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Restricting Back Pain and Subsequent Mobility Disability in Community-Living Older Persons

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Abstract

Objectives—To evaluate the relationship between back pain severe enough to restrict activity (restricting back pain) and subsequent mobility disabilityin community-living older persons.

Design—Prospective cohort study.

Setting—Greater New Haven, Connecticut.

Participants—709community-living men and women, aged ≥70 years.

Measurements—Restricting back pain and mobility disability (defined as needing help with/ unable to: walk 1/4 mile, climb flight of stairs, or lift/carry 10lb) were assessed during monthly telephone interviews for up to 159 months. The association betweenrestricting back painandsubsequent mobility disabilitywasevaluated using a recurrent events Cox model. These analyses were repeated among participants without baseline mobility disability. Additional secondary analyses evaluated the association between restricting back pain and mobility disability for ≥2 consecutive months (persistent mobility disability).

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Dr. Makris had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors meet the criteria for authorship stated in the Uniform Requirements for Manuscripts Submitted to Biomedical Journals.
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Results—Theevent rate (95% Confidence Interval (CI)) for mobility disability was 7.26 per 100-person months (95% CI, 6.89, 7.64). Mobility disability episodes lasted for a median of 2 months (interquartile Range (IQR)=1-4). In a recurrent event Coxregression analysis, after adjusting for 11 covariates,restricting back pain was strongly associated with mobility disability (hazard ratio (HR), 95% CI=3.23; 2.87, 3.64). The association was maintained when participants with baseline mobility disability were omitted (adjusted HR, 95% CI=3.71; 3.22, 4.28) and when the outcome was defined as persistent mobility disability (adjusted HR, 95% CI=3.63; 3.15, 4.20).

Conclusion—In this prospective study, restricting back pain was strongly associated with the occurrence of mobility disability. Interventions that prevent or ameliorate restricting back pain may prove to be effective for reducing the burden of mobility disability in older persons.

Keywords

Aged; Back Pain; Mobility Disability; Cohort Studies

INTRODUCTION

Back pain is the most common type of pain. Over 26% of adults reportback pain lasting for at least one day in the past three months, and 2.3% of all office-based physician visits are related to this condition[1]. We previouslyreported that back pain severe enough to restrict activities, hereafter referred to as restricting back pain, in older persons is common, often short-lived, and recurrent[2]. The US spends over $100 billion (based on 2005 dollars)forhealth care related to back pain[3], and these costs are expected to rise as the prevalenceof back pain increases[4]. Despite the high prevalence andfinancial cost attributable to back pain, longitudinal data evaluating its consequencesin older personsare sparse.

Cross-sectional data from the Framingham Heart Studyhave shownthat back symptoms account for a large percentage of functional limitations in older adults, especially in women[5]. Other cross-sectional data using the Health ABC cohort have shown that the presence and severity of low back pain are independently associated with perceived difficulty in performing functional tasks, but not with physical performance[6]. Other cross-sectional[7] and longitudinal[8] data from Health ABC, have shown a link between trunk muscle composition and functional decline, which was more pronounced among older adults with back pain. Anearlier longitudinalstudy demonstrated an independent association of restricting back pain and decline in lower extremity function using two assessments over an 18-month follow-up period[9]. Given the dynamic nature of pain and disability[10], an important next step is to characterize restricting back pain and subsequent disability over timewith frequent assessments that capture changes in these clinical phenomena.

Mobility is critical for maintaining independence inolder persons. Those who lose independent mobility are less likely to remain in the community, have higher rates of morbidity, mortality, self-care disability, and experience poorer quality of life[11-13]. In aprior cross-sectional study that used data from the Women's Health and Aging Study,older women with severe back pain had a higher likelihood of having difficulty with mobility tasks as well as basic activities of daily living (ADL)[14]. Few longitudinalstudies have evaluated back pain and subsequent mobility disability in both older men and women.

The objectives of the currentstudy wereto evaluate the association between restricting back pain and subsequent mobility disabilityin older persons, and to determine whether this relationship differs by sex. We used data from a unique longitudinalstudy that includes monthly assessments of both restricting back pain and mobility disability for more than 13 years in a large cohort of older community-living men and women. A better understanding of the impact of restricting back pain on mobility disabilitymay provide additional evidence needed to inform the development of more effective interventions to prevent the occurrence, persistence, or recurrence of mobility disability in older persons.

METHODS

Study Population

Participants were members of the Precipitating Events Project (PEP), a prospective study of 754 non-disabled community-living persons, aged 70 years or older[15]. Exclusion criteria included the need for personal assistance in one or more of four essential activities of daily living (ADLs): bathing, dressing, walking inside the house, and transferring from a chair; significant cognitive impairment with no available proxy; 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 following 12 months.

