limitations-physical composite scale, and a mental health and role limitations-emotional composite scale (McHorney et al., 1993). The mental health scale is the composite of role-emotional and mental health primary scales.
4. *Sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI)* (Buysse et al., 1989; Buysse et al., 1991). The global PSQI score was used in the analyses.

2.2.3. Physical function measures

Physical function was assessed using both self-report and performance-based measures, as these two approaches have been shown to tap distinct constructs (Rudy and Lieber, 2005). Because the goal of the study was to compare older adults with CLBP and those that were pain-free, pain-specific measures of physical performance and disability were not included. Only measures that were applicable to both groups were included and are described below.

2.2.3.1. Self-report measure.

1. *Functional Status Index* is comprised of 18 ADL items in five categories and defines function in three distinct but related dimensions: degree of dependence, degree of difficulty, and the amount of pain experienced in performing specific activities of daily living (Jette, 1980). Only the difficulty scale was used and was completed by controls and CLBP subjects.
2. *MPI-General Activity Scale*, from the Multidimensional Pain Inventory (MPI), is designed to measure the frequency of participation in 19 common activities (Kerns et al., 1985).

We believe this type of activity checklist is important because it evaluates the frequency of activity, in contrast to most self-report functional measures that only focus on the difficulty or pain related to performing ADLs.

3. *Physical Activity Scale* is designed to measure the level of physical activity in the past week in the areas of leisure, occupation, and household (Washburn et al., 1993).
4. *SF-36 physical functioning and role limitations-physical composite scale* (McHorney et al., 1993). The physical activity scale is the composite of physical functioning and role-physical primary scales.

2.2.3.2. Performance-based measures. A registered occupational therapist (SL) instructed and monitored the safety of the subjects during the completion of the functional performance-based measures.

1. *Static lifting strength*: Each subject's maximum voluntary static lifting strength was measured to determine the resistive load for the isodynamic lifting task with a Chatillon muscle strength dynamometer (Sammons Preston, Bolingbrook, IL, USA) attached to a platform. The subjects were instructed to assume a bilateral symmetrical leg lift position with the forearm in supination and the handle of the dynamometer adjusted to knee height. The subject was then instructed to pull steadily on the force gauge for 4 s and the mean of three trails was used as the subject's mean voluntary static strength.
2. *Isodynamic Lifting task*: A lifting task that has been validated in young and older patients with CLBP (Boston et al., 1995; Slaboda et al., 2002; Rudy et al., 2003) was performed on a Work Simulator (Baltimore Therapeutic Equipment [BTE] Company, Baltimore, MD, USA). Each subject stood on a force platform (AMI OR-6, MA, USA) and lifted a resistive load attached to a 12-inch handle from knee to waist level, then returned the handle to the holder. The resistive load was equivalent to 40% of the subject's mean voluntary static lifting strength. The Work Simulator applied resistance during the up-phase of the lift.
   Subjects lifted at their own pace for a maximum time of 15 min with a 15-second resting period between the lifts. During the task, the subjects were prompted with a series of audible tones that instructed the subject when to lift the load and when to lower the load. The lifting task was self-paced in that the computer began the rest period after the subject released the handle and returned to standing position. Subjects were instructed to lift until they felt physically unable to continue or were told by the occupational therapist to stop. The subjects were given no instructions or feedback on lifting technique during the task. The task was terminated if: (1) maximum heart rate was reached as measured by pulse oximeter sensor attached to the subject's forehead (Nellcor Puritan Bennett, CA, USA), (2) the subject demonstrated unsafe body mechanics as determined by the occupation therapist, (3) the subject was unable to perform at the designed pace, or (4) the time limit was reached. Physical performance measures of the lifting task included mean static lifting strength, number of lifts completed, and a work index. The work index was calculated as the weight lifted times the number of lifts performed during the lifting task.
3. *Functional Reach* was included as a measure of balance performance (Duncan et al., 1990; Weiner et al., 1992, 1993). While musculoskeletal pain is associated with falls in older adults (Leveille et al., 2002), the mechanism of this association is unknown. Pain has been shown to impair attention and concentration (Weiner et al., 2006), and attention is a required component of sensory integration needed for postural control in older adults (Redfern et al., 2001). An association between back pain and impaired postural control has been demonstrated in laboratory studies of younger individuals (Nies and Sinnott, 1991; Luoto et al., 1996, 1998), thus we examine the relationship between postural control (using functional reach) and pain in this study. Subjects were asked to reach forward beyond arms length while maintaining a fixed base of support in the standing position. The displacement of the fingertips from the arms length position to reaching position in inches was calculated and an average over three trials was used for comparison.
4. *Chair Rise* was included because of its ecological validity in older adults with CLBP. Subjects were asked to sit in a lightly padded hard-backed chair, place their arms across their chest, and stand. If successful, the subject is then asked to return to sitting and after a brief rest, repeat the sit-to-stand five times for a timed score.
5. *Gait Speed* was included as a general measure of physical function because of its predictive validity for disability in older adults (Guralnik et al., 2000). Twenty-five foot (7.6 m) gait speed was assessed based on the methods of Bohannon (1997). Subjects were asked to walk twice, once at a normal speed and then at a fast pace, and the mean time for the two trials was calculated.
6. *Stair Climb* is the time in seconds to ascend and descend one flight of stairs (12 steps), and is a subtest extracted from the Physical Performance Test (PPT) (Reuben and Siu, 1990).
7. *Trunk Rotation* was included as a measure of spinal mobility and endurance that also has ecological validity because of frequent encounters with trunk rotation in the course of daily activities (e.g., retrieving objects from drawers or cabinets, dressing, and reaching items while seated in a car). This test was administered in standardized format (Lechner, 1993). The subject is seated and asked to complete 20 rotations (10 right and 10 left) without stopping while holding an empty plastic bin and tapping it on top of stools (45 cm high) positioned at the hip joint and at arms length to the left and right of the subject. The average time in seconds for a single complete rotation is computed from the total time and the number of complete rotations completed.

