Chronic Pain Increases the Risk of Decreasing Physical Performance in Older Adults: The San Luis Valley Health and Aging Study

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Background. Pain often accompanies chronic disease in older adults and may exacerbate physical limitations, which the Disablement Model suggests may increase disability and decrease independence. This study tests the hypothesis that chronic pain and change in levels of pain over time have associations with worsening physical performance independent of disease conditions.

Methods. We studied the effects of initial and changing levels of pain on observed physical performance over approximately 22 months in 925 community-dwelling Hispanic and non-Hispanic white participants in the San Luis Valley Health and Aging Study. Logistic regression models controlled for demographic variables, baseline performance, and comorbidities.

Results. We found that chronic pain has an independent association with worsening physical performance, regardless of ethnicity. The intensity of the pain appears to have no independent effect. Although the presence of multiple comorbidities (or vascular disease or diabetes singly) also increases the risk of a worsened physical performance outcome, an independent effect of chronic pain remains after adjusting for these disease conditions. Furthermore, ongoing chronic pain increases the risk of worsening performance; conversely, recovery from chronic pain has a significant and substantial protective effect.

Conclusions. Pain in and of itself appears to increase physical impairment. These results strongly suggest that controlling chronic pain may interrupt the negative disease–impairment–disability trajectory by significantly reducing impaired physical performance, no matter the disease conditions that may underlie the pain.

CHRONIC conditions in older adults contribute to loss of physical abilities, which in turn often leads to decreased function and increasing dependence. Pain often accompanies these conditions.

Many reports have documented the relationships between chronic conditions (e.g., arthritis, diabetes, high blood pressure, heart disease) and functional disability (1–5) or physical performance, which the Disablement Model (6) suggests lie in the path from disease to disability (7–11). Incident as well as prevalent conditions predicted 3-year decline in observed physical performance in the high-functioning cohort of the MacArthur Studies of Successful Aging (12). A review by Stuck and colleagues of 78 studies of functional decline found that depression and multiple comorbidities had the greatest effects (13). In a substudy of the Women’s Health and Aging Study, Guralnik and colleagues (14) did not find an association between number of acute or chronic conditions and change in performance test results, but their assessment lasted only 6 months.

Less research has examined the effect of chronic condition–related pain on physical and functional outcomes, but significant relationships exist. A study of Mexican-American elders reported that pain on weight bearing significantly increased 2-year incident limitations in lower-body activities of daily living and adversely affected observed lower body physical performance (15). A recent study of 659 adults 70 years old and older found chronic, restricting back pain associated with worsening lower extremity physical function over 18 months of follow-up (16). Researchers in another recent study, a cross-sectional assessment of approximately 1500 adults 70–79 years old in the Health, Aging and Body Composition study, similarly found that participants with more severe lower back pain had significantly lower physical performance (lower body) scores (17). The Study of Assets and Health Dynamics Among the Oldest Old (AHEAD) (11) and the Established Populations for Epidemiologic Studies of the Elderly (EPESE) (10) found, respectively, that frequent pain and exertional leg pain predicted impairment, but the studies did not address independent effects of pain. A small Finnish study found pain and pain behavior the most important determinants of self-reported disability, with an additional association between pain and observed impaired performance (18).

Many studies have linked socioeconomic status (SES) and poorer physical and functional outcomes; Hispanic ethnicity has not generally had an additional significant effect. Exceptions exist. Hispanic elders in the San Luis Valley Health and Aging Study (SLVHAS) reported greater prevalent dependence in activities of daily living (19,20) but no significant difference in incidence (21). In another community, researchers also found a greater prevalence...
of disability among Hispanic elders, and attributed the disparity to less education and greater disease prevalence (22). A study of Mexican-American elders in five Southwestern states (23) reported that medical conditions—primarily stroke and hip fracture—increased the risk of self-reported lower extremity dysfunction. Multiple conditions may interact significantly: An Hispanic EPESE study of depression (24) found a significant interactive relationship with diabetes and arthritis. Data from the biethnic SLVHAS make it possible to examine the issues of chronic conditions, pain and change in pain over time, physical performance, and Hispanic or non-Hispanic white ethnicity. In the study reported here we hypothesize that pain has an independent association with worsening physical performance beyond the effects of the conditions themselves, regardless of ethnicity.

METHODS

Population and Sampling

The community-based SLVHAS examined health and disability among older Hispanic and non-Hispanic white residents of rural Alamosa and Conejos counties in southern Colorado. The study design has been described in detail elsewhere (19); it is briefly summarized here. All occupied households were enumerated (97.2% response rate). Study eligibility required the participant to be 60 years old or older, to reside in either county, and to be Hispanic or non-Hispanic white based on the 1980 U.S. Census question, “Are you of Spanish or Hispanic origin or descent?” (25). Differential sampling ensured appropriate numbers of participants for ethnic contrasts, yielding 1757 eligible persons.

