Chronic Low Back Pain in Older Adults: Prevalence, Reliability, and Validity of Physical Examination Findings

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OBJECTIVES: To develop a structured physical examination protocol that identifies common biomechanical and soft-tissue abnormalities for older adults with chronic low back pain (CLBP) that can be used as a triage tool for healthcare providers and to test the interobserver reliability and discriminant validity of this protocol.

DESIGN: Cross-sectional survey and examination.

SETTING: Older adult pain clinic.

PARTICIPANTS: One hundred eleven community-dwelling adults aged 60 and older with CLBP and 20 who were pain-free.

MEASUREMENTS: Clinical history for demographics, pain duration, previous lumbar surgery or advanced imaging, neurogenic claudication, and imaging clinically serious symptoms Physical examination for scoliosis, functional leg length discrepancy, pain with lumbar movement, myofascial pain (paralumbar, piriformis, tensor fasciae latae (TFL)), regional bone pain (sacroiliac joint (SIJ), hip, vertebral body), and fibromyalgia.

RESULTS: Scoliosis was prevalent in those with (77.5%) and without pain (60.0%), but prevalence of SIJ pain (84% vs 5%), fibromyalgia tender points (19% vs 0%), myofascial pain (96% vs 10%), and hip pain (48% vs 0%) was significantly different between groups ($P < .001$). Interrater reliability was excellent for SIJ pain (0.81), number of fibromyalgia tender points (0.84), and TFL pain (0.81); good for scoliosis (0.43), kyphosis (0.66), lumbar movement pain (0.75), piriformis pain (0.71), and hip disease by internal rotation (0.56); and marginal for leg length (0.00) and paravertebral pain (0.39).

CONCLUSION: Biomechanical and soft tissue pathologies are common in older adults with CLBP, and many can be assessed reliably using a brief physical examination. Their recognition may save unnecessary healthcare expenditure and patient suffering. **J Am Geriatr Soc 54:11–20, 2006.**

Key words: low back pain; physical examination; assessment; aging; primary care

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Chronic low back pain (CLBP) has long been recognized as a disorder that is complex, challenging to treat, and associated with wide-ranging adverse consequences, including physical disability;[1] psychosocial disruption manifest as depression, anxiety, and fear of engaging in activities;[2] disturbed sleep;[3] increased use of healthcare resources;[4] and impaired appetite.[5] Despite these findings and the fact that more than one in three community-dwelling older adults experiences low back pain (LBP),[6] the primary practitioners to whom these patients seek care are often poorly trained in appropriate physical examination techniques[7] and rely heavily on advanced imaging modalities such as magnetic resonance imaging (MRI) and computed tomography to provide clinical insight.[8] Unfortunately, the correlation between imaging findings and symptoms is poor, with similar pathology identified in those with and without pain.[9–12] Whether these facts, taken together, contribute to the 5% to 40% incidence of failed back surgery syndrome is unknown.[13–19]

The majority of LBP research has focused on younger individuals, although investigators have recently started to examine unique aspects of the consequences of this disorder[2,6] and development of nontoxic treatment modalities for frail older adults.[20] Nevertheless, no one has examined unique etiological aspects of CLBP in this population. LBP is typically classified as being related to mechanical factors, nonmechanical factors, and visceral disease, with the majority of cases designated mechanical and related to disc herniation, degenerative disease, spinal stenosis, spondylolisthesis, and compression fractures.[21] However, because of its complexity, CLBP is often labeled idiopathic, which contributes to imprecise treatment planning, wasted healthcare resources, and compromised treatment outcomes.

At the University of Pittsburgh's Older Adult Pain Management Program (OAPMP), where the majority of patients suffer from CLBP, the pathoanatomical factors that

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contribute to pain are typically multiple rather than solitary. Frequently, these patients are referred for evaluation and treatment of refractory LBP attributed to lumbar spinal stenosis or a herniated disc that have been "diagnosed" using MRI findings. Nevertheless, many of these individuals have had biomechanical and soft-tissue disorders that are responsible for their symptoms, and the MRI findings are incidental. Furthermore, the underlying painful disorders, such as myofascial pain,[22] sacroiliac joint (SIJ) syndrome,[23] and fibromyalgia,[24] can be diagnosed without radiological assistance and managed using conservative techniques.

Because the majority of older adults with CLBP are not referred to pain clinics,[25–27] it was desired to develop a practical tool that primary care practitioners can use instead of basic and advanced imaging as a first, and often only, necessary diagnostic step. The purpose of this study was to develop a structured physical examination protocol that identifies common biomechanical and soft-tissue abnormalities for older adults with CLBP that can be used as a triage tool for healthcare providers, to test the interobserver reliability and discriminant validity of this protocol, and to determine the prevalence of the physical examination findings that the protocol was designed to target.

METHODS

Sample

One hundred eleven community-dwelling adults aged 60 and older with CLBP and 20 pain-free individuals were evaluated using a cross-sectional design. CLBP participants were recruited from the OAPMP and two ongoing CLBP research studies. None of the OAPMP participants had clinically serious symptoms (cancer, fever, worsening neurological status, sudden change in pain). Subjects recruited from the research studies had moderate or worse pain measured using the pain thermometer[28] for 3 months or longer and according to standardized history, physical examination, and spine x-ray were without evidence of nonmechanical disease (e.g., cancer, infection, osteoporotic compression fractures) or they were pain-free (defined as pain less than once a week of no more than "little" intensity measured using the pain thermometer, anywhere in the body). Subjects were excluded if they reported recent sudden worsening of their pain. Using this method of recruitment, it was assured that all CLBP participants had mechanical LBP, which is reflective of the vast majority of older adults with CLBP. All participants, whether recruited from the OAPMP or the research studies, were evaluated at the time of the first encounter with them.