2.3. Statistical analyses

Prior to conducting the primary statistical analyses, the statistical models used were evaluated for violations of heteroscedasticity of errors and non-linearity using standard graphical methods. No measures needed to be transformed because of these analyses. To provide better control for experimentwise error rates for hypotheses that evaluated group

differences between pain-free and CLBP subjects on biomedical, psychosocial, self-reported function, and performance-based measures of function, a multivariate analysis of variance (MANOVA) approach, based on the unweighted general linear model, was used. When the MANOVAs showed significant effects, univariate ANOVAs were examined to determine which variables were most important in the obtained significant difference (Bray and Maxwell, 1982; Bray and Maxwell, 1985). Effect sizes also were computed to evaluate the magnitude of the differences between CLBP and pain-free controls. Discriminant function analysis (DFA), stepwise, was used to determine what measures provided the best unique discrimination between pain-free and CLBP subjects. Chi-square analyses were used to evaluate group differences on dichotomous and ordinal measures. The SYSTAT Version 11 statistical package was used to compute all analyses (SYSTAT, 2004). $P < 0.05$ was used to indicate statistical significance.

3. Results

The means and standard deviations by experimental group for the 22 assessment measures, listed by domain, are displayed in Table 2. A MANOVA, with subject group as the independent variable and the 22 biomedical, psychosocial, self-reported function, and performance-based function assessment scores as the dependent measures, indicated significant differences existed between the groups on one or more of these measures ($F[22,310] = 12.31$, $P < 0.0001$). Follow-up univariate ANOVAs indicated that CLBP and control subjects were significantly different on all 22 measures (Table 2). To better understand these significant differences, effect sizes were computed. As can be seen in Table 2, these effect sizes ranged from a high of 1.70 for the Functional Status Index to a low of 0.23 for the back range of motion. Thus, these findings confirm our hypotheses that CLBP subjects, compared with pain-free controls, would demonstrate significantly more disrupted psychosocial function, more self-reported disability, and lower scores on performance-based measures of physical capacity.

