Journal of Gerontology: MEDICAL SCIENCES
2005, Vol. 60A, No. 6, 793–797

Back Pain and Decline in Lower Extremity Physical Function Among Community-Dwelling Older Persons

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Background. Little is known regarding the longitudinal effects of back pain on physical function among older persons. We sought to determine whether back pain leading to activity restriction (i.e., restricting back pain) is associated with decline in lower extremity physical function among community-dwelling older persons.

Methods. In this prospective study with an 18-month follow-up period, participants ($N = 659$) were aged 70 years or older and independent in bathing, dressing, transferring, and walking at baseline. Restricting back pain, defined as staying in bed for at least one-half day or cutting down on one's usual activities due to back pain, was ascertained during monthly telephone interviews. Lower extremity physical function was assessed using three timed, performance-based tests (rapid gait, chair stands, and foot taps) at baseline and 18 months. Decline in lower extremity physical function was defined as an increase in timed scores on these tests between the baseline and 18-month assessments.

Results. The mean (standard deviation) number of months with restricting back pain was 1.3 (2.3); 364 (55%) participants reported 0 months, 209 (32%) reported 1–3 months, and 86 (13%) reported 4 or more months. After adjustment for baseline performance score and other covariates, the number of months with restricting back pain was independently associated with worsening rapid gait ($p < .001$), chair stand ($p = .030$), and foot tap ($p < .001$) performance. The deleterious effects of the ''exposure'' were limited to participants with 4 months of restricting back pain.

Conclusions. Restricting back pain is independently associated with decline in lower extremity physical function among community-dwelling older persons. Treatment of restricting back pain may help to decrease functional decline in this population.

BACK pain is common among older persons (1,2) and is strongly associated with difficulty performing mobility-related tasks, as well as basic and instrumental activities of daily living (3–10). For example, among 5201 participants in the Cardiovascular Health Study (5), back and joint pain were the two most commonly reported symptoms causing difficulty performing 17 tasks of daily living. Furthermore, a cross-sectional association has been demonstrated between back pain and poorer lower extremity physical function among older disabled women (9), but not among high functioning older men and women (10). Longitudinal research examining the effects of back pain on physical function is scant (11,12).

We sought to prospectively determine the association between back pain and lower extremity physical function among community-dwelling older persons. Because the potentially deleterious effects of back pain are most likely to occur in older persons whose pain causes them to restrict their customary activities, we evaluated the relationship between restricting back pain and change in lower extremity physical function over an 18-month period. Change in lower extremity physical function is a pertinent outcome, because prospective studies have demonstrated associations between poor lower extremity physical function and subsequent decline in activities of daily living functioning (13,14), as well as increased rates of hospitalization (15), nursing home admission (16), and mortality (16).

Methods

Study Population

Participants were members of the Precipitating Events Project, a longitudinal study of 754 community-dwelling persons aged 70 years or older (17). Exclusion criteria included the need for personal assistance in any of four key activities of daily living—bathing, dressing, walking inside the house, and transferring from a chair; significant cognitive impairment with no available proxy (18); inability to speak English; diagnosis of a terminal illness with a life expectancy less than 12 months; and plans to move out of the New Haven area during the next 12 months. The assembly of the cohort has been described in detail elsewhere (17). The Human Investigation Committee at Yale University approved the study.

Of the 754 cohort members, 46 (6.1%) died, 27 (3.6%) refused to complete the 18-month follow-up assessment, 21 (2.8%) completed a telephone interview at 18 months and did not undergo the performance-based tests of physical function, and 1 (0.1%) participant had no assessment of restricting back pain. The remaining 659 (87.4%) participants constituted the analytic sample for the current study. Compared with these participants, the 95 cohort members who were not included in the analytic sample were significantly older {mean [standard deviation (*SD*)] age = 80.0 [5.8] vs 78.2 [5.1] years; $p = .002$} and demonstrated significantly slower scores on the performance-based tests at baseline. [For example, the mean (*SD*) times to walk 20 feet as quickly as possible (10 feet back and forth) at baseline for nonparticipants and participants were 12.6 (7.7) and 10.4 (6.1) seconds, respectively; $p = .009$.]

Data Collection

Monthly telephone assessments were conducted to ascertain the occurrence of restricting back pain. The baseline and 18-month follow-up assessments were conducted in participants' homes by research nurses, who were blinded to the results of the monthly assessments.