Procedures

The purpose of this study was to develop a reliable, structured physical examination protocol to help practitioners identify biomechanical and soft-tissue disorders that commonly exist in older adults with CLBP. The targeted disorders do not require spinal imaging for evaluation and, with the exception of severe hip arthritis, are amenable to noninvasive or minimally invasive treatment. The ultimate goal for the tool was to triage older adults with CLBP to appropriate specialists for further evaluation and treatment.

As a first step in protocol development, an expert panel was convened. This panel of three physical therapists (PB) and a geriatrician/rheumatologist (DKW) first agreed upon the categories of pathology commonly overlooked or misdiagnosed by primary practitioners in older adults with CLBP. Four categories were identified: myofascial pain, fibromyalgia, SIJ syndrome, and hip disease.

Next, a list of physical examination abnormalities commonly found in these patients was created that included the abnormal findings themselves as well as postural abnormalities (i.e., kyphosis and scoliosis) and functional leg length discrepancies that contribute to the four categories of pathology. Pain with axial movement was also assessed because of its association with disability[29] and its utility in differentiating mechanical from visceral disease. An operational definition for each of the physical findings was then developed and a clinically feasible protocol outlined. The examiners (SS and DW) underwent training in the resulting protocol under the tutelage of one of the expert physical therapists (PB) to refine and standardize the physical examination procedures shown in Table 1. Lower extremity assessment was included in the protocol because of the common co-occurrence of low back and leg pain and the diverse associated pathologies and treatment approaches.

The interrater reliability of this examination tool was tested in two phases on 30 subjects with CLBP. The second examiner performed the physical examination independently and within 5 minutes of the first examiner. In Phase 1, both examiners evaluated 16 subjects. Retraining then occurred in an effort to optimize standardization of the protocol, after which both examiners evaluated 14 additional subjects.

Measures

The University of Pittsburgh institutional review board approved the following protocol. All research study subjects signed informed consent. Data collected on clinic patients were de-identified.

1. Demographic and descriptive information—Information on age, sex, pain duration (in years), pain location (low back, buttocks, legs), and history of lumbar surgery was collected.
2. LBP history—All subjects were interviewed to determine the presence of neurogenic claudication that suggested lumbar spinal stenosis (LBP radiating to the buttocks or legs with standing or walking, relieved with rest or forward flexion). All histories were taken and clinical impressions documented with the examiner masked to any available MRI findings. Current or recent history of pain involving the buttocks or legs was also documented.
3. Physical examination findings—The protocol outlined in Table 1 was administered to all subjects.

Data Analysis

Descriptive statistics for the sample were generated to obtain a prevalence estimate of biomechanical and soft-tissue pathology in older adults with CLBP. Interrater reliability of individual examination findings was evaluated using the kappa statistic, Kendall's tau, or Pearson correlation coefficient, as appropriate, for the 30 subjects who underwent the repeat examination. A reliability of 0.00 to 0.40

Table 1. Physical Examination Abnormalities in Older Adults with Low Back and Leg Pain

Finding	Operational Definition	Examination Technique	Criteria for Positive Finding	Scoring
Fibromyalgia tender points	Presence of pain when approximately 4 kg of force is applied to defined tender points.	Have patient sit comfortably on examination table, arms resting in lap. Tell patient that you are going to apply pressure at several points on the body and that you want to know whether pressure on any point causes pain. Examine the following points bilaterally, using enough pressure to blanch thumb nail: (1) occiput at suboccipital muscle insertions (2) low cervical at the anterior aspects of the intertransverse spaces at C5–C7 (3) trapezius, midpoint of upper border (4) supraspinatus at origins, above the scapular spine near the medial border (5) 2nd rib at the 2nd costochondral junction, just lateral to the junction on the upper surfaces (6) lateral epicondyle 2 cm distal to the epicondyle (7) medial fat pad of the knee, proximal to joint line (8) greater trochanter, just posterior to the trochanteric prominence (9) gluteal at upper outer quadrant of buttocks in anterior fold of muscle	Patient reports pain when point is palpated.	0 = no pain 1 = pain Score range: 0–18
Functional leg length discrepancy	Pelvic asymmetry	Have patient stand with both feet on floor, shoes removed. Ask him to stand with feet together and as erect as possible. Kneel behind patient. With palms parallel to floor and fingers extended, place lateral surface of index finger of both hands atop pelvic brim bilaterally. Eyes should be level with hands while performing the examination. Determine whether right and left hands are at different heights.	Left-right discrepancy of pelvic brim height.	0 = no discrepancy 1 = difference in heights noted
Scoliosis (lateral/ rotational)	Lateral/rotational curvature of thoracolumbar spine	Have patient stand on floor with shoes removed. Stand behind patient. Run index finger along spinous processes (do not lift hand between vertebrae) three times. If you do not detect scoliosis, then: Ask patient to bend forward. Determine whether there is asymmetry in height of paraspinal musculature.	Evidence of scoliosis on palpation or asymmetry in height of paraspinal musculature when patient flexes forward.	0 = no scoliosis 1 = scoliosis
Sacroiliac joint pain	Pain with direct palpation of sacroiliac joint or with Patrick test	Direct Palpation: Have patient stand on floor with shoes removed. Stand behind patient. Exert firm pressure over sacroiliac joint, first on one side then the other. Palpate right	Unilateral pain on palpation.	0 = no pain 1 = pain Score range: 0–2

(Continued)

Table 1. (Contd.)