Because of significant inter-correlations among some of the 22 assessment measures, a stepwise DFA was computed to evaluate which measures uniquely maximized the separation between the two groups. This

Table 2
Means (SDs), Effect Sizes, and Discriminant Function Analysis (DFA) Entry Order Comparing Pain-Free and CLBP Subjects

Domain/Measure	Means (SD)		Effect size	Univariate *P*-Value	DFA Entry Order
	Controls	CLBP			
Biomedical					
Cumulative Illness Rating Scale	6.63 (2.98)	9.54[a] (3.51)	−0.90	<0.001	4
Body Mass Index	26.14 (3.75)	29.04[a] (4.47)	−0.71	<0.001	7
X-ray disc severity	4.69 (3.32)	6.45[a] (3.36)	−0.53	<0.001	5
X-ray facet severity	9.99 (3.67)	11.47[a] (4.15)	−0.38	0.002	
Back range of motion	17.19[b] (8.17)	15.39 (7.26)	0.23	0.035	
Number of medications	3.96 (2.08)	5.58[a] (2.69)	−0.68	<0.001	
Psychosocial					
Chronic Pain Self-Efficacy Scale	94.50[b] (7.35)	81.78 (15.09)	1.13	<0.001	
Task-specific (lifting) Self-Efficacy	2348.76[b] (334.77)	1940.47 (475.32)	1.01	<0.001	
Geriatric Depression Scale	1.60 (2.15)	4.75[a] (4.83)	−0.90	<0.001	2
SF-36: Mental health and role limitations-emotional composite scale	93.34[b] (7.08)	83.05 (20.32)	0.75	<0.001	
Pittsburgh Sleep Quality Index	3.33 (2.47)	4.47[a] (3.19)	−0.40	0.001	
Self-Report Function					
Functional Status Index	0.05 (0.09)	0.39[a] (0.31)	−1.70	<0.001	1
Multidimensional Pain Inventory–General Activity Scale	3.17[b] (0.73)	2.84 (0.77)	0.44	<0.001	
Physical Activity Scale	124.42[b] (65.02)	105.76 (64.38)	0.29	0.017	
SF-36: Physical functioning and role limitations-physical composite scale	95.05[b] (9.87)	66.45 (27.66)	1.52	<0.001	6
Performance-based Function					
Static lifting strength (kg)	58.43[b] (24.59)	49.57 (19.64)	0.40	0.001	
Work done, dynamic lifting	2085.92[b] (986.01)	1680.31 (823.13)	0.45	<0.001	
Functional Reach (cm)	31.22[b] (5.17)	27.82 (5.72)	0.62	<0.001	8
Chair Rise (s)	2.26[c] (0.51)	3.10 (1.42)	−0.87	<0.001	
Gait Speed (s)	12.33[c] (1.60)	14.08 (3.09)	−0.75	<0.001	
Stair Climb (s)	46.43[c] (7.11)	54.24 (16.22)	−0.67	<0.001	
Trunk rotation (s)	2.31[c] (0.57)	3.03 (0.84)	−1.02	<0.001	3

[a] Higher numbers indicate more pathology or poorer performance.
[b] Higher numbers indicate less pathology or better performance.
[c] Lower number indicate less pathology or better performance.

analysis also allowed us to determine a more parsimonious set of assessment measures. The stepwise DFA indicated eight measures were statistically significant and independent contributors to group separation. The classification accuracy of the DFA model was 92% for the pain-free control subjects, and 87% for the CLBP subjects.

The DFA model contained at least one measure from each of the four domains. The order of entry of the eight measures into the stepwise DFA model is shown in Table 2. The first two measures that maximized group separation were functional status index (FSI) from the self-reported functional domain and geriatric depression scale (GDS) from the psychosocial domain. The FSI indicated that CLBP subjects reported more difficulties in performing ADLs and the GDS found that CLBP subjects have higher levels of depressed mood than control subjects. In addition to the FSI, the SF-36 measure from the self-reported functional domain entered the model, indicating that CLBP subjects reported greater role limitations for physical activities. Two measures from the performance-based functional domain were found to provide unique contributions to groups differences, trunk rotation and functional reach. CLBP subjects were found to rotate the trunk at a slower pace and when instructed to reach, extended their arms for a shorter distance than control subjects. Three measures from the biomedical domain also were included in the model. Compared with controls, CLBP subjects displayed more comorbidities, more lumbar disc disease on the radiographs, and were more overweight (BMI).

