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Research Article

Increasing Pain Interference Is Associated With Cognitive Decline Over Four Years Among Older Puerto Rican Adults

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Abstract

Background: Pain is associated with cognitive decline among older adults, but few studies have investigated bidirectional associations between pain and cognitive decline, especially in older Hispanic populations. Our objective was to assess the bidirectional association between pain interference and cognitive performance in a sample of older Puerto Rican adults.

Methods: Data came from baseline and 4-year follow-up of the Puerto Rican Elderly: Health Conditions Study, a longitudinal representative study of Puerto Rican older adults aged 60 and older. Pain and cognitive performance were assessed at each wave. A pain interference variable was created using the sum of pain status (yes/no) and pain interference (yes/no; range 0–2). Global cognitive performance was assessed with the Mini-Mental Cabán. We tested bidirectional associations using a path model with concurrent and cross-lagged paths between pain and cognitive performance, adjusting for sociodemographic and health factors (n = 2 349).

Results: Baseline pain interference was not associated with baseline cognitive performance (p = .636) or with cognitive performance at follow-up (p = .594). However, increased pain interference at follow-up was associated with greater cognitive decline at follow-up (β = –0.07, standard error [SE] = 0.02, p = .003). Greater baseline cognitive performance was associated with lower pain interference at follow-up (β = –0.07, SE = 0.02, p = .007).

Conclusions: These findings highlight the importance of worsening pain interference as a potentially modifiable risk factor for cognitive decline, as pain treatment options exist. Additionally, better baseline cognitive performance may be a protective factor for pain, providing further evidence of the dynamic relationship between pain and cognitive performance.

Keywords: Aging, Bidirectional, Cognitive function, Longitudinal, Pain

Pain is a leading cause of functional loss (1–3) and independence in later life (4–6). Pain is associated with lower cognitive performance among older adults, but findings, including those from longitudinal studies (7–10), are mixed (11–16). Older adults with persistent pain had faster memory decline over ten years compared to older adults without persistent pain in the Health and Retirement Study (8). Older adults with severe pain had greater memory decline, but the pain was not associated with overall cognitive performance in the English Longitudinal Aging Study (ELSA) of a similar design (9). Recent work has found that pain that limits activities, also known as pain interference, rather than pain severity, is associated with worse cognitive performance over time (10). Because these studies were of similar design, their discrepancies highlight the need for the examination across different populations.

Most studies examine pain as a predictor of cognitive decline; however, it is important to consider whether individuals with lower cognitive performance are more susceptible to pain. Understanding this association would help elucidate whether the pain is a modifiable risk factor for cognitive decline or if lower cognitive performance is a risk factor for increased pain as one ages. The interruptive model of pain, which is supported by evidence from nonolder adult samples, postulates that pain overtakes attention due to its salience for

survival, leaving fewer attentional resources for cognitive functioning (17). Alternatively, the shared-network model postulates that pain and cognitive performance share overlapping neural networks for pain and cognitive processing (18). Because cognitive performance is reflective of the integrity of shared neural networks for pain modulation, older adults with lower cognitive performance may be more susceptible to increasing pain as they age. Assessment of pain and cognitive performance over time may help clarify the temporal relationship between pain and cognitive performance. More research is needed to fully understand the mechanisms underlying cognition and pain (19).

Hispanic older adults are the fastest growing segment of the older adult population and will represent one in five older adults in the United States by 2050 (20). Hispanic older adults are twice as likely to have cognitive impairment compared to non-Hispanic Whites (21). Recent work among adults aged 50 and older in the United States found that Hispanics had higher pain intensity but not higher levels of pain interference compared to non-Hispanic White adults (22). Other research has suggested that the burden of frequent and high-impact pain is similar between non-Hispanic White and Hispanic older adults (23,24). Significant heterogeneity in health outcomes exists by country of origin. Puerto Rican adults have a greater burden of pain (25) compared to other Hispanic individuals in the United States, as well as higher rates of dementia (26,27).