Finding	Operational Definition	Examination Technique	Criteria for Positive Finding	Scoring
		joint with right thumb, standing to left side of patient; palpate left joint with left thumb, standing to right of patient.		
		Patrick test: Have the patient lie supine on the examining table and place the foot of involved side on opposite knee. Then slowly lower the test leg in abduction toward the examining table. If patient reports pain in back (not groin, buttocks, or leg), then test is positive.		0 = no pain 1 = pain Score range: 0–2
Myofascial pain, piriformis	Presence of pain on deep palpation of piriformis	Have patient lay supine on examination table. Have patient flex right hip and knee, keeping sole of foot on table. Cross bent leg over opposite leg; again place sole on table and exert mild medially directed pressure on lateral aspect of knee to put piriformis in stretch. Exert firm pressure (4 kg) over middle extent of piriformis. Repeat examination on opposite side.	Patient reports pain when muscle is firmly palpated.	0 = no pain 1 = pain Score range: 0–2
Myofascial pain, tensor fasciae latae (TFL) with or without iliotibial (IT) band pain	Presence of pain on deep palpation of tensor fascia lata or IT band	Have patient lie supine on examination table. Using thumbs of both hands, exert firm pressure (4 kg) over full extent of TFL and IT band. Repeat examination on opposite side.	Patient reports pain when muscle or band is firmly palpated.	0 = no pain 1 = pain Score range: 0–2
Kyphosis	Deformity of thoracic spine creating forward flexed posture	Have patient stand on floor with shoes removed. Ask him to stand fully erect. Inspect posture from the side.	Fixed thoracic forward curvature.	0 = no kyphosis 1 = kyphosis
Myofascial pain of paralumbar musculature	Presence of pain on deep palpation of paralumbar musculature	Have patient stand on floor with shoes removed. Stand behind and to left of patient and brace him in front with left arm; palpate full extent of right paravertebral musculature with right thumb. Exert approximately 4 kg force. Repeat, palpating the left paravertebral musculature.	Patient reports pain when muscle is firmly palpated.	0 = no pain 1 = pain Score range: 0–2
Vertebral body pain	Presence of pain on firm palpation of lumbar spinous processes	Position yourself behind patient, as for examination of paravertebral musculature above. Using dominant thumb, firmly palpate spinous processes L1–L5.	Patient reports pain when any spinous process is firmly palpated.	0 = no pain 1 = pain
Hip disease	Pain and restricted motion of hip	Hip internal rotation: Have patient lie supine on examining table with hip and knee bent to 90°. Put the hip into maximum internal rotation and ask patient whether he experiences pain.	Pain with maximal internal rotation	0 = no pain 1 = pain Score range: 0–2
		Patrick test: As above.	Pain in groin, buttocks, or leg (not back).	0 = no pain 1 = pain Score range: 0–2
Axial pain on movement	Presence of pain on maximal forward flexion, extension, lateral flexion, or axial rotation	Have patient stand on floor with shoes removed and hands at side.	Report of pain with movement	0 = no pain 1 = pain Score range: 0–6

Table 1. (Contd.)

Finding	Operational Definition	Examination Technique	Criteria for Positive Finding	Scoring
		Ask patient whether he has pain when he: bends forward. Then ask him to bend forward as far as possible, or until he reports pain. bends backward. Then ask him to bend backward as far as possible (brace from behind), or until he reports pain. bends to the side. Then ask him to bend laterally to right then left as far as possible while sliding arm down leg or until he reports pain. twists. Then ask him to perform axial rotation maximally to right then left as far as possible or until he reports pain.		

was accepted as marginal, a value of 0.40 to 0.75 was considered good, and a value greater than 0.75 was interpreted as excellent.[30] Because of sometimes paradoxical behavior of the kappa statistic, percentage agreement (p_0), percentage positive agreement (p_{pos}), and percentage negative agreement (p_{neg}) were also computed.[31,32] To evaluate the efficacy of the protocol as a triage tool, individual tests were placed into one of four categories depending on whether a positive finding was an indicator of SIJ pain, myofascial pain, fibromyalgia, or hip disease. A positive finding for an individual test rendered a positive score for the triage category. The interrater reliability for these triage findings was also generated using the kappa statistic, p_0, p_{pos}, and p_{neg}. Discriminant validity of each of the tests was assessed by comparing each examination component between those with and without pain using Fisher exact test, Wilcoxon rank sum test, or Jonckheere-Terpstra test.[33,34]

RESULTS

Sample Characteristics

Sample characteristics of the 131 participants are summarized in Table 2. Twenty were pain-free, and 111 reported CLBP with or without leg pain. Mean age for the pain group was 75, and 59% were women; mean age for the pain-free group was 74, and 50% were women. CLBP subjects reported symptoms for an average of 158.4 months (13.2 years) with 52% experiencing concomitant buttocks pain and 52% concomitant leg pain. Twenty-six percent of CLBP subjects reported symptoms consistent with spinal stenosis (i.e., neurogenic claudication), and 16% had undergone back surgery.