The assembly of the PEP cohort, which took place between March 1998 and October 1999, has been described in detail elsewhere[15]. Potential participants included age-eligible members of a large health plan in greater New Haven, Connecticut. Only 4.6% of the 2753 health plan members who were alive and could be contacted refused to complete the screening telephone interview; 75.2% agreed to participate in the study. Those who refused to participate did not differ significantly by sex or age from those who enrolled in the study[15]. The Yale Human Investigation Committee approved the study protocol.

Data Collection

Data on independent and dependent variables were collected during monthly telephone interviews, which were completed through June 30, 2011. Covariates were assessed at baseline and updated during comprehensive home-based assessments every 18-months for 144 months. For participants with significant cognitive impairment or who were not available,assessments were completed with the assistance of a designated proxy; this protocol has been shown to be reliable and validas described in previous reports[16]. Of the 754 participants in the original cohort, 492 (65%) died after a median follow-up of 82 months; 38 (5.0%) dropped out of the studyafter a median follow-up of26 months. Data from the monthly interviews were otherwise 99% complete.

Restricting Back Pain

Back pain leading to restricted activity (restricting back pain), the independent variable, was assessed during the monthly interviews. Each month, participants were asked, “Since we last talked [one month ago], have you stayed in bed at least half the day due to an illness, injury, or other problem?” and, “Have you cut down on your usual activities due to an illness, injury, or other problem?” Participants who answered yes to either question were considered to have restricted activity and were subsequently asked whether their restricted activity was due to back pain. Test-retest reliabilityfor restricting back pain was high, with kappa = 0.84[17]. The referent group included all participants who did not have restricting back pain, including those who had restricted activity for other reasons and those who did not have restricted activity but may have had back pain, which was not assessed in the absence of restricted activity.

Mobility Disability

Mobility disability, the dependent variable, was defined asneeding personal assistance with or inability to perform any of the following three tasks: walking 1/4 mile, climbing flight of stairs, or lifting/carrying ten pounds[18],[19]. Each month, participants were asked, “At the present time, do you need help from another person to [complete the task]?” for each of the three mobility tasks. Participants who reported, “Yes” or “Unable to complete the task” were considered to have mobility disability. The primary outcome was the onset of mobility disability (including both new and recurrent episodes), defined as one or more consecutive months of needing help with any of the three tasks that had to be preceded by a month with no mobility disability. The test-retest reliability for mobility disability, amonga subgroup of the original sample (n=107), was substantial with a kappa of 0.74.

Covariates

During the comprehensive assessments, data were collected on several covariates, selected based on their associations with adverse functional outcomes in prior studies[20],[21]. As described previously,the covariates were dichotomized to facilitate clinical interpretation[21]. Demographic characteristics includedage, sex, race/ethnicity, living situation, and education. Cognitive status was assessed by theFolstein Mini-Mental State Examination (MMSE)[22]. Depressive symptoms were assessed by the Center for Epidemiologic Studies Depression (CES-D) scale[23]. Nine self-reported, physician-diagnosed chronic conditions were assessed: arthritis, hypertension, diabetes mellitus, myocardial infarction, chronic lung disease, cancer, stroke, congestive heart failure, and hip fracture. Body mass index (BMI)was calculated using participants’ self-reported height and weight, according to the World Health Organization definition. Physical frailty was defined by slow gait speed, as previously described[18]. Lower extremity (hip) weakness, an independent risk factor for restricting back pain[24], was assessed with a hand-held Chatillon MSE 100 dynamometer (AMATEK Measurement and Calibration, Largo, Florida). The cut points demarcated the worst sex-specific quartile for the nondominant limb, on the basis of the first 356 enrolled participants randomly selected from the source population[21]. Additional operational details are provided in Table 1.

To account for the small amount of missing datafor the covariates (<10% across all comprehensive assessments), multiple imputation was used with 50 random draws per missing observation.

Statistical Analysis

Of the 754 participants, 45 (6%) reported mobility disability at baseline and throughout the follow-up period and, hence, were never at risk for developing a new episode of mobility disability. The primary analytic sample included the remaining 709 participants, who were at risk for developing mobility disability over the follow-up period.

The baseline characteristics were summarized using means and standard deviations for continuous variables, and frequencies and proportions for categorical variables. The incidence of mobility disability was estimated using a Generalized Estimation Equation binomial model. The 95% confidence intervals (CI) were based on empirical standard errorsthat accountedfor the correlation of recurrent events inthe same participants. Descriptive statistics were calculated for each mobility task per total months of disability.