Restricting back pain.—Our independent variable was operationalized as the number of months with restricting back pain between the baseline and 18-month assessments. Each month, participants were asked ''Since we last talked (date of last interview), have you stayed in bed for at least half a day due to illness, injury, or other problem?'' and ''Have you cut down on your usual activities due to illness, injury, or any other problem?'' Participants who answered yes to either question were asked whether the activity restriction was due to back pain and/or to one or more of 23 other prespecified health problems (e.g., swelling in feet and/or ankles, cold or flu symptoms, fall or fall injury, etc.). Participants could report activity restriction due to causes other than back pain during months when restricting back pain was present or absent. The number of months with restricting back pain was summed for each participant. Follow-up data were available for 99.6% of the 11,820 scheduled monthly assessments. Test–retest reliability for the presence of restricting back pain (mean time between assessments = 4.1 days) was excellent (kappa = 0.84).

Lower extremity physical function.—To evaluate change in participants' lower extremity physical function, we administered three performance-based tests (19,20) at the baseline and 18-month assessments: (1) walk over a 20-foot course, i.e., 10 feet out and 10 feet back (rapid gait); (2) stand up and sit down from a hard-back chair three times with arms folded (chair stands); and (3) tap the ball of the right foot alternating between two circles, while seated comfortably in a chair (foot taps), a total of 10 times. Participants were instructed to perform each task as fast as they felt ''safe and comfortable'' doing so. The time required to complete each task was recorded to the nearest 0.1 second. The test–retest reliability of these measures has been previously demonstrated (20).

To determine the specificity of the relationship between restricting back pain and lower extremity physical function, we also evaluated a test of upper extremity physical function (21). Participants were instructed to put their right index finger on their nose, and then using this finger to tap one circle, retouch their nose, and tap the other circle (finger taps) a total of 10 times. The time required to complete this task was recorded to the nearest 0.1 second.

Participants who were unable, refused, or scored at or above the maximum allowable time (30 seconds except for rapid gait [60 seconds]) on any performance-based test were assigned the worst possible score for that test. At baseline, the number of participants assigned the worst possible score was 4 for rapid gait, 64 for chair stands, 7 for foot taps, and 2 for finger taps.

Covariates.—Demographic data included age, sex, race, educational level, and marital status. Information was collected on 12 self-reported, physician-diagnosed chronic conditions including hypertension; myocardial infarction; congestive heart failure; stroke; diabetes; hip fracture; fracture of wrist, arm, or spine since age 50; amputation of leg; chronic lung disease; cirrhosis or liver disease; cancer (other than minor skin cancer); and Parkinson's disease. We identified participants who were seen by a physician in the past year for back or other musculoskeletal pain by asking whether they had visited a physician in the past 12 months for arthritis and pain or stiffness in the back, hands, fingers, shoulders, hips, or knees. The use of analgesic medications was defined as either scheduled or as needed intake of acetaminophen, any nonsteroidal anti-inflammatory agent, or an opiate medication. (Because aspirin use has several indications, it was excluded from this list.) Participants' self-reported height and weight were used to determine their body mass index (BMI). Participants were asked to estimate the number of hours walked, on average, each week (22). We administered the Folstein Mini-Mental State Examination to measure participants' global cognitive status (23), and the 11-item Center for Epidemiologic Studies Depression (CES-D) Scale to assess for depressive symptoms (24). Participants' scores were transformed to correspond to the 20-item scale using a previously validated procedure (25), and participants with transformed scores of 16 or greater were considered to have depressive symptoms (25). Finally, we determined the number of months of activity restriction that were attributed to causes other than back pain, ascertained during the monthly interviews. We hereafter refer to this variable as restriction due to other causes.

Statistical Analysis

To estimate the association between restricting back pain and change in lower extremity physical function, we used multiple linear regression, with separate regression models for each performance-based test. In each case, the independent variable was the number of months with restricting back pain and the dependent variable was the difference in the time (in seconds) to perform the test between the baseline and 18-month assessments, with worsening performance (increase in time) coded as negative. We first constructed models that examined the relationship between restricting back pain and decline in lower extremity physical function adjusting only for participants' baseline performance. We subsequently constructed models that adjusted for baseline performance and age in years, sex, race (white vs other), marital status (currently married vs not), educational level, number of self-reported chronic conditions, history of clinically evident back pain, history of other clinically evident musculoskeletal pain, high BMI (greater than 27 kg/m^2), use of non-aspirin analgesics, Folstein Mini-Mental State Examination score, CES-D score, and the number of months with restriction due to other causes. These covariates were selected based on their potential association with the dependent and independent variables. All covariates except months with restriction due to other causes were assessed at baseline.