Prevalence of Painful Disorders

Table 3 summarizes the prevalence of physical examination findings as determined by one rater. The most common findings were myofascial pain in 95.5% of CLBP subjects, SIJ pain in 83.6% of subjects, and signs of hip disease in 48.0%. Thirteen percent of subjects had neurogenic claudication and physical findings consistent with SIJ syndrome plus myofascial pain of the piriformis, tensor fascia lata/iliotibial (TFL/IT) band, or both. Thirty-six percent of subjects had SIJ syndrome plus piriformis myofascial pain, TFL/IT band pain, or both in the setting of scoliosis but no neurogenic claudication. Ninety-six percent of subjects with CLBP had one or more abnormalities identified by the physical examination protocol. One subject had evidence only of hip disease; 6.9% had only myofascial findings; 4.9% had a combination of hip disease and myofascial pain; and one had a combination of fibromyalgia tender points, hip disease, and myofascial pain. SIJ pain never occurred in isolation. Thirty-one percent of participants had only SIJ pain and myofascial pain; 31% had SIJ pain, hip pain, and myofascial pain; 9.8% had SIJ pain, fibromyalgia tender points, and myofascial pain; and 9.8% had SIJ pain, myofascial pain, hip pain, and fibromyalgia tender points.

Interrater Reliability

Interrater reliability of the individual components of the physical examination protocol is shown in Table 4. SIJ pain (0.81), fibromyalgia tender points (0.84), and TFL/IT band

Table 2. Sample Characteristics

Characteristic	Main Sample: With Pain (n = 111)	Main Sample: Without Pain (n = 20)	Reliability Subsamples: Pretraining (n = 16)	Reliability Subsamples: Posttraining (n = 14)	Reliability Subsamples: Combined (n = 30)
Age, mean ± SD	74.8 ± 6.3	73.8 ± 5.9	73.8 ± 4.7	74.9 ± 8.1	74.3 ± 6.4
Female, n (%)	65 (58.6)	10 (50.0)	8 (50.0)	7 (50.0)	15 (50.0)
Pain duration (months), mean ± SD	158.4 ± 159.3	—	107.6 ± 127.0	93.6 ± 80.7	101.1 ± 106.3
Surgery, n (%)	17 (15.5)	0 (0.0)	0 (0.0)	2 (14.3)	2 (6.9)
Buttocks pain, n (%)	58 (52.3)	0 (0.0)	5 (31.3)	10 (71.4)	15 (50.0)
Left	38 (34.2)	0 (0.0)	3 (18.8)	6 (42.9)	9 (30.0)
Right	43 (38.7)	0 (0.0)	4 (25.0)	7 (50.0)	11 (36.7)
Leg pain, n (%)	58 (52.3)	0 (0.0)	5 (31.3)	6 (42.9)	11 (36.7)
Left	41 (36.9)	0 (0.0)	3 (18.8)	5 (35.7)	8 (26.7)
Right	43 (38.7)	0 (0.0)	4 (25.0)	6 (42.9)	10 (33.3)
Clinical spinal stenosis, n (%)	28 (25.7)	0 (0.0)	4 (25.0)	0 (0.0)	4 (13.3)

SD = standard deviation.

pain (0.78) had excellent posttraining reliability values; hip disease according to Patrick test (0.45) and internal rotation (0.56), scoliosis (0.43), kyphosis (0.66), pain with axial motion (0.75), and piriformis myofascial pain (0.71) had good posttraining reliability values; lumbar paravertebral myofascial pain (0.39) and functional leg length discrepancy (LLD) (0.0) had marginal posttraining reliability values. Because kappa values can be misleading under certain conditions, simple descriptive measures (p_0, p_{pos}, and p_{neg}) were also evaluated, with results shown in Table 4.

Effects of Retraining

Retraining was found to be especially helpful for the identification of myofascial pain, SIJ pain, and hip pain according to internal rotation but not according to Patrick test. Kappa values for interrater agreement were 0.29 before versus 0.63 after retraining for myofascial pain, 0.54 before versus 0.81 for SIJ pain, and 0.38 versus 0.56 for hip internal rotation. There was no significant change in reliability for fibromyalgia tender points (0.89 vs 0.84).

DISCUSSION

The purpose of this study was to determine the prevalence, reliability, and discriminant validity of biomechanical and soft-tissue abnormalities in community-dwelling older adults with CLBP. The findings suggest that these abnormalities are common, that the majority can be detected reliably, and that they appear to have good discriminant validity. The findings also suggest that CLBP in older adults should be considered a clinical syndrome with multiple potential physical contributors rather than idiopathic, as the current literature suggests.[35]

The vast majority of subjects with CLBP had physical findings consistent with SIJ pain (83.6%), myofascial pain (95.5%), or both. Forty-eight percent had hip pain, 19% had 11 or more of 18 tender points supportive of fibromyalgia,[36] and 88% had multiple sites of pain-related pathology. Furthermore, although 26% of subjects had a clinical history supportive of lumbar spinal stenosis, none of the 111 participants with CLBP had clinically serious symptoms that pointed to a need for advanced imaging. These findings, taken together, have potentially important implications regarding healthcare delivery and resource utilization for older adults with CLBP.

