ORIGINAL RESEARCH

Association of Cognitive Impairment and Spinal Pain in the Older Adult Population in the United States: A Cross-Sectional Study

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ABSTRACT

Objective: The objective of this study was to explore the association between cognitive impairment and spinal pain in the older population in the United States.

Methods: We undertook a secondary analysis of cross-sectional data from the 1999 to 2000 and 2001 to 2002 National Health and Nutrition Examination Survey. The pooled data included a representative sample (n = 2975) of older adults (aged 60-85 years) in the United States. Cognitive impairment was assessed through the Digit Symbol Substitution Test. Spinal pain was defined with a multisite definition, including both nonspecific low back pain and neck pain present in the past 3 months. To account for the complex sampling design, logistic regression was performed using Taylor linearized variance estimation to compute weighted measures of associations.

Results: For older adults with spinal pain, the proportion of cognitive impairment increased with age, from 32.64% in the 60 to 64 age group to 93.83% in the 80 to 84 age group, which was also statistically significantly higher than the general population group and the group without spinal pain ($P < .001$). After controlling for demographic characteristics, socioeconomic status, and general health status, older adults with spinal pain had significantly increased odds of cognitive impairment (odds ratio 1.76, 95% confidence interval: 1.12, 2.79). Vulnerable subgroups (older, female, and less education) were identified.

Conclusion: There was a significant association between cognitive impairment and spinal pain in the older adult population in the United States. Within this population, there were vulnerable subgroups for which spinal pain and cognitive impairment had a greater impact, namely people who are older, female, and those with less education. (J Manipulative Physiol Ther 2025;00;1-12)

Key Indexing Terms: *Back Pain; Neck Pain; Spine; Cognitive Function; Comorbidity; Ageing*

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Introduction

Spinal pain is common, with a lifetime prevalence reported between 54% and 80%.[1] Spinal pain imposes a substantial socioeconomic burden on society and individuals.[2-4] In the United States, low back and neck pain have the highest level of health cost spending of any specific health condition, at $134.5 billion annually.[5] Prevalence of spinal pain and related disability peak in older adults,[6] and 20% of older adults with low back pain report difficulties in fundamental activities of daily living.[7] Research on disabilities related to spinal pain has focused on functional disabilities with few studies giving attention to exploring the relationship between cognitive impairment may have with spinal pain.[8] Spinal conditions such as low back pain[4] and neck pain[9] remain as major contributors to disability globally and cognitive impairment, as an intermediate stage between normal aging and dementia, has a significantly rising global prevalence.[10]

Cognitive function includes mental capacities, such as attention, learning, decision-making, problem-solving, reasoning, and memory.[11] Mild cognitive impairment increases with age, rising from a prevalence of 6.7% in those aged 60 to 64 years to 25.2% in those aged 80 to 84 years.[12] A body of studies indicates that increasing cognitive deficits is a normal process of aging, with age-related cognitive changes including altered neuronal structure, loss of synapses, and dysfunctional neuronal networks.[13,14] In the field of chronic pain and cognition, one theory suggests that there is a biophysiological link between chronic pain and cognitive impairment[15,16] and that pain is seen as a strong cognitive experience. When pain becomes chronic, this experience may use limited cognitive resources, resulting in impairment of normal cognition.[16] This hypothesis is based on a tripartite model of pain composed of sensory/discriminative, affective/motivational, and cognitive/evaluative dimensions, which was developed by Melzack and Casey[17] about 50 years ago.