AmultivariateCox model was used to evaluate the association between restricting back pain and the onset of new or recurrent episodesofmobility disability over the 13+ years of follow-up. In this model, participants were assumed at risk for developing mobility disability at any given month during the 13 year follow-up period, as long as they reported no mobility disability in that month. Accordingly, participants who report 1or more consecutive months of mobility disability would be temporarily removed from the risk set until the next month of no mobility disability[26]. Temporal precedence was strengthened through the use of monthly assessments and by evaluating restricting back pain during the preceding month and mobility disability "at the present month."Allcovariates, other than sex and race, were updated every 18-months, and entered into the models as time-dependent variables. The crude and adjusted hazard ratios (HR)(and 95% CIs) for developing mobility disabilitywereestimated for restricting back pain, with robust sandwich variance estimators to account for the correlation within individuals[25,26]. We also stratified the primary resultsaccording to sex, and subsequently tested for a formal statistical interaction. We conducted two sets of secondary analyses. First, based on prior work demonstrating that disability is often short-lasting (i.e. one month or less), we evaluated the association between restricting back pain and mobility disability that persisted for at least two months (persistent mobility disability)[27]. Second, we repeated the primary analysisafter excluding participants who had mobility disability at baseline.

All statistical tests were two-tailed, and $p<0.05$ was considered to indicate statistical significance. All analyses were performed using SAS version 9.2(SAS Institute, Inc., Cary, NC).

RESULTS

Table 1 provides baseline characteristics of participants in the primary analytic sample. On average, participants were nearly 80 years old; the majoritywerefemale, white, and had completed high school. A minority of participants were cognitively impaired or reported depressive symptoms. Greater than half of the participants reportedtwo or more chronic conditions, with the most common being hypertension (54.9%), arthritis (29.1%), coronary artery disease (17.8%), or diabetes (17.2%). Nearly 60% of the participants were overweight. 213 (30%) reported disability in at least one of the three mobility tasks at baseline, as shown in Table 1.

Over a median follow-up of 114 months,the rate (95% CI) of mobility disabilitywas 7.26 (6.89, 7.64) per 100-person months. Of the 5,232 episodes of mobility disability, the median duration was two months (interquartile range, (IQR) 1-4). Of the 35,328 total months of mobility disability, 87.4%, 49.3%, and 60.1% involved disability in walking a quarter mile, climbing a flight of stairs, and lifting/carrying ten pounds, respectively.

Table 2 provides the hazard ratios for the association between restricting back pain and mobility disability in the primary and secondary analyses. In the primary multivariable analysis, the association between restricting back pain and mobility disability was statistically significantamong all participants, withHR (95% CI)=3.23 (2.87, 3.64). The corresponding HR (95% CI) was3.65 (2.92, 4.57) for men and 3.03 (2.64, 3.47) for women. There was no significant interaction between restricting back pain andsex (p=0.68). The association of restricting back pain and mobility disability remained significant in the secondary analyses, as shown in Table 2.

DISCUSSION

In this prospective cohort study of older persons, we found thatthe occurrence of restricting back pain is strongly associated with subsequent mobility disability. We also found that the relationship between restricting back pain and mobility disability did not differ between men and women. Prior work has pointed out the need for additional evaluation of the pain-disability relationship using prospective data[20]. The data generated from the PEP cohort, using monthly assessments over 13 years of follow-up,helps to clarify the relationship between restricting back pain and subsequent disability.

Other reports have highlighted the pathway between osteoarthritis, musculoskeletal pain(including back pain) and mobility difficulty or disability[20,28]. Many of these studies,however, were cross-sectional and cannot establish temporal precedence[6,14,29]. Others have evaluated only older women who were already disabled at baseline[28]. Our results differ from those of previous longitudinal studies[28,30,31]. Buchman et al[31] found no significant association between a single measurement of self-reported musculoskeletal pain (including back and neck) and self-reported mobility disability (assessed annually) in 898 older adults. However, these investigators did find a significant association between musculoskeletal pain and mobility disability as assessed by an objective measure of gait speed. In contrast, we report a significant association between restricting back pain and self-reported mobility disability. Different study designs and definitions of pain or disability (i.e. self-report versus performance-based measures of disability) may account for thesediscordant findings. Because the PEP study includes monthly assessments of the exposure and outcome over 13+ years of follow-up, we were able to capture the dynamic nature of both restricting back pain and mobility disability.

Several authors have challenged the supposition that pain is a predictor of future disability[14,30], especially when the analyses do not account for baseline functional limitations[30]. In our study, where all participants were independent in their basic ADL at baseline, we found a strong relationship between restricting back pain and subsequentmobility disability. For our primary analysis, we chose to include all participants who had the opportunity to develop one or more new episodes of mobility disability during the follow-up period, including those who had mobility disability at baseline. This decision increased the sample size (and power) of the primary analysis, enhances the generalizability of our results, and involves the fewest assumptions. When participants who had mobility disability at baseline were omitted from the analysis, the results were comparable.

Prior research has shown that the association between back symptoms and functional limitations is stronger in women than men[5]. In the current study, men had a high likelihood of developing mobility disability in the setting of restricting back pain, although this difference did not achieve statistical significance. While women more oftenreport pain than men, it appears that this difference does not impact on future disability.