To better understand the relationship between pain and cognitive performance across cultures, we examine the bidirectional associations between pain interference and cognitive performance over 4 years in community-dwelling Puerto Rican older adults. Based on previous studies (8,11–13) and the postulations of the interruptive model of pain (17), we hypothesized that higher pain at baseline would be associated with greater cognitive decline over 4 years. Considering the interdependence of pain and cognitive performance through shared networks (18), we also explored bidirectionality.

Method

Participants

We used data from waves 1 (2002/2003) and 2 (2006/2007) of the Puerto Rican Elderly: Health Condition (PREHCO) Study, a longitudinal representative study of community-dwelling Puerto Rican adults aged 60 and older (28). Data collection were approved by the University of Puerto Rico Institutional Review Board (IRB) and the University of Wisconsin IRB. From 2002 to 2003, the study used probability-based methods to collect a representative sample of participants in homes with at least one adult older than 60 years of age. Once interest in the study was confirmed, researchers screened for eligibility, obtained consent, and assessed health and sociodemographic characteristics in-person. At baseline, 4 291 older adults agreed to participate (Figure 1). Of this group, 578 completed proxy interviews and were not included in these analyses. Of the direct baseline sample (n = 3 713), 423 participants were excluded as they were missing baseline information on pain or cognitive performance. Finally, 941 participants were excluded as they were missing follow-up information on pain or cognitive performance. Our final analytical sample included 2 349 participants who had baseline and follow-up information on cognitive performance and pain interference. Those who were excluded from the analyses were older at baseline ($p < 0.001$). No statistically significant difference was seen for any pain variables or other covariates of interest.

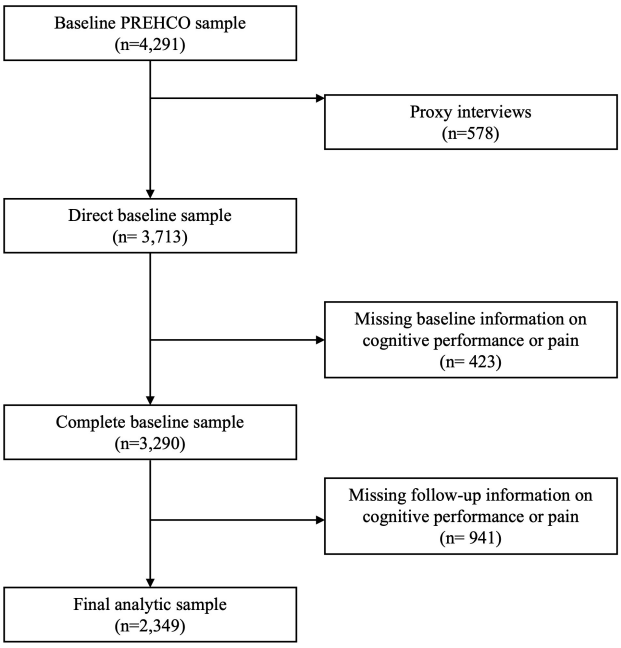

Figure 1. Selection of the analytic sample. PREHCO = Puerto Rican Elderly: Health Conditions Study.

Measures

Pain interference

At both waves, participants were asked, "do you suffer from physical body pain?" If they responded yes, they were asked, "does the pain severity interfere with or make your daily activities more difficult?" A 3-level ordinal pain interference variable was constructed using the sum of pain status (yes/no) and pain interference (yes/no), ranging from 0 to 2. A score of 0 represents no pain, 1 represents having noninterfering pain, and 2 represents having interfering pain.

Cognitive performance

Cognitive performance was measured at both waves using the Mini-Mental Cabán (MMC) (29). The MMC is designed to measure global cognition in diverse populations, including those with low educational attainment and Hispanic populations. The MMC includes items on orientation, immediate and delayed verbal, visual memory (immediate recall and drawing a complex figure after 15 seconds of exposure), executive function (clock drawing and abstraction), and comprehension of a 3-step command. Scores range from 0 to 20, with higher scores representing better cognitive performance.