Clinical research has reported an association between cognitive impairment and chronic low back pain.[18-20] One study from Australia found that compared a small sample of patients with chronic low back to age and gender-matched healthy controls, where patients with chronic low back pain performed significantly worse on cognitive testing.[16] A study from Germany reported decreased spatial memory capacity, inflexibility for concept change, and impaired working memory in patients with chronic low back pain who received opioid treatment, compared with healthy controls.[17] In a study from Japan, over 1/3rd of patients with lumbar spinal stenosis had symptoms of mild cognitive impairment and deterioration of quality of life.[18] The populations in these clinical studies were middle-aged adults who were receiving treatment for their spinal pain. A study based on data from the 2016 to 2018 National Health Interview Survey reported that cognitive function impairment in an older population in the US had significantly increased likelihoods for spinal pain, ranging from 90% to 100%, after controlling for different chronic conditions (cardiovascular disease, hypotension, obesity and diabetes), and demographic and health behavioral factors, as well as mental conditions (anxiety and depression).[21] Regarding potential mechanisms underlying suboptimal cognitive performance in individuals with chronic low back pain, the literature has discussed altered activity in the cortex and neural networks, grey matter atrophy, microglial activation and neuroinflammation, as well as comorbidities.[22] However, it still seems is somewhat unknown whether an association between cognitive impairment and spinal pain exists in a community-based sample, or population study.

Therefore, the objective of this study was to investigate the association between cognitive impairment and spinal pain in the older adult population in the United States. A second objective was to explore the association between cognitive impairment and spinal pain in demographic and socioeconomic subgroups.

Methods

Study Design

This was a secondary analysis of data from the National Health and Nutrition Examination Survey (NHANES) study, where we pooled 2 data sets. The NHANES is a cross-sectional health survey of the noninstitutionalized population of the United States.[23] Each survey focuses on a variety of health and nutrition measurements to meet emerging needs and combines interviews and physical examinations. Each NHANES data file has 2 years of data. This study was reported using the Strengthening the Reporting of Observational Studies in Epidemiology Guidelines.[24] The Protocol (#98-12) for the 1999 to 2000 and the 2001 to 2002 NHANES Survey data sets were approved by the NHANES Institutional Review Board.[25]

Dataset

For this study, we chose to use data from the NHANES to explore the association between cognitive impairment and spinal pain in the older population, as it is a general health study in the United States that collects reliable measurements of cognitive function in the general population. We used data from 1999 to 2000 and 2001 to 2002 NHANES, accessing 2 separate data modules—Cognitive Functioning and Miscellaneous Pains. The Cognitive Functioning module was used to assess cognitive function through the Digit Symbol Substitution Test (DSST). The Miscellaneous Pains module collected data on spinal pain (low back pain and neck pain). These 2 files, along with the Demographics file and the Current Health Status files, were merged. The 1999 to 2000 and 2001 to 2002 data files were later appended to increase sample stability. The unweighted response rate was estimated to be 74% for the 1999 to 2000 NHANES and 75% for the 2001 to 2002 NHANES. The participation rate of the cognitive functioning component of the NHANES was estimated to be 80.2%.

The dataset from NHANES 1999 to 2000 and 2001 to 2002 is over 20 years old. However, this time point was the only time where Cognitive Functioning, together with the Miscellaneous Pains module data, were simultaneously collected.[26,27] In our knowledge, there has been no recent population-based data available that would allow for this analysis. We argue that these factors are highly relevant and warrant exploration. This report is of benefit as spinal conditions such as low back pain[4] and neck pain[9] are major contributors to disability globally and cognitive impairment, as an intermediate stage between normal aging and dementia, with a rising global prevalence.[10] Furthermore, back pain has not been included in NHANES after the 2009 to 2010 survey.[28,29] While cognitive function was assessed in the 2013 to 2014 NHANES, low back pain and neck pain were not. Therefore, the 1999 to 2000 and 2001 to 2002 NHANES datasets were the only ones available to provide an opportunity to explore population-based data from the older population in the United States.

Sample Population

The general study sample inclusion criteria were participants in the United States, of the modules from 1999 to 2000 and 2001 to 2002 NHANES; aged 60 to 85 years; able to understand or read English (proxy interviews were ineligible); and were administered the DSST. The study population for assessing cognitive impairment was required to do the DSST test without distraction, complete the DSST sample test, and complete the DSST within the specific time limit.