Bilingual interviewers collected responses twice from 1358 community-dwelling participants between 1993 and 1995 (as well as from 75 nursing home residents, whom this study does not include because they were not offered all questions about pain; 81.6% response rate); Spanish-language forms were available. Refusers were more likely to be non-Hispanic white (response rate 78.2%; Hispanic response rate 84.3%), less likely to report any functional disability, and slightly older. They did not differ significantly by sex, education, self-rated health, or hospitalization in the past year (19). This study excludes 188 individuals who required proxy informants because they were unable or unwilling to respond. Inability generally meant cognitive impairment based on Folstein’s Mini-Mental Status Examination (MMSE) scores < 18 (26).

Bilingual interviewers revisited the respondents an average of 22 months after their first visits and readministered the assessment. By that time, 67 of the participants eligible for this analysis had died, 71 refused the second visit, and 107 required proxy assistance, leaving 925 individuals available for this study. Participants who refused at visit 2 had significantly lower visit 1 MMSE scores than the respondents had (p < .01), but otherwise they did not differ significantly.

Outcome Measure

We measured worsened physical performance, the primary outcome, as a decrease (vs increase or no change), over the 22 months between study visits, in scores that combine Tinetti-type observations of lower extremity balance, gait, and coordination into a summary scale (27) with a maximum score of 17 (no difficulty with any item). Meaningful change was defined as change of at least 1 standard deviation in the difference between visit scores. The tests included standing up and sitting down in a chair; bending over and picking up an object; maintaining sitting and standing balance; initiating gait, walking smoothly along a 10-foot course, and staying on a path while walking; and turning a full circle. Cronbach’s alpha for the summary scale was 0.89.

Explanatory Variables

Visit 1 observed performance.—Because of the skewed distribution at visit 1 (two thirds of respondents had no difficulty with any item), we recoded scores from the continuous scale 0–17 to a dichotomous measure of no versus any difficulty with any item.

Pain.—Measures of pain included intensity (or severity) and chronicity. They were drawn from questions used in the San Antonio Longitudinal Study of Aging (SALSA) (28) and the EPESE (29). The question “[If you are ever troubled by pain], when it is at its worst would you describe it as mild, moderate, severe or unbearable?” assessed intensity, generating a dichotomous variable that compared mild with the other three responses combined. Responses to the question “During the past week, how much of the time have you been troubled with pain? Would you say: all of the time, most of the time, some of the time, rarely or never?” generated a dichotomous chronicity variable that compared all, most, and some of the time with rarely or never. We also evaluated new (incident) chronic or intense pain and recovery from pain at visit 2.

Chronic disease.—Unlike the situation in many multiethnic and rural communities, a Valley-wide network of clinics has provided reliable access to health care for both Hispanic and non-Hispanic white residents of the San Luis Valley for many years. SLVHAS reports have consistently used a comorbidity score that sums (a) positive responses to a series of questions asking if a doctor had ever told respondents that they had cancer, heart attack, mild (transient ischemic attack) or severe stroke, angina, Parkinson’s disease, heart failure, pulmonary disease, cirrhosis, kidney failure, osteoporosis, seizure, migraine, angioplasty or vascular disease requiring surgery, diabetes, or depressive symptoms (that is, current symptoms if ever diagnosed); (b) severe arthritis, a conservative estimate that combines self-report of having arthritis or rheumatism accompanied by swelling or stiffness with self-report of a doctor’s specific diagnosis of osteoarthritis, degenerative arthritis, or rheumatoid arthritis; and (c) high blood pressure, ascertained as self-report only in the absence of information from auscultation and medication history (n = 26 of the 925 study participants). For the analyses here, we have substituted responses to the Center for Epidemiologic Studies-Depression (CES-D) inventory of depressive symptoms (30) for the
self-reported depressive symptoms score; a score of ≥16 indicated a high level of depressive symptoms. The comorbidity score summed the prevalence of these 18 conditions; one categorical variable distinguished among 0, 1, 2, and ≥3 conditions, and an incidence variable registered any visit 2 report of new chronic conditions. We also assessed cumulative incidence of chronic conditions at visit 2.

Other explanatory variables.—Analyses included age; gender; ethnicity (Hispanic or non-Hispanic white); education (0–8 years, 9–12 years, or more than high school); general cognitive function (MMSE > 24); and body mass index (BMI) of < 22 (undernourished), 22–29 (normal), or ≥30 (overweight/obese) kg/m² (11).