Covariates

We examined time-stable and time-varying covariates. Time-stable covariates included gender, race (White, Black, other/multiracial [Trigueño, Mezclado, Mulatto, Mestizo, and other]), and education. Time-varying covariates included health insurance, number of depressive symptoms, number of comorbidities, physical activity, and activities of daily living (ADL) limitations. Depressive symptoms were measured with the short version of the Geriatric Depression Scale (30), with scores ranging from 0 to 15. Chronic disease comorbidities, including diabetes, arthritis, stroke, congestive heart failure, heart attack, hypertension, lung disease, asthma, and cancer were summed, ranging from 0 to 9. At wave 1, participants were asked if they had ever been told they had any of these health

conditions. At follow-up, participants were asked if they had been told they had these conditions since the last wave. Physical function was measured using the Get Up and Go task, in which participants are timed (in seconds) as they stand up from a stable chair and walk 3 meters ahead (31). People who were unable to complete the task due to physical limitations were scored at the maximum value (32). ADL limitations were measured as reporting limitations due to health (unable to do = 1; can still do = 0) in 6 tasks (eating, dressed or undressed, using the toilet, walking from one side of the room to the other, difficulty getting up from or lying down in bed, and taking a bath or showering).

Statistical Analysis

Descriptive statistics for baseline characteristics were calculated, including means and standard deviations for continuous variables and percentages and frequencies for categorical variables using SPSS version 26.0 (SPSS Inc., Chicago, IL). We constructed a path model that examined all associations simultaneously while controlling for the time-stable and time-varying covariates described earlier using MPlus version 8.4 (Muthén & Muthén, Los Angeles, CA). Model fit was assessed to determine the appropriateness of the model (ie, is it accounting for a significant amount of variance above chance) Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). As shown in Figure 2, outcomes in the path models included cognitive performance and pain interference measured at waves 1 and 2. Pain interference was modeled by estimating ordinal threshold liabilities (CATEGORICAL ARE command with THETA parameterization), which allows the model to estimate effects given that pain interference involves a continuous distribution in the population. Pain interference and cognitive performance at wave 1 were regressed onto covariates at wave 1; pain interference and cognitive performance at wave 2 were regressed onto covariates at waves 1 and 2. Bootstrapping with 5 000 resamples were to provide *p*-values from robust standard errors. Standardized betas are reported to emphasize effect sizes for all significant findings.

Regarding missingness, there were missing values in covariates including depressive symptoms at baseline (n = 3) and follow-up (n = 2), physical function at baseline (n = 212) and follow-up (n = 83), and ADL limitations at baseline (n = 2) and follow-up (n = 2). Missingness in depressive symptoms and ADL limitations at baseline and follow-up were not related to differences in age, gender, or education (*p*s > .05). Missingness of physical function at baseline was not related to any demographic variable (*p*s > .05). Missingness in physical function at follow-up was related to older age (p < .001). We accounted for this age-related missingness in physical function at follow-up using inverse probability weighting (33).

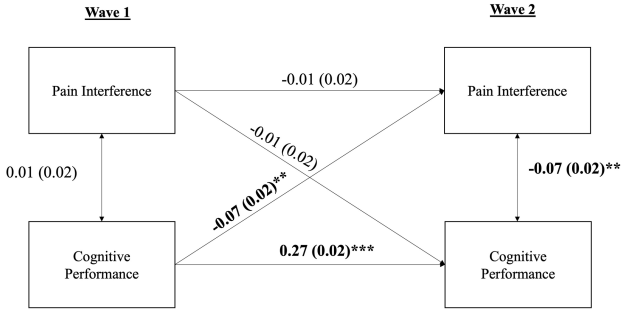

Figure 2. Concurrent and cross-lagged associations between pain interference and cognitive performance. ADL = activities of daily living. *p < .05, **p < .01, ***p < .001.