Nonsurgical interventions can largely be used to manage the disorders targeted by the physical examination protocol. At the foundation of myofascial pain treatment related to LBP is identification and modification of perpetuating factors such as poor posture, dysfunctional body mechanics, and leg length discrepancies.[37] Gentle stretching, exercise, and trigger point injections may also be beneficial. A variety of noninvasive treatment approaches, including aerobic exercise, tricyclic antidepressants, oral analgesics, and cognitive behavioral therapy, may be beneficial for the treatment of fibromyalgia, a disorder that is common in older women.[24] Treatment of SIJ syndrome can be challenging because of the complexity of this disorder, but as with myofascial pain, management of contributing factors such as functional LLD, pelvic musculature abnormalities, and lower extremity arthritis should start the process,[38] perhaps along with SIJ injection.[39]

The first step in treatment of hip disease is the sometimes challenging differentiation of this problem from that of spine disease[40] or, as in the case of the participants in the current study, recognition of the co-occurrence of these disorders. The purpose of the maneuvers in the protocol (pain with internal hip rotation and pain with flexion, abduction, and external hip rotation (Patrick test)) is to help the examiner determine whether there is a problem with the hip joint itself or the periarticular musculature. Although it may not be possible to definitively make this determination on examination, abnormalities on either maneuver should prompt a plain hip radiograph and referral for nonsurgical or surgical treatment, depending upon the severity of symptoms and response to prior treatments.

Interrater reliability for the finding of SIJ pain improved significantly after retraining (0.54 preretraining, 0.81 postretraining), as did myofascial pain (0.29 preretraining and 0.63 postretraining). Postretraining reliability for the assessment of piriformis myofascial pain and TFL/IT band pain was 0.71 and 0.81, respectively, whereas relia-

Table 3. Prevalence of Physical Examination Findings in Older Adults ($\geq$60) with and without Low Back Pain

Examination Component	Range	Prevalence or Score: With Pain (n = 111)	Without Pain (n = 20)	*P*-value*
Functional leg length discrepancy, n (%)	yes/no	19 (17.1)	1 (5.0)	.31
Scoliosis, n (%)	yes/no	86 (77.5)	12 (60.0)	.16
Kyphosis, n (%)	yes/no	34 (30.6)	3 (15.0)	.18
Axial pain				
Pain with axial motion, mean ± SD	0–6	2.47 (1.88)	0.0 (0.0)	<.001
Forward flexion, n (%)	yes/no	42 (37.8)	0 (0.0)	<.001
Extension, n (%)	yes/no	53 (47.8)	0 (0.0)	<.001
Right lateral flexion, n (%)	yes/no	59 (53.2)	0 (0.0)	<.001
Left lateral flexion, n (%)	yes/no	57 (51.4)	0 (0.0)	<.001
Right axial rotation, n (%)	yes/no	31 (27.9)	0 (0.0)	.004
Left axial rotation, n (%)	yes/no	32 (28.8)	0 (0.0)	.003
Lumbar vertebral pain, n (%)	yes/no	59 (53.2)	0 (0.0)	<.001
Sacroiliac joint pain (triage), n (%)	yes/no	92 (83.6)	1 (5.0)	<.001
Sacroiliac joint pain with palpation	0–2	71 (64.0)	1 (5.0)	<.001
Left, n (%)	yes/no	80 (72.1)	1 (5.0)	<.001
Right, n (%)	yes/no	14 (13.2)	0 (0.0)	<.001
Patrick test for back pain	0–2	25 (24.5)	0 (0.0)	.005
Left, n (%)	yes/no			.12
Right, n (%)	yes/no			.01
Fibromyalgia tender points, mean ± SD	0–18	5.6 (5.2)	0.8 (1.8)	<.001
≥11 (triage), n (%)	yes/no	21 (19.3)	0 (0.0)	.04
Myofascial pain (triage), n (%)	yes/no	106 (95.5)	2 (10.0)	<.001
Lumbar paravertebral	0–2	61 (55.0)	1 (5.0)	<.001
Left, n (%)	yes/no	63 (56.8)	0 (0.0)	<.001
Right, n (%)	yes/no	63 (56.8)	1 (5.0)	<.001
Piriformis	0–2	57 (51.4)	0 (0.0)	<.001
Left, n (%)	yes/no	68 (61.3)	2 (10.0)	<.001
Right, n (%)	yes/no	68 (61.3)	1 (5.0)	<.001
Tensor fascia lata with/without iliotibial band pain	0–2			<.001
Left, n (%)	yes/no			<.001
Right, n (%)	yes/no			<.001
Hip disease (triage), n (%)	yes/no	50 (48.1)	0 (0.0)	<.001
Patrick test positive for hip pain	0–2	28 (26.4)	0 (0.0)	<.001
Left, n (%)	yes/no	33 (32.4)	0 (0.0)	.007
Right, n (%)	yes/no	15 (13.9)	0 (0.0)	.002
Internal rotation test	0–2	20 (18.5)	0 (0.0)	.02
Left, n (%)	yes/no			.13
Right, n (%)	yes/no			.04

* *P*-value obtained using Fisher exact test for dichotomous examination components, Jonckheere-Terpstra test for those scoring 0–2, and Wilcoxon rank sum test for pain with axial motion (0–6) and fibromyalgia tender points (0–18).
SD = standard deviation.

bility for the assessment of lumbar paravertebral musculature was poor (0.39). Poor reliability for the assessment of myofascial findings in the lower back has previously been reported.[41] The good reliability for the assessment of the piriformis and TFL/IT band in this study was therefore encouraging. The lesser reliability of the piriformis examination than of the TFL/IT band likely relates to the fact that the piriformis is a deeper and more-challenging muscle to examine.