Analysis
Analysis began with descriptions of characteristics of the study sample. Pearson chi-square tests and Student t tests provided assessments of the degree to which characteristics differed by ethnicity. We examined the relationships between chronic conditions and pain to determine which conditions had the strongest associations with chronic pain.

We used logistic regression to model the contributions of visit 1 pain, chronic conditions, and other explanatory variables to worsened versus improved or unchanged physical performance at visit 2. Preliminary analyses modeled the age-adjusted relationship between the outcome and each explanatory variable, including both individual chronic conditions and the summed comorbidity score. We then constructed multivariable models with factors found significant in the age-adjusted bivariate models, and tested for interactions between pain and chronic conditions. For all analyses, we used the Statistical Analysis System (SAS) version 9.1 for Windows (SAS Institute, Cary, NC).

RESULTS
Table 1 presents visit 1 characteristics of respondents; Table 2 adds information about incident characteristics. The mean age of the study sample at visit 1 was 72.2 years (range 60.3–95.1 years), nearly 59% were female, 53% mean age of the study sample at visit 1 was 72.2 years (range 60.3–95.1 years), nearly 59% were female, 53%

numbers of conditions were not significant. Hypertension (51%), arthritis (31%), and diabetes (24%) were the most commonly reported conditions. Angina (12% vs 8%, p = .05), arthritis (34% vs 28%, p = .04), vascular surgery (10% vs 6%, p = .04), any cancer (22% vs 9%, p < .0001), emphysema (12% vs 7%, p = .03), heart failure (8% vs 4%, p = .01), and osteoporosis (12% vs 4%, p < .0001) were significantly more prevalent among non-Hispanic white respondents. Conversely, Hispanic persons reported significantly greater prevalences of diabetes (30% vs 16%, p < .0001) and CES-D depressive symptoms (13% vs 8%, p = .03). Patterns of cumulative incidence paralleled prevalence, with highest rates for hypertension and arthritis.

Table 3 describes physical performance. Data include summary scores at visits 1 and 2 and meaningful differences between the two scores. The standard deviation of the difference score was 2.53 (around the mean of −0.72, which represents worsened performance); meaningful difference, therefore, represents visit 2 scores at least 3 points lower (or higher) than visit 1 scores. The mean visit 1 score was 15.9 on the 17-point scale; 16% of participants experienced worsened performance at visit 2. Applying the same definition to better versus unchanged or worse performance (not shown), 50 persons (5.5%) improved their performance. Hispanic elders had slightly but significantly higher visit 1 performance scores, and a smaller percentage of them had worsened performance at visit 2. Persons who died during the interval between study visits had lower visit 1 performance scores.

Figure 1 shows the burden of chronic pain associated with the most prevalent chronic conditions. At least half of participants with at least one of these conditions—high blood pressure, arthritis, diabetes, cancer, depressive symptoms, osteoporosis, and vascular disease—reported chronic pain; the percentages reached 70% for persons with arthritis or depressive symptoms, singly or in combination with other conditions. Results of a logistic regression model of chronic pain on these conditions, adjusted for demographic variables (results not shown), showed that arthritis had the strongest independent association with chronic pain (odds ratio [OR] 4.23; 95% confidence interval [CI], 3.05–5.88), followed by depressive symptoms (OR 2.09; 95% CI, 1.28–3.41) and diabetes (OR 1.81; 95% CI, 1.29–2.54). Similar modeling identified the chronic conditions that had statistically significant independent associations with the worsening physical performance outcome—vascular disease requiring surgery (OR 1.94; 95% CI, 1.08–3.49) and diabetes (OR 1.89; 95% CI, 1.25–2.87). When adjusted for these other conditions, depressive symptoms did not retain a statistically significant association (OR 1.43; 95% CI, 0.83–2.49). There were no significant interactions between pain and chronic conditions.

Table 4 presents the results of logistic regression models of worsened physical performance on visit 1 pain and chronic conditions, adjusted for other explanatory factors and the presence of any visit 1 performance limitation. The first column presents the effects of baseline pain, adjusted for the basic explanatory variables. The second column shows the differential effect of changes in pain over time (i.e., recovery from pain, pain when it did not exist before). The
third column provides information about the degree to which the presence of chronic conditions contributes to the relationship between pain and physical performance—modeled first as a sum of all comorbidities and then, in separate models, individually for the two chronic conditions that had significant relationships with the outcome. BMI did not contribute significantly to any model; it has been excluded from the results. Neither did general cognitive status (MMSE) contribute significantly, but we retained it in the model to confirm the absence of confounding with education, a common proxy for SES. (Neither variable contributed significantly to performance models, either in the presence or in the absence of the other.) Gender also had no significant effect but was retained as a common demographic adjustment. OR values for explanatory covariates were nearly identical across models for summed and separate
CHRONIC PAIN AND PHYSICAL PERFORMANCE

As hypothesized, we found that chronic pain has an independent association with worsening physical performance, regardless of ethnicity or specific condition. The intensity of pain, however, appears not to have any additional effect. Although the presence of multiple comorbidities also increases the risk of worsened physical performance, the effect of chronic pain appears substantially independent of disease condition. That is, the effect of pain on worsened physical performance changed only negligibly with the addition of disease conditions to the model, either in the aggregate or as individual conditions.