4. Discussion

This study represents the first well-controlled comprehensive examination of the effects of chronic pain on functionally independent community dwelling older adults. Its main purpose was to apply multidimensional pain theory developed in younger persons with chronic pain to older adults to determine the multidimensional impacts (i.e., physical function, psychosocial function, and severity of medical comorbidity) of CLBP on these individuals. Our results indicate that all three of the domains examined were significantly different in older adults with CLBP as compared with those that were pain-free. Further, based upon the differences demonstrated, a brief, practical functional/medical assessment battery is recommended for investigators doing research in these individuals and that could be easily adapted for use in the clinical setting.

Physical function was described by two domains and both the self-reported and performance-based functional domains contained measures that discriminated between subjects with CLBP and subjects who were pain-free. Specifically, among the self-reported measures of function, the Functional Status Index and the SF-36 physical functioning and role limitations-physical composite scale were the strongest discriminators between the two groups. Among the performance-based measures, functional reach and repetitive trunk rotation were the strongest discriminating measures. The identification of robust performance-based measures for CLBP represents a significant addition to the literature given that functional outcome measures in CLBP studies have exclusively been limited to self-report tools such as the Roland and Oswestery instruments (Birkmeyer et al., 2002; Atlas et al., 2005).

For practitioners, inquiring about the impact of pain on patients' abilities to perform their daily activities is routine. Our results indicate that practitioners may also want to incorporate direct observation of physical performance into the clinical assessment of older adults with CLBP. Functional reach and repetitive trunk rotation are brief and cost-effective measures that can easily be performed in the clinical setting. The equipment needed to perform the tasks is minimal and consists of a chair, stopwatch, and a 12-inch ruler. In addition, office staff could be trained to perform these assessments and the assessments would add no more than 5 min to the screening procedures.

We would have expected the isoinertial lifting task to be a more powerful discriminator between groups than the clinical measures of performance because the lifting task was more physically demanding task. The subjects were required to repetitively lift a resistive load for 15 min with a 15-s rest period between the lifts. We believed that the task would stress the lower back and possibly cause CLBP subjects to stop the task due to pain as seen in the younger adults' study. The lack of discriminatory power in the lifting task may suggest a difference in our participants as compared with younger adults with CLBP on whom the lifting task was originally validated. In younger adults, CLBP is most likely a result of a sudden injury. These individuals may, therefore, change their body mechanics to avoid further injury. In older adults, CLBP is probably caused by a combination of factors that develop over many years, such as arthritis and muscular and neurological changes. In addition, older adults may be better able to cope with the pain because they believe it is part of the aging process. This combination of slowly developing pathology and more robust coping skills may together allow older adults to move more normally than younger adults, despite their pain.

Performance on all measures within the psychosocial domain was significantly different between groups. This is an important finding, given that psychosocial function can cause progressive physical decline and have a devastating impact on older adults (Pennix et al., 1998; Hebert et al., 1999; Sarkisian et al., 2000). Scores on the Geriatric Depression Screen (GDS) uniquely maximized the separation between our two study groups.

The complex relationship between depressive symptoms and physical performance has undergone considerable investigation in older adults. For example, Rozzini and colleagues (Rozzini et al., 1997) found that depression and cognition were independently associated with self-reported loss of basic and instrumental ADL functions, but not with physical performance. In contrast, Pennix et al. (1998) found increasing levels of depression in community dwellers were predictive of greater decline on physical performance measures. Depressive symptoms also have been linked to self-reported disability (Kivinen et al., 1998), and most recently to disabling musculoskeletal pain of diverse origins (Reid et al., 2003). Thus, the strong role of depressive symptoms in distinguishing older adults with CLBP from their pain-free counterparts is logical.