To more fully explore the relationship between our exposure and outcome variables, we conducted additional analyses in which the number of months with restricting back pain was treated as a categorical variable (0 months, 1–3 months, and 4 or more months). These cutpoints were selected based on the distribution of the independent variable and unadjusted data indicating a substantial decrement in performance between 3 and 4 months with restricting back pain. For each performance-based test, we used linear regression and the complete set of covariates described in the above models to compute the adjusted mean change score for each of the three categories and, using *t* tests, we subsequently compared 1–3 months and 4 or more months with restricting back pain, respectively, to the zero category.

Finally, to assess the specificity of the relationship between restricting back pain and change in lower extremity physical function, we examined the effects of the number of months with restriction due to other causes on change in lower extremity physical function.

Results

Table 1 shows the baseline characteristics of the participants according to the number of months with restricting back pain. Among all participants, the mean number of months with restricting back pain was 1.3 (range = 0–16); 364 (55%) participants reported 0 months, 209 (32%) reported 1–3 months, and 86 (13%) reported 4 or more months. For the group reporting 4 or more months, the mean (*SD*) number of months with restricting back pain was 6.3 (2.7). More months of restricting back pain were reported by women, unmarried persons, those with more chronic conditions, those who were seen by a physician in the past year for back pain, those taking non-aspirin analgesic medication, as well as those who had higher BMI and CES-D scores (Table 1). Significant trends were also present on two of the three baseline tests of lower extremity physical function (rapid gait and chair stands). Of the 168 (25.4%) participants who experienced 2 or more months with restricting back pain, 59 (35.1%) reported at least 3 consecutive months, and 107 (63.7%) reported at least 2 consecutive months with restricting back pain. Only 21 (12.5%) of the 168 participants reported that all of their months with restricting back pain occurred in a consecutive manner.

The relative proportions of participants whose physical function scores worsened during the 18-month study period were: rapid gait = 55%, chair stands = 45%, foot taps = 33%, and finger taps = 40%. The number of months with restricting back pain was significantly associated with worsening rapid gait, chair stand, and foot tap performance in models that adjusted for participants' baseline performance score only and in models that also included the complete set of covariates (Table 2). When restricting back pain was analyzed as a categorical variable, the deleterious effects of restricting back pain on lower extremity physical function were limited to participants who reported 4 or more months with restricting back pain (Table 3). Because back pain and depressive symptoms are strongly related (26), we conducted additional analyses that adjusted both for participants' baseline as well as change in depressive symptom scores, and found that our results did not change (data not shown).

In a final series of analyses, we examined the effects of the number of months with restriction due to other causes on change in lower extremity physical function. The mean (*SD*) number of months with restriction due to other causes in the sample was 2.3 (2.3), and ranged from 1.9 (2.2) to 2.8 (2.3) to 2.7 (2.3) across the three categories of restricting back pain (*p* for trend <.001). The number of months with restriction due to other causes showed a weaker association with decline in lower extremity physical function (as compared to the number of months with restricting back pain), and was significantly associated with worsening performance in rapid gait only. The regression coefficients for the continuous measures from the fully adjusted model were: rapid gait ($\beta = -0.293$; $p = .043$); chair stands ($\beta = -0.131$; $p = .143$); and foot taps ($\beta = -0.077$; $p = .257$).

Table 1. Baseline Characteristics of the Study Sample According to the Number of Months With Restricting Back Pain ($N = 659$)

Characteristic	Months With Restricting Back Pain: 0 ($N = 364$)	1–3 ($N = 209$)	≥4 ($N = 86$)	*p* Value*
Demographic				
Age in years, mean (*SD*)	78.0 (5.3)	78.4 (5.0)	78.4 (5.1)	.314
Female, *n* (%)	218 (59.9)	144 (68.9)	67 (77.9)	.001
White race, *n* (%)	324 (89.0)	193 (92.3)	77 (90.0)	.799
Years of school, mean (*SD*)	12.0 (2.8)	12.2 (2.9)	11.6 (3.1)	.645
Married, *n* (%)	192 (52.7)	95 (45.5)	28 (32.6)	<.001
Medical/Functional				
Number of chronic conditions, mean (*SD*)	1.3 (1.1)	1.6 (1.2)	1.9 (1.4)	<.001
Physician visit in past year for back pain, *n* (%)	36 (9.9)	38 (18.2)	28 (32.6)	<.001
Physician visit in past year for other musculoskeletal (but not back) pain, *n* (%)	65 (17.9)	26 (12.4)	13 (15.1)	.445
Analgesic medication use (excluding aspirin), *n* (%)	134 (36.8)	114 (54.5)	65 (75.6)	<.001
Body mass index ≥27 kg/m^2, *n* (%)	148 (40.7)	83 (39.7)	49 (57.0)	.008
Hours walked per week, mean (*SD*)	6.4 (5.5)	5.0 (4.8)	3.9 (4.3)	<.001
Cognitive/Psychological				
Folstein MMSE score, mean (*SD*)	26.8 (2.3)	26.9 (2.5)	26.7 (2.5)	.900
11-item CES-D score, mean (*SD*)	3.7 (2.8)	4.8 (3.4)	7.4 (3.7)	<.001
Depressive symptoms, *n* (%)	43 (11.8)	42 (20.1)	42 (48.8)	<.001
Physical performance (in seconds)				
Rapid gait, mean (*SD*)	10.0 (5.6)	10.4 (6.4)	12.2 (6.8)	.008
Chair stands, mean (*SD*)	11.8 (6.7)	12.2 (6.7)	13.9 (7.6)	.019
Foot taps, mean (*SD*)	7.7 (4.0)	7.6 (4.0)	8.2 (3.9)	.454
Finger taps, mean (*SD*)	12.1 (3.8)	12.1 (3.5)	13.0 (3.6)	.090