Furthermore, chronic pain has a larger effect on physical performance when it persists over an extended period of time. That is, when we adjusted the presence of chronic pain at visit 1 for recovery from that pain over the period of the study, we found the risk of worsened physical performance for participants who continued to have pain to be about one third greater than estimated by the unadjusted model. Conversely, recovery from chronic pain appears to reduce the risk of worsened physical performance by two thirds.

As in earlier studies reviewed by Stuck and colleagues (13), we found that multiple comorbidities and, individually, diabetes and vascular disease had the greatest significant associations with poor outcomes. Although the conservatively estimated prevalence of severe arthritis had an independent association with pain, it had no effect on the performance outcome. Because we had no information about the location of arthritis (10), we could not assess the degree to which lower extremity arthritis impairment might affect the types of physical performance measured here. The nearly 2:1 ratio of Hispanic to non-Hispanic white self-reported prevalence of diabetes, higher than generally reported among older adults, is consistent with the 2- to 4-fold excess of confirmed Type II diabetes in this population (31).

The estimate of the prevalence of depression (12.7% among Hispanic respondents, 8.4% among non-Hispanic white respondents) falls in the middle of the range of 5%–

![Table 2. Incident Characteristics of the Study Sample (N = 925), San Luis Valley Health and Aging Study, 1993–1997](https://academic.oup.com/biomedgerontology/article-abstract/62/9/989/525960/925)
analysis because they required proxy assistance had at least one physical limitation (83.3% vs 33.1%). The absolute number of lost responses, however, is not large (n = 18). The relatively short time to follow-up (22 months on average between visits) may mean that we did not observe the full impact of chronic disease and pain over time. It is interesting, however, that even in this relatively short time, recovery from pain provided dramatic protection against

Figure 1. Pain associated with chronic conditions.
worsened physical performance. The definitions of intensity and chronicity of pain may have affected our results. The question about intensity asked if the respondent was ever troubled by pain, whereas the chronicity question asked about frequency of pain during the previous week.

Perhaps the greatest concern has to do with self-report. Chronic conditions are among the main predictors included in the multivariate models, and this study relied primarily on self-report, which previous studies have shown may lead to misclassification. The SLVHAS assessment of chronic disease was not intended as a diagnostic test for every condition that individuals might have but as a means of estimating the chronic disease load in the population. Correlations between measured and self-reported presence of high blood pressure (0.61, \( p < .0001 \)) and depressive symptomatology (0.28, \( p < .0001 \)), the two conditions for which we have both types of measures, show the range of self-report “validity.” The parallel patterning between self-reported diabetes here and clinically ascertained Type II diabetes in the overlapping SLV Diabetes Study increases our trust in these data.

These findings have important clinical and social implications. It appears that controlling chronic pain may interrupt the negative trajectory from disease to functional disability by significantly reducing impaired physical performance, no matter the disease condition or conditions that may underlie or accompany the pain. The Disablement Model has shown us that functional disability may in turn lead to loss of independence and the need for costly interventions and care. We may now have evidence to support interventions to delay or prevent those undesirable consequences while simultaneously decreasing discomfort and distress due to pain.

### ACKNOWLEDGMENTS

The research reported here was supported by National Institute on Aging Grant R01 AG 10940.

We wish to acknowledge our appreciation to the residents, most especially the older residents, of Alamosa and Conejos counties for their cooperation and participation in this study. We also thank the many investigators and staff associated with the project for their general contributions to study design, data collection, and analysis.

### CORRESPONDENCE

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### REFERENCES


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**Notes:** *The contribution of basic explanatory variables varied little between the model of summed comorbidities and chronic conditions models that included only single items (i.e., vascular disease, depressive symptoms, diabetes); the table therefore provides estimates and confidence intervals for these basic variables only for the model that includes the sum of all comorbidities. OR = odds ratio; CI = confidence interval; MMSE = Mini-Mental Status Examination; CES-D = Center for Epidemiologic Studies-Depression Scale.


Received June 6, 2006
Accepted December 1, 2006
Decision Editor: Luigi Ferrucci, MD, PhD