Results

Sample Characteristics

At baseline, our sample was 69.9 years old on average (standard deviation [*SD*] = 7.2 years), and 60.5% were women (Table 1). Over half (69.5%) of respondents reported no pain at baseline, 21.3% reported noninterfering pain, and 9.2% reported interfering pain. Participants with noninterfering pain were more often women and more often had a history of diabetes, congestive heart failure, lung disease, or asthma compared to those with no pain (p < .001). Those with either noninterfering or interfering pain had more depressive symptoms and comorbidities (specifically arthritis and a history of heart attacks) compared to those with no pain (p < .001). Participants with noninterfering pain more often had a history of hypertension compared to those with no pain or with interfering pain (p < .001). People with noninterfering and interfering pain had more ADL limitations (*p*s < .01). People with noninterfering pain had more ADL limitations than people with interfering pain (p < .001). Supplementary Table 1 displays follow-up characteristics by baseline pain interference level (no pain, noninterfering pain, and interfering pain), showing similar findings.

Baseline Cognitive Performance

Fit of the main cross-lagged path model was acceptable (CFI = 0.99; TLI = 0.99; RMSEA = 0.06). Baseline cognitive performance was not associated with baseline pain interference (p = .636). Shown in Table 2, identifying as a woman (β = 0.10, standard error [*SE*] = 0.02, p < 0.001), fewer years of education (β = 0.28, *SE* = 0.02, p < .001), older age (β = −0.11, *SE* = 0.02, p < .001), more depressive symptoms (β = −0.09, *SE* = 0.02, p < .001), and worse physical function (β = −0.06, *SE* = 0.02, p = .013) were associated with worse baseline cognitive performance.

Baseline Pain Interference

White individuals had lower pain interference at baseline (β = −0.05, *SE* = 0.02, p = .035) while having more comorbidities (β = 0.05, *SE* = 0.03, p = .045) were associated with greater baseline pain interference.

Cognitive Decline

At follow-up, 50.4% of participants experienced cognitive decline, 31.6% had improved cognitive performance, and 17.2% had no change in their cognitive performance (Supplementary Table 2). Baseline pain interference was not associated with cognitive performance at follow up (p = .594; Figure 2). People who had pain interference at follow-up had greater cognitive decline than people without pain interference (β = −0.07, *SE* = 0.02, p = .003). Identifying as a man (β = 0.05, *SE* = 0.02, p = .028), having fewer years of education (β = 0.22, *SE* = 0.02, p < .001), worse physical function at baseline (β = −0.06, *SE* = 0.02, p = .004) were each independently associated with increased cognitive decline at follow-up (Table 2).

Changes in Pain Interference

Over half of the sample (52.2%) had no change in their pain interference at follow-up, 36.0% had an increase in pain interference, and 11.9% had a decrease in pain interference (Supplementary Table 2). Greater baseline cognitive performance (β = −0.07, *SE* = 0.02,

Table 1. Baseline Characteristics of PREHCO Participants by Baseline Pain Status (n = 2 349)