Note: **p* value is based on Mantel–Haenszel test for trend for the categorical characteristics and linear regression of characteristic on the three-level ordinal back pain measure for the continuous characteristics.

SD = standard deviation; MMSE = Mini-Mental State Examination; CES-D = Center for Epidemiologic Studies Depression Scale.

Discussion

We found that restricting back pain was strongly associated with decline in lower extremity physical function among community-dwelling older persons. We also found evidence of a possible threshold effect, in which the deleterious effects

Table 2. Multiple Linear Regression to Predict Change in Physical Function Between Baseline and 18 Months According to the Number of Months With Restricting Back Pain ($N = 658$)*

Timed Physical Performance Measure	Adjusted for Baseline Physical Performance Only: Regression Coefficient (Standard Error)‡	Adjusted for Baseline Physical Performance Only: p Value	Adjusted for all Covariates†: Regression Coefficient (Standard Error)	Adjusted for all Covariates†: p Value
Rapid gait	−0.61 (0.14)	<.001	−0.57 (0.15)	<.001
Chair stands	−0.26 (0.09)	.003	−0.19 (0.10)	.045
Foot taps	−0.28 (0.06)	<.001	−0.24 (0.07)	<.001
Finger taps	−0.20 (0.06)	.002	−0.10 (0.07)	.146

Note: *One participant was excluded from the analyses due to missing data on the number of hours walked per week.

†Estimates are adjusted for the following baseline covariates in addition to participants' score on the physical performance measure: age in years, sex, race (white vs other), married (yes vs no), educational level, number of self-reported chronic conditions, physician visit in past year for back pain, physician visit in the past year for other musculoskeletal (but not back) pain, high body mass index, use of non-aspirin analgesics, number of hours walked per week, Folstein Mini-Mental State Examination score, Center for Epidemiologic Studies Depression Scale score, as well as the number of months with activity restriction due to other causes that occurred during follow-up.

‡Coefficient indicates change (in seconds, with negative indicating slowing) in the timed performance measure for each 1-month increment with activity restricting back pain.

Table 3. Adjusted Mean Change in Physical Function According to the Number of Months With Restricting Back Pain Between Baseline and 18 Months ($N = 658$)

Physical Performance Measure	0: LS Mean (SE)	1–3: LS Mean (SE)	1–3: p Value†	≥4: LS Mean (SE)	≥4: p Value
Rapid gait	−1.26 (0.45)	−1.62 (0.57)	.631	−3.47 (0.96)	.045
Chair stands	0.65 (0.27)	1.20 (0.35)	.229	−0.85 (0.58)	.026
Foot taps	1.44 (0.21)	1.65 (0.27)	.539	0.04 (0.44)	.006
Finger taps	0.22 (0.20)	0.82 (0.26)	.073	0.004 (0.43)	.664

Note: Least squares (LS) means are adjusted for the participants' baseline score on the relevant test; baseline demographic, medical, functional, cognitive, and psychological covariates; and the number of months with restriction due to other causes (as described in Methods).

†p value is for t test comparing the LS means for 1–3 months or 4 or more months with restricting back pain to the 0 months with restricting back pain category.

SE = standard error.

of restricting back pain were limited to participants with 4 or more months of restricting back pain.