Postretraining reliability for the identification of postural abnormalities and functional LLD and the potential relationship between these abnormalities and LBP is worthy of discussion. There was modest improvement for the identification of scoliosis (0.26 vs 0.43) and significant improvement for identification of kyphosis after retraining (−0.08 vs 0.66) but poor reliability for functional LLD and no improvement after retraining. Although kyphosis primarily involves the thoracic spine, practitioners should be aware of its potential for contribution to LBP. Several mechanisms may be involved, including direct involvement of lumbar vertebrae; altered spinal mechanics, including pseudoarthroses[42] and paraspinal muscle pain; and direct pressure of the rib cage on the pelvis.[43] Based upon the high prevalence of scoliosis in subjects with pain and those who were pain-free, it appears that this postural abnormality is not alone sufficient to cause symptoms. It is also possible

Table 4. Physical Examination Findings: Interrater Reliability and Utility as a Triage Tool (n = 30; 16 preretraining, 14 postretraining)

		Measures of Interrater Agreement (Pre/Post/Total Reliability Sample)			
Examination Component	Range	Reliability*	Percentage Agreement	Percentage Positive Agreement	Percentage Negative Agreement
Functional leg length discrepancy	yes/no	0.09/ – 0.17/0.00	69/71/70	29/0/18	80/83/82
Scoliosis	yes/no	0.26/0.43/0.33	69/79/73	78/86/82	44/57/50
Kyphosis	yes/no	– 0.08/0.66/0.21	50/86/67	20/75/44	64/90/76
Axial pain					
Pain with axial motion	0–6	0.80/0.75/0.77			
Forward flexion	yes/no	0.71/0.32/0.56	88/79/83	80/40/67	91/87/89
Extension	yes/no	0.50/0.84/0.65	75/93/83	71/89/78	78/95/86
Right lateral flexion	yes/no	0.73/1.00/0.86	88/100/93	83/100/92	90/100/94
Left lateral flexion	yes/no	0.61/0.57/0.59	81/79/80	77/77/77	84/80/82
Right axial rotation	yes/no	0.46/0.65/0.53	75/86/80	60/75/67	82/90/86
Left axial rotation	yes/no	0.54/0.76/0.63	81/93/87	67/80/71	87/96/91
Lumbar vertebral pain	yes/no	0.43/0.59/0.47	69/79/73	67/80/73	71/77/73
Sacroiliac joint pain (triage)	yes/no	0.54/0.81/0.66	81/93/87	87/95/91	67/86/75
Sacroiliac joint pain with palpation	0–2	0.51/0.70/0.59			
Left	yes/no	0.38/0.85/0.60	69/93/80	67/94/81	71/91/79
Right	yes/no	0.60/0.51/0.56	81/79/80	86/84/85	73/67/70
Patrick test for back pain	0–2	0.63/0.45/0.54			
Left	yes/no	0.43/ – 0.08/0.26	88/85/86	50/0/33	93/92/92
Right	yes/no	0.43/0.23/0.30	88/69/79	50/33/40	93/80/88
Fibromyalgia tender points	0–18	0.89/0.84/0.87			
≥11 (triage)	yes/no	0.85/0.63/0.79	94/93/93	89/67/83	96/96/96
Myofascial pain (triage)	yes/no	0.29/0.63/0.42	81/93/87	89/96/92	40/67/50
Lumbar paravertebral	0–2	0.34/0.39/0.34			
Left	yes/no	0.25/0.43/0.33	63/71/67	67/67/67	57/75/67
Right	yes/no	0.40/ – 0.09/0.22	69/50/60	67/63/65	71/22/54
Piriformis	0–2	0.60/0.71/0.66			
Left	yes/no	0.21/0.59/0.41	63/79/70	70/77/73	50/80/67
Right	yes/no	0.50/0.71/0.59	75/86/80	78/88/82	71/83/77
Tensor fascia lata with/without iliotibial band	0–2	0.70/0.78/0.75			
Left	yes/no	0.61/0.81/0.70	81/93/87	84/95/90	77/86/80
Right	yes/no	0.74/0.76/0.75	88/93/90	90/96/93	83/80/82
Hip disease (triage)	yes/no	0.73/0.35/0.59	88/69/79	90/50/79	83/78/80
Patrick test positive for hip pain	0–2	0.64/0.45/0.58			
Left	yes/no	0.49/0.63/0.58	75/92/83	71/67/71	78/96/88
Right	yes/no	0.38/0.18/0.28	69/62/66	67/29/55	71/74/72
Internal rotation test	0–2	0.38/0.56/0.47			
Left	yes/no	– 0.09/0.63/0.27	81/92/86	0/67/33	90/96/92
Right	yes/no	–––/0.44/0.24	81/85/83	0/50/29	90/91/90

* Kappa for dichotomous examination components, Kendall's tau for those scoring 0–2 and pain with axial motion (0–6), and Pearson correlation coefficient for fibromyalgia tender points (0–18).

that the method used to detect scoliosis was inaccurate. Future studies should employ anteroposterior spine radiograph-measured Cobb angle[44] to further explore the contribution of scoliosis to LBP in older adults.

The relationship between LBP and LLD is controversial,[45] although this has not been specifically examined in older adults. The role of LLD in causing SIJ syndrome is accepted[38] and in the authors' experience is a particular concern in older adults after total hip or knee replacement. The method that was devised for assessing functional LLD was unreliable, although the low prevalence of this phenomenon in these subjects may have contributed to the low interrater reliability.

A methodological strength of this study was the rigorous treatment of data, with attention to possible paradoxical behavior of the commonly used kappa statistic. Prevalence influences the kappa statistic, like any other omnibus index used in a two-by-two table setting,[46,47] which can have a small value despite a higher rate of interrater agreement and vice versa.[31] To confirm that the high kappa statistics observed with the examination components were due to good and excellent interrater reliability rather than a fortunate combination of ratings, p_0, p_{pos}, and p_{neg} were also evaluated, and similar findings were reached.[32]

Comparison of the preretraining and postretraining data suggests that learning reinforcement is an important component of teaching primary care practitioners these critical physical examination skills and that, after such learning reinforcement, competence can be achieved. The protocol is also practical, taking no more than 5 minutes to perform. In a busy office practice, the intake nurse could conceivably evaluate older adults with CLBP using the protocol described in this study.