Baseline Characteristic		Total (n = 2 349)	No Pain (n = 1 633; 69.51%)	Noninterfering Pain (n = 500; 21.29%)	Interfering Pain (n = 216; 9.20%)
Age	*M* (*SD*)	69.85 (7.20)	70.01 (7.18)	69.72 (7.42)	68.93 (6.84)
Gender*					
Men	% (*n*)	39.5 (928)	43.6 (712)	29.2 (146)	32.4 (70)
Women	% (*n*)	60.5 (1 421)	56.4 (921)	70.8 (354)	67.6 (146)
Race/ethnicity					
White	% (*n*)	43.1 (1 012)	43.5 (771)	45.2 (226)	34.7 (75)
Black	% (*n*)	5.4 (128)	5.8 (94)	4.0 (20)	6.5 (14)
Other	% (*n*)	51.5 (1 209)	50.7 (828)	50.8 (254)	58.8 (127)
Years of education	*M* (*SD*)	8.55 (4.47)	8.76 (4.47)	8.11 (4.49)	7.94 (4.33)
Insured	% (*n*)	97.2 (2 284)	96.8 (1 579)	98.6 (493)	98.1 (212)
Depressive symptoms*,†	*M* (*SD*)	2.88 (3.15)	2.36 (2.75)	4.31 (3.73)	3.46 (3.36)
Comorbidities*,†	*M* (*SD*)	1.39 (1.19)	1.21 (1.10)	1.90 (1.29)	1.59 (1.30)
Diabetes*	% (*n*)	26.0 (610)	23.3 (381)	32.6 (163)	30.6 (66)
Arthritis*,†	% (*n*)	46.7 (1 096)	37.7 (614)	70.8 (352)	60.5 (130)
Stroke	% (*n*)	4.0 (94)	3.6 (58)	4.8 (24)	5.6 (12)
Congestive heart failure*	% (*n*)	17.5 (491)	11.9 (194)	27.4 (137)	19.9 (43)
Heart attack*,†	% (*n*)	8.5 (200)	6.6 (108)	12.4 (62)	13.9 (30)
Hypertension*,‡	% (*n*)	56.7 (1 333)	52.9 (864)	70.6 (353)	53.7 (116)
Lung disease*	% (*n*)	6.2 (146)	4.5 (74)	11.2 (56)	7.4 (16)
Asthma*	% (*n*)	13.5 (318)	11.1 (181)	20.4 (102)	16.3 (35)
Cancer	% (*n*)	4.8 (113)	4.7 (77)	4.6 (23)	6 (13)
Physical function*,‡	*M* (*SD*)	33.11 (39.23)	41.69 (44.07)	39.37 (2.83)	39.23 (0.85)
ADL limitations†,‡	*M* (*SD*)	0.90 (1.62)	0.08 (0.42)	0.44 (1.00)	0.22 (0.68)

Notes: ADL = activities of daily living; PREHCO = Puerto Rican Elderly: Health Conditions Study; *SD* = standard deviation.
*p < .001 between no pain and noninterfering pain.
†p < .001 between no pain and interfering pain.
‡p < .001 between noninterfering pain and interfering pain.

p = .007) was associated with lower pain interference at follow-up (Figure 2). Shown in Table 2, having greater cognitive decline was related to greater odds of having pain interference at follow-up (β = −0.07, *SE* = 0.02, p = .003). Regarding covariates, greater physical function (β = 0.08, *SE* = 0.03, p = .001) and greater depressive symptoms at baseline (β = −0.05, *SE* = 0.02, p = .019) were related to lower odds of pain interference at follow-up. More ADL limitations at baseline was related to lower odds of pain interference at follow-up (β = −0.03, *SE* = 0.01, p = .002).

Discussion

In our study of Puerto Rican adults aged 60 and older, baseline pain interference was not associated with baseline or follow-up cognitive performance. Instead, reporting greater pain interference at follow-up was associated with decreased cognitive performance at follow-up. In addition, higher baseline cognitive performance was associated with lower pain interference at follow-up. The Puerto Rican context is important for examining the relationship between pain and cognitive performance. Puerto Rican adults report more chronic, severe, and interfering pain compared to those of other Hispanic ancestry groups (25). Additionally, the Caribbean islands, including Puerto Rico, have among the highest prevalence of dementia in Latin America (26). Compared to other Hispanic subgroups in the United States (Cuban, Mexican, and other Hispanics), older Puerto Rican adults have worse cognitive performance (27).

Our findings on pain and cognitive performance at baseline are consistent with the previous literature (8,16), especially those studies examining pain interference (10,16). Previous studies with null findings often examined the relationship between pain severity and cognitive performance (7,9), rather than interference. This may suggest that pain interference is a stronger predictor of cognitive decline than pain severity. This association is in alignment with the interruptive model of pain (17), as pain that is severe enough to limit daily activities likely demands more cognitive resources than the pain that does not interfere with daily activities. Our findings are also consistent with previous work using data from the PREHCO, which found that new pain, but not persistent pain, was associated with cognitive decline (34). Our work builds on these findings by incorporating pain interference, which may be more important for cognitive performance among older adults. We also build on these findings by using path models to assess concurrent and cross-lagged relationships between pain and cognitive performance.