While the GDS score can be considered the most parsimonious psychosocial measure in older adults with CLBP the importance of the other psychosocial constructs requires discussion. Studies of self-efficacy, defined as the personal judgment about one's performance abilities, have found that elders tend to minimize their abilities, resulting in lower self-efficacy and lower physical performance (Grembowski et al., 1993; Clark, 1996). Low self-efficacy has been linked to declines in self-reported disability (Seeman et al., 1999; Rejeski et al., 2001), and has been found to be a predictor of depressive symptoms in older adults (Davis-Berman, 1990). While sleep disturbance commonly coexists in patients with depression, and in patients with chronic pain, the unique contribution of disrupted sleep to physical function is unknown. Our results indicate that sleep measures should be routinely included in studies of older adults with chronic pain and that the unique contribution of sleep difficulty to physical function should be examined in future research.

It is noteworthy that three of the constructs, disc severity, comorbidity, and BMI, in the biomedical domain uniquely discriminated between the CLBP and pain-free groups. Differences in severity of degenerative radiographic pathology have not previously been demonstrated. In fact, severity of imaging-documented spinal pathology has been previously touted as having poor predictive validity for both pain and disability (Jarvik et al., 2001). We used a detailed radiographic scoring instrument with previously established reliability and validity in our study (Weiner et al., 1994), which may have enabled us to determine more subtle differences than could have been previously accomplished.

Medical comorbidity was a strong discriminator of subjects with CLBP and pain-free subjects. This result is not surprising since increasing evidence in the literature points to chronic pain as an independent contributor to morbidity and mortality. For example, Reyes-Gibby and colleagues (Reyes-Gibby et al., 2002) have demonstrated that pain severity in community dwelling older adults is strongly correlated with self-rated health, which is a powerful predictor of morbidity and mortality (Idler and Benyamini, 1997). Thus, it appears that chronic pain may be much more than a detriment to quality of life. Similarly, whether differences in body mass index are a contributor to CLBP or a result of CLBP-associated inactivity cannot be determined. These questions should be examined in future research.

In order to appreciate the true meaning of our findings, the reader must take a step back and look at the functional profiles of study participants. All subjects were independent community dwelling older adults with high functional status, as evidenced by gait speed performance. Based on reports of other investigators, our subjects, both those with CLBP and those pain-free, were in the top physical performance quartile (Guralnik et al., 1995). Even so, CLBP was associated with measurable differences in physical and psychosocial performances. In addition to the physical and psychosocial performances, we have previously reported that measurable differences in neuropsychological performance existed between the groups in this sample (Weiner et al., 2006). Whether the differences demonstrated predict future disability should be the focus of future research efforts. Given the prevalence of chronic pain in older adults in general and of CLBP in particular, combined with the progressive graying of our societies, additional research in this vital area is mandatory.

While our study had a number of strengths, its limitations should be highlighted. First, because its data collection was cross-sectional, we can only draw conclusions about associations between CLBP and the various domain parameters, but causal relationships cannot be determined. There is no way to disprove that certain factors (e.g., comorbidity, functional status) were not more likely to cause back pain than vice versa. Second, it should be noted that physical performance data were collected by examiners aware of individuals' pain status. The clinical status of participants that underwent the physical capacities evaluation was known because the testing procedures included questions about pain. Although examiners were careful to follow standardized testing procedures, ideally all assessments should have been performed by individuals masked to the clinical status of the subjects (i.e., CLBP vs. pain-free). Because of the common existence of nonverbal indicators of pain (such as grimacing, guarding, sighing, bracing and rubbing) in patients with chronic low back pain (Weiner et al., 1996), however, true masking would be extremely difficult, if not impossible. A third study limitation was the large number of exclusion criteria to insure safety of the testing procedures, which forced the selection of a very high functioning group of older adults. Thus, the ability to generalize our results is somewhat restricted. Future studies using a longitudinal design and broader inclusion criteria will help to extend

our findings, including replicating the classification accuracy of the measures derived in our discriminant analyses, and ultimately develop treatment programs for these vulnerable individuals.

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