Measurements

The study outcome variable was cognitive impairment, and the exposure variable was self-reported spinal pain. Confounding variables included demographic characteristics (sex, age, and race/ethnicity), socioeconomic status (education and the poverty income ratio [PIR]), and general health status.

Cognitive Impairment. Cognitive impairment was assessed with the DSST, which provides a valid and sensitive measure of cognitive function, commonly used in clinical neuropsychology, and has been described in detail elsewhere.[30] Cognitive impairment was coded as a dichotomous variable based on the median value (40) of the DSST test of the study population. When the DSST corrected score was $\leq$40, the cognitive impairment was coded "Yes," and when the DSST corrected score was >40, the DSST was coded "No." This method of defining cognitive impairment was used in a study on the association between white matter hyperintensity and DSST performance.[31]

Self-Reported Spinal Pain. The NHANES Miscellaneous Pains data modules included for this study had 2 questions related to spinal pain: (1) low back pain lasted a whole day or more, in the past 3 months, not including aches and pains that were fleeting or minor, and (2) neck pain lasted a whole day or more, in the past 3 months, not including aches and pains that were fleeting or minor. We generated "spinal pain" from these 2 questions as "Yes" to both "low back pain" and "neck pain." We used spinal pain as a multisite definition in the multivariable analysis of this study. This concept of the multisite definition of spinal pain with both neck pain and low back pain has been used in several epidemiological studies in this area as they often co-occur together.[21,32]

Demographic Variables. Demographic variables included: age, sex, and race/ethnicity. Age was defined as adults 60 to 85 years of age. Age was coded into 5 groups: (1) "60-64," (2) "65-69," (3) "70-74," (4) "75-79," (5) "80-84," and (6) "85." Age "60-64" was used as the reference group. Sex was defined as male and female. Male was defined the reference group. Race/ethnicity was recoded as 4 categories: "Non-Hispanic White," "Non-Hispanic Black," "Hispanic (Mexican American and Other Hispanic)," and "Other non-Hispanic race." "Non-Hispanic White" was used as the reference group.

Socioeconomic Status. Socioeconomic status included education and income. Education was coded into 4 categories: "less than high school," "high school," "some college," and "college and above." "Less than high school" was used as the reference group. Income was measured by the PIR, a ratio of family income to poverty threshold which represents the ratio of family or unrelated individual income to the Federal Poverty Threshold.[33] Ratio below 1.00 indicates that the income for the respective family or unrelated individual is below the official definition of poverty, while a ratio of 2.00 indicates that income was 200% above the appropriate poverty threshold.[33] The PIR was coded into 5 categories: "<1," ">=1 & <=2," ">=2.01 & <=3.99," ">=4 & <=4.99," and ">=5." Family income below the official poverty threshold ("<1") was used as the reference group.

General Health Status. General health status was derived from the question: "Would you say your health in general is excellent, very good, good, fair, or poor?". "Excellent" was used as the reference group.

Statistical Analysis

To account for the complex sampling design of the NHANES, the Taylor linearized variance estimation method in STATA 12 was used to compute weighted descriptive statistics and measures of associations. We divided the weight by 4 for the 2 combined data sets of 4 years of data, 1999 to 2000 and 2001 to 2002. Three logistic regression models were constructed to explore associations between cognitive impairment and spinal pain. These models were developed based on the biophysiological theory that links pain with cognitive impairment and were also developed based on the studies of cognitive impairment and low back pain. Cognitive impairment was treated as the health outcome variable, and spinal pain was treated as the exposure/independent explanatory variable, and general health status was treated as one of the confounders. Age was treated as an important confounder in the model to see the impact of age on cognitive impairment. Prior to the main analysis, an analysis for multicollinearity was conducted, and the correlation between a given explanatory variable and other explanatory variables were determined as not severe enough to require attention.

Model 1 focused on the association between cognitive impairment and spinal pain, controlling for demographic characteristics (ie, age, sex, and race/ethnicity); Model 2 controlled for socioeconomic factors (ie