The lack of association between pain interference and cognitive performance at baseline was unexpected and may be explained by multiple factors. In particular, asking about pain, in general, may better capture neurological intactness, especially as people age. Pain processing involves multiple brain regions also important for cognitive performance, including the prefrontal cortex, anterior cingulate, and the hippocampus (18,35); hence, being able to report on pain may be a sign of neurological intactness. In comparison, increases in the likelihood of pain interference appear to coincide with cognitive decline, aligned with a previous study showing a concurrent relationship between accumulating pain interference and cognitive decline in older adults (10). Our findings extend these results to Puerto Rican older adults.

While most studies focus on pain predicting a cognitive decline, few have examined whether cognitive performance predicts

Table 2. All Estimates From the Structural Equation Model

	Pain Interference Baseline			Pain Interference Follow-up			Cognitive Performance Baseline			Cognitive Performance Follow-up		
	β	*SE*	*p*	β	*SE*	*p*	β	*SE*	*p*	β	*SE*	*p*
Demographics												
Women	0.03	0.02	.221	0.02	0.02	.459	0.10	0.02	<.001	0.05	0.02	.028
Race (White)	−0.05	0.02	.035	−0.01	0.02	.586	−0.03	0.02	.142	0.02	0.02	.305
Education	−0.04	0.02	.065	−0.03	0.02	.170	0.28	0.02	<.001	0.22	0.02	<.001
Baseline health variables												
Pain interference				−0.01	0.02	.673	0.01	0.02	.636	−0.01	0.02	.594
Cognitive performance	0.01	0.02	.636	−0.07	0.02	.007				0.27	0.02	<.001
Age	−0.03	0.02	.079	−0.12	0.24	.625	−0.11	0.02	<.001	0.01	0.08	.956
Insurance status	0.01	0.03	.836	0.34	1.01	.740	0.01	0.03	.580	0.41	0.49	.399
Depressive symptoms	0.04	0.02	.078	−0.05	0.02	.019	−0.09	0.02	<.001	0.001	0.02	.995
Comorbidities	0.05	0.03	.045	−0.02	0.03	.604	0.02	0.02	.430	0.01	0.03	.817
Physical function	−0.03	0.02	.226	0.08	0.03	.001	−0.06	0.02	.013	−0.06	0.02	.004
ADL limitations	0.01	0.02	.565	−0.03	0.01	.002	0.01	0.02	.423	0.01	0.02	.765
Follow-up health variables												
Pain interference										−0.07	0.02	.003
Cognitive performance				−0.07	0.02	.003						
Age				0.11	0.24	.644				0.01	0.22	.957
Insurance status				0.01	0.02	.640				0.02	0.02	.404
Depressive symptoms				−0.02	0.02	.385				0.04	0.02	.109
Comorbidities				−0.001	0.03	.970				−0.03	0.03	.286
Physical function				−0.02	0.02	.338				0.03	0.02	.194
ADL limitations				−0.03	0.02	.071				0.01	0.02	.788

Notes: Main columns represent the outcomes in the structural equation model (SEM), while rows represent the effects of each predictor on the respective outcome. Results are from an Structural equation model that included time-invariant variables (gender, race, and education) at baseline only and time-varying variables at both baseline and follow-up. Pain interference was a 3-level ordinal variable representing no pain (0), noninterfering pain (1), and interfering (pain). ADL = activities of daily living; *SE* = standard error.

pain (36). A study conducted among surgical patients aged 18–85 found that lower scores on assessments of executive function, visual memory, and attention were associated with chronic pain at the 12-month follow-up (36). Previous work using data from the ELSA examined the longitudinal relationship between pain, depression, and cognitive performance among older adults recently diagnosed with arthritis using cross-lagged models (37). The researchers found that better cognitive performance at baseline was protective against pain at follow-up, providing evidence that better cognitive functioning may be a protective factor against pain in later life (37). Similarly, we found that better baseline cognitive performance was associated with lower pain interference at follow-up. This finding is consistent with the shared-network model (18), which hypothesizes that pain and cognition share neural networks, and provides evidence that older adults with worse cognitive performance may be more vulnerable to developing pain, as they may have decreased integrity of neural networks. It is important to note that reports of pain may vary by cognitive status, where individuals with worse cognitive performance may have communication barriers making them unable to report their pain (38). However, we excluded proxy interviews and thus excluded more cognitively impaired participants.