Several strengths of this study are worth highlighting. The PEP data include monthly assessments of restricting back pain and mobility disability over 13+ years of follow-up with a very low rate of attrition for reasons other than death. Our operational definition of back pain established a threshold of severity based on restricted activity. Because non-restricting back pain could also lead to poor physical function, the inclusion of participants with non-restricting back pain in the referent group would result in an underestimate of the effect of restricting back pain. The validity of our results is further strengthened by nearly complete ascertainment of restricting back pain and mobility disability and by the high reliability and accuracy of these assessments. To help establish temporal precedence, our primary strategy was to reassess both the exposure (restricting back pain) and outcome (mobility disability) over much shorter intervals (i.e. monthly) than in previous studies. Furthermore, during these monthly interviews, restricting back pain was ascertained over the preceding month, while mobility disability was assessed “at the present time,” thereby providinga time lag between exposure and outcome. However, our data do not allow us to determine how often, or during which specific days of the preceding month, the restricting back pain resulted immediately in mobility disability. Lastly, we tested the relationship between restricting back pain and mobility disability in three different analyses, including an evaluation of persistent mobility disability, that all yielded consistent results.

Our study alsohas several limitations. First, the severity,specific etiology, and the treatments usedfor restricting back pain were not assessed. Hence, we cannot distinguish between different causes of restricting back pain, which may include psycho-social factors, such as fear avoidance[32,33], in addition to the severity of back pain. Nonetheless, the definition of restricting back pain used in this study increased the likelihood that the reported symptoms were clinically meaningful. Second, generalizability may be limited because participants were members of a single health care plan in the greater New Havenregion. The demographics of our cohort mirror the US population except for race and ethnicity[34]. Third, the associations reported in this observational study cannot be interpreted as causal despite our attemptto establish temporal precedence between restricting back pain and (within one month) mobility disability.

In summary, restricting back pain is strongly associated with the developmentand persistence of mobility disability. Clinicians should be mindful that back pain in their older patients can lead to adverse functional consequences, including mobility disability and the

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impact disability has on the ability of older persons to remain independent. Interventions that prevent or reduce the occurrence or recurrence of restricting back painmay prove to be effective for alleviating the burden of mobility disability in older persons.

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Table 1

Baseline Characteristics of Study Participants (N = 709)

Characteristic	Operational Details	Baseline Value n (%)
Demographic		
Age in years, mean (±SD)		78.3 (5.2)
Female		447 (63.1)
Non-Hispanic white		643 (90.7)
Living alone		275 (38.8)
Did not complete high school		228 (32.2)
Cognitive-Psychosocial		
Cognitive impairment	Score on Folstein MMSE[a] < 24	77 (10.9)
High depressive symptoms	Score on CES-D[b] ≥ 16	134 (18.9)
Health Related		
No. of chronic conditions ≥ 2[c]	9 self-reported physician diagnoses	370 (52.2)
Habitual		
Overweight	BMI (kg/m^2) ≥ 25	419 (59.1)
Physical Capacity		
Physical frailty	>10 seconds on rapid gait test[18]	282 (39.8)
Hip (lower extremity) weakness	< 7.9kg (women) or < 12.6kg (men)	243 (34.3)
Disability in Mobility Tasks		
Walking a quarter mile		143 (20.2)
Climbing a flight of stairs		47 (6.6)
Lifting/carrying ten pounds		135 (19.0)

[a] MMSE = Mini-Mental State Examination

[b] CES-D = Center for Epidemiologic Studies Depression Scale

[c] Cut-point was defined on the basis of the frequency distributions in the analytic sample.

Table 2

Associations of Restricting Back Pain and Subsequent Mobility Disability

	Hazard Ratio (95% Confidence Interval)	P-value
Primary Analysis (N = 709), Mobility Disability[a]		
Unadjusted	3.53 (3.13-3.97)	<0.001
Adjusted[b]	3.23 (2.87-4.27)	<0.001
Secondary Analysis, Persistent Mobility Disability, Lasting 2+ Months (N = 709)[c]		
Unadjusted	3.91 (3.38-4.52)	<0.001
Adjusted	3.64 (3.15-4.20)	<0.001
Secondary Analysis, Excluding Participants with Baseline Mobility Disability (N = 496)[c]		
Unadjusted	3.98 (3.47-4.56)	<0.001
Adjusted	3.71 (3.22-4.28)	<0.001

[a]Included all episodes regardless of duration.

[b]Adjusted for age (in years), female sex, non white race, living alone status, less than high school education, depressive symptoms, overweight, physical frailty, cognitive impairment, ≥ 2 chronic conditions, hip weakness. Additional details are provided in the text and Table 1.

[c]Analytic samples are described in the text.