Although this novel approach to the physical assessment of CLBP and the encouraging interrater reliability findings are noteworthy, the study's limitations should also be pointed out. Because the subjects were a convenience sample that consisted of individuals who presented to a tertiary referral center pain clinic or who presented for evaluation in the context of LBP research studies, it may not be appropriate to generalize these results to all older adults with CLBP. In addition, because of the cross-sectional nature of the study, it could only be concluded that these physical examination abnormalities were associated with LBP, but causal links could not be tested. Future studies will examine the relationship between treatment of the physical abnormalities identified and pain reduction.

The structured physical examination protocol was developed as a screening tool to help primary providers identify common soft-tissue and biomechanical abnormalities associated with LBP. There are likely many more physical examination abnormalities not included in the protocol that contribute to LBP, such as knee disease and muscular weakness and restrictions. Future studies designed to deconstruct LBP in older adults should include a more-comprehensive list of musculoskeletal impairments. The protocol is not a tool to identify all of the contributors to LBP in older persons but a potential substitute for commonly ordered imaging studies in older adults with LBP who have no clinically serious symptoms. Basic and advanced imaging in these patients often identifies skeletal pathology that is incidental[9,12,48] and cannot identify soft-tissue pathology and other important subtle biomechanical abnormalities that contribute to pain.

Another limitation of the study is that the two examiners were not masked to the clinical status of the participants (i.e., they knew whether patients had back pain or were pain-free) to simulate a real-world clinical encounter; thus, the possibility exists that this knowledge may have biased the examination techniques. Nevertheless, the possibility of this significantly influencing the results is low, because the examiners were careful to follow the protocol as outlined and the magnitude of the difference in prevalence of findings between groups was substantial. In addition, nonverbal indicators of pain are common in older adults with CLBP;[49] thus, true masking to pain status may not be feasible. Future examination of the reliability and validity of this protocol will employ participants in a primary care setting that includes independent examiners who are masked to participants' clinical status.

Significant healthcare resources are spent on MRIs in the evaluation of patients with LBP, even though the correlation between MRI findings and clinical symptoms is poor,[9,11] and the likelihood of ongoing pain and disability after MRI-directed back surgery is not insubstantial.[13–19] Because these findings were based upon a small convenience sample, additional investigation in this area should be undertaken. To improve the care of older adults with LBP, a paradigm shift is needed. Primary care physicians must assume the role of frontline pain practitioners. Hands-on physical examination must take the place of expensive technology that often confuses rather than clarifies the treatment needed to effect improvement. Whether the physical examination protocol described in this study is feasible and accurate in the primary care setting and whether its implementation could result in improved patient outcomes should be the subject of future investigation.

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REFERENCES

1. Lavsky-Shulan M, Wallace RB, Kohout FJ et al. Prevalence and functional correlates of low back pain in the elderly: The Iowa 65+ rural health study. J Am Geriatr Soc 1985;33:23–28.
2. Reid MC, Williams CS, Concato J et al. Depressive symptoms as a risk factor for disabling back pain in community-dwelling older persons. J Am Geriatr Soc 2003;51:1710–1717.
3. Gentili A, Weiner DK, Kuchibhatla M et al. Factors that disturb sleep in nursing home residents. Aging (Milano) 1997;9:207–213.
4. Carey TS, Evans A, Hadler N et al. Care-seeking among individuals with chronic low back pain. Spine 1995;20:312–317.
5. Bosley BN, Weiner DK, Rudy TE et al. Is chronic nonmalignant pain associated with decreased appetite in older adults? Preliminary evidence. J Am Geriatr Soc 2004;52:247–251.
6. Weiner DK, Haggerty CL, Kritchevsky SB et al. How does low back pain impact physical function in independent, well-functioning older adults? Evidence from the Health ABC cohort and implications for the future. Pain Med 2003;4:311–320.
7. Weiner DK, Turner GH, Hennon JG et al. The state of chronic pain education in geriatrics fellowship training programs: Results of a national survey. J Am Geriatr Soc in press.
8. Schroth WS, Schectman JM, Elinsky EG et al. Utilization of medical services for the treatment of acute low back pain: Conformance with clinical guidelines. J Gen Intern Med 1992;7:586–597.
9. Boden SD, Davis DO, Dina TS et al. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects. A prospective investigation. J Bone Joint Surg Am 1990;72:403–408.
10. Wiesel S, Tsourman N, Feffer H. A study of computer-assisted tomography. I. The incidence of positive CAT scans in an asymptomatic group of patients. Spine 1984;9:549–551.
11. Jensen M, Brant-Zawadzki M, Obuchowski N et al. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med 1994; 331:69–73.