Our findings suggest a dynamic relationship between pain and cognitive performance. About one third of our sample had an increase in pain over the 4-year follow-up, while about half experienced a decline in cognitive performance, and one third improved in cognitive performance. This improvement in cognitive performance is likely owed to the susceptibility of cognitive status screeners to practice effects, especially as our sample has low levels of education on average (39,40). The improvement we observed is consistent with other estimates of reversion rates from MCI to normal in a community-based samples, which range from 25% to 31% (41,42).

Our findings highlight the importance of preserving cognitive function as well as effectively managing and treating pain. Reports of pain interference, in particular, may be an indication for health care providers to assess cognitive changes in their patients (10). Pain treatment may be beneficial for cognitive performance; however, the relationship between opioids, commonly used to treat pain, and cognitive performance is not clear (43). Previous work examining the risk of cognitive decline and dementia among community-dwelling older adults (≥65) found that individuals with the heaviest use of opioids or nonsteroidal anti-inflammatory drugs had a slightly higher risk of dementia compared to those with no or little use; however, the study did not collect information on pain, so this slightly higher risk may have been due to residual pain (43). Additionally, as cognitive performance declines, individuals may be at risk for more pain, yet may experience barriers to communication and may therefore risk underdiagnosis and undertreatment of their pain (44).

Limitations

Our findings should be considered with some limitations. First, the use of 2-time points limits our ability to examine nonlinear trends in cognitive performance. Second, selection bias may have occurred, as we included only participants with complete information on pain, cognitive performance, and relevant covariates at both waves. This may have led to an underestimation of the relationship between pain and cognitive performance. We also used observational data and cannot establish causality from this study. Additionally, the 4-year follow-up may have restricted our ability to examine nuanced changes in pain. Also, we examined pain interference, not pain location or pain treatment; however, recent studies suggest that pain interference is a strong pain predictor of cognitive impairment (10,45). We used self-reported health conditions, which may be subject to recall bias. However, previous work has shown that self-report was generally accurate for chronic conditions, including hypertension and diabetes, including among older adults (46). Finally, the data used in this analysis is over 15 years old. Unfortunately, PREHCO remains the only island-wide population-based study of older adults in Puerto Rico, and Puerto Rico is not included in other population-based studies of cognitive aging in the United States. The association between pain and cognitive performance may remain consistent over time, but the prevalence of risk factors for pain and cognitive impairment, such as diabetes, have increased (47), and the prevalence of dementia is projected to increase in Puerto Rico (26,48). These population-level trends in pain, cognitive impairment, and risk factors make it important for our findings to be replicated using more current data from Puerto Rico. The third wave of data collection are ensuing and will allow for replication with more recent data in the future. Study strengths include a large, well-characterized sample of older Puerto Rican adults and our examination of bidirectional pathways.

Conclusion

Using a sample of older Puerto Rican adults, we found that increased pain interference over 4-years was associated with lower cognitive function at follow-up. Furthermore, those with better baseline cognitive performance had less pain at follow-up. These findings highlight the importance of worsening pain interference as a potentially modifiable risk factor for cognitive decline in an at-risk sample, as pain treatment options exist and may result in population-level benefits in cognitive performance. Additionally, greater baseline cognitive performance may be a protective factor against pain interference over time, suggesting a dynamic relationship between pain and cognitive performance.

Supplementary Material

Supplementary data are available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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Conflict of Interest

The authors declare the absence of known competing financial or personal relationships that could have influenced the work reported in this article.

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Author Contributions

S.A.M. was responsible for study design, interpretation of the results, and writing of the manuscript. T.R.B. conducted data analyses assisted in conceptualization of the study aims and contributed to the manuscript by revising it critically for important intellectual content. C.N.P., B.D., and M.C. assisted in conceptualization of the study aims and contributed to the manuscript by revising it critically for important intellectual content. M.C. additionally assisted in study design, data coding, and data analyses.

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