Two prior prospective studies (11,12) have demonstrated a relationship between back pain and self-reported disability among older persons. In a study (11) that sought to identify long-term predictors of high physical function, the absence of back pain at baseline was associated with high self-reported physical function at the 19-year follow-up (adjusted odds ratio = 2.0, 95% confidence interval = 1.1–3.6). In the Framingham Disability Study (12), the presence of ''back problems'' at baseline was associated with greater self-reported disability at the 27-year follow-up assessment, although the magnitude of this association was not provided. Our results, when coupled with these findings, provide additional support for a back pain–disability relationship.

While our study did not directly evaluate the relationship between back pain and disability, a decline in lower extremity physical function due to restricting back pain could lead to difficulty performing a wide array of functional activities including transfers, housecleaning, and walking outside the home. Over time, older persons affected by restricting back pain may cease doing one or more of these activities altogether. Although the mechanisms underlying a back pain–disability relationship are likely complex, a decline in lower extremity physical function likely lies on the causal pathway.

Although few studies have examined rates of change in physical function using performance-based measures, at least one study (27) examined change in gait speed among disabled older women living in the community. The mean decline in gait speed (expressed as the percent change from baseline) was 5.2% over a 12-month period and 16.3% over a 36-month period. In our study, the decline in rapid gait speed over the 18-month study period (expressed as the percent change from baseline) was 11.3% for those participants with no months of restricting back pain, as compared with 33.2% for participants with 4 or more months with restricting back pain. These results indicate that the deleterious effects of restricting back pain on gait speed were substantial.

Back pain among older persons is a heterogeneous disorder (28). Contributing conditions include (either singly or in combination) osteoarthritis, lumbar sprain or strain, spinal stenosis, vertebral fractures, as well as other conditions. However, because a precise diagnosis cannot be established with certainty in a majority of cases (29,30), back pain is typically considered to be a single entity in research settings. Various definitions have been used to characterize back pain in prior studies (1,2), including the presence or persistence of pain during a defined time interval, sometimes in combination with a measure of pain severity (6,8). Given the lack of a standard definition, we defined our exposure as back pain of sufficient magnitude to interfere with customary activities; this definition provided a clinically pertinent spectrum of back pain for study.

In analyses that examined restricting back pain as a categorical variable, several distinct patterns emerged in our data. For rapid gait, an apparent dose-response effect was seen with progressively worsening timed scores across the three categories. For the chair stands and foot tap measures, timed scores improved in the 0 and 1–3 month categories, whereas participants reporting 4 or more months with restricting back pain experienced a decline in chair stand (but no measurable change in foot tap) performance. The patterns are consistent in that the deleterious effects are largely limited to the group that experienced 4 or more months with restricting back pain. Rapid gait and chair stands may, in fact, be more sensitive measures (vs the foot tap measure) for identifying the longitudinal effects of restricting back pain on lower extremity physical function in older community-dwelling persons. Our finding that 1–3 months with restricting back pain was not associated with decline in lower extremity physical function suggests that isolated or infrequent episodes of restricting back pain may not lead to functional decline. In turn, this finding suggests that efforts aimed at reducing functional decline should target older persons who report frequent episodes of restricting back pain, and that restricting back pain does not have to be completely eliminated to avoid the adverse consequences.

The rather weak association between restricting back pain and decline in upper extremity physical function provides support for the specificity of the relationship between back pain and lower extremity physical function. The specificity of this relationship is further supported by our findings that indicate that exposure to restricting back pain was a stronger predictor of decline in lower extremity physical function than was exposure to restriction due to other causes.

Our study has some limitations. Because participants were members of a single health plan located in the northeastern United States, our findings may not generalize to older persons in other settings or sections of the country. Furthermore, as is true for any observational study, we cannot firmly establish a cause-effect relationship between restricting back pain and decline in lower extremity physical function.

Conclusion

Restricting back pain is independently associated with decline in lower extremity physical function among community-dwelling older persons. Efforts to prevent or reduce the occurrence of restricting back pain may help to decrease functional decline in older persons.

Acknowledgments

Dr. Reid was supported by an Advanced Career Development Award from the Department of Veterans Affairs Health Services Research and Development Service at the time of this study. Dr. Reid's work is currently supported by a Paul Beeson Physician Faculty Scholar in Aging Research and a Robert Wood Johnson Foundation Generalist Physician Faculty Scholar Award. Dr. Gill is the recipient of a Midcareer Investigator Award in Patient-Oriented Research (K24AG021507) from the National Institute on Aging. During the course of this study, he was also a Paul Beeson Physician Faculty Scholar in Aging Research and Robert Wood Johnson Foundation Generalist Physician Faculty Scholar. This work was also supported in part by a grant from the National Institute on Aging (RO1AG17560).

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Received December 30, 2003
Accepted March 12, 2004
Decision Editor: John E. Morley, MB, BCh