12. Jarvik JJ, Hollingworth W, Heagerty P et al. The Longitudinal Assessment of Imaging and Disability of the Back (LAIDBack) Study: Baseline data. Spine 2001;26:1158–1166.
13. Osterman H, Sund R, Seitsalo S et al. Risk of multiple reoperations after lumbar discectomy. Spine 2003;28:621–627.
14. Keskimaki I, Seitsalo S, Osterman H et al. Reoperations after lumbar disc surgery. Spine 2000;25:1500–1508.
15. Yorimitsu E, Chiba K, Toyama Y et al. Long-term outcomes of standard discectomy for lumbar disc herniation. Spine 2001;26:652–657.
16. Malter AD, McNeney B, Loesser JD et al. 5-year reoperation rates after different types of lumbar spine surgery. Spine 1998;23:814–820.
17. Davis RA. A long-term outcome analysis of 984 surgically treated herniated lumbar discs. J Neurosurg 1994;80:415–421.
18. Hirsch C, Nachemson A. The reliability of lumbar disc surgery. Clin Orthop 1963;29:189–195.
19. Law JD, Lehman RAW, Kirsch WM. Reoperation after lumbar intervertebral disc surgery. J Neurosurg 1963;29:189–195.
20. Weiner DK, Rudy TE, Glick RM et al. Efficacy of percutaneous electrical nerve stimulation (PENS) for the treatment of chronic low back pain in older adults. J Am Geriatr Soc 2003;51:599–608.
21. Carragee EJ, Hannibal M. Diagnostic evaluation of low back pain. Orthop Clin North Am 2004;35:7–16.
22. Gerwin RD. Classification, epidemiology, and natural history of myofascial pain syndrome. Curr Pain Headache Rep 2001;5:412–420.
23. Dreyfuss P, Michaelsen M, Pauza K et al. The value of medical history and physical examination in diagnosing sacroiliac joint pain. Spine 1996;21: 2594–2602.
24. Wolfe F, Ross K, Anderson J et al. The prevalence and characteristics of fibromyalgia in the general population. Arthritis Rheum 1995;38:19–28.
25. Kee WG, Middaugh SJ, Redpath S et al. Age as a factor in admission to chronic pain rehabilitation. Clin J Pain 1998;14:121–128.
26. Harkins SW, Kwentus J, Price DD. Pain and the elderly. In: Benedetti C, Chapman CR, Moricca G, eds. Advances in Pain Research and Therapy. New York: Raven Press, 1984, pp 103–121.
27. Helme RD. Chronic pain management in older people. Eur J Pain 2001; 5(Suppl A):31–36.
28. Roland M, Morris R. A study of the natural history of back pain—Part I. Development of a reliable and sensitive measure of disability in low-back pain. Spine 1983;8:141–144.
29. Weiner DK, Rudy TE, Kim Y-S et al. Do medical factors predict disability in older adults with persistent low back pain? Pain 2004;112:214–220.
30. Rosner B. Fundamentals of Biostatistics. Belmont, CA: Duxbury Press, 2000.
31. Feinstein AR, Cicchetti DV. High agreement but low kappa. I. The problems of two paradoxes. J Clin Epidemiol 1990;43:543–549.
32. Cicchetti DV, Feinstein AR. High agreement but low kappa. II. Resolving the paradoxes. J Clin Epidemiol 1990;43:551–558.
33. Hollander M, Wolfe DA. Nonparametric Statistical Methods. New York: John Wiley & Sons, Inc., 1973.
34. Pirie W. Jonckheere tests for ordered alternatives. In: Kotz S, Johnson NL, eds. Encyclopedia of Statistical Sciences. New York: John Wiley & Sons, Inc., 1983, pp 315–318.
35. Jarvik JG, Deyo RA. Diagnostic evaluation of low back pain with emphasis on imaging. Ann Intern Med 2002;137:586–597.
36. Wolfe F, Smythe HA, Yunus MB et al. The American College of Rheumatology 1990 criteria for the classification of fibromyalgia—report of the multicenter criteria committee. Arthritis Rheum 1990;33:160–172.
37. Graff-Radford SB. Myofascial pain: Diagnosis and management. Curr Pain Headache Rep 2004;8:463–467.
38. Prather H. Sacroiliac joint pain: Practical management. Clin J Sport Med 2003;13:252–255.
39. Chou LH, Slipman CW, Bhagia SM et al. Inciting events initiating injection—proven sacroiliac joint syndrome. Pain Med 2004;5:26–32.
40. Brown MD, Gomez-Marin O, Brookfield KF et al. Differential diagnosis of hip disease versus spine disease. Clin Orthop Rel Res 2004;1:280–284.
41. Nice DA, Riddle D, Lamb R et al. Intertester reliability of judgments of the presence of trigger points in patients with low back pain. Arch Phys Med Rehabil 1993;73:893–898.
42. Phillips F. Minimally invasive treatments of osteoporotic vertebral compression fractures. Spine 2003;28:S45–S53.
43. Old J, Calvert M. Vertebral compression fractures in the elderly. Am Fam Physician 2004;69:111–116.
44. Cobb JR. Outline for the study of scoliosis. In: Instructional Course Lectures, Volume V. American Academy of Orthopaedic Surgeons, 1948, pp 261–275.
45. Gurney B. Leg length discrepancy. Gait Posture 2002;15:195–206.
46. Kraemer HC. Ramifications of a population model for kappa as a coefficient of reliability. Psychometrika 1979;44:461–472.
47. Grove WM, Andreasen NC, McDonald-Scott P et al. Reliability studies of psychiatric diagnosis: Theory and practice. Arch Gen Psychiatry 1981;38: 408–413.
48. Weiner DK, Distell B, Studenski S et al. Does radiographic osteoarthritis correlate with flexibility of the lumbar spine? J Am Geriatr Soc 1994;42:257–263.
49. Weiner D, Pieper C, McConnell E et al. Pain measurement in elders with chronic low back pain: Traditional and alternative approaches. Pain 1996;67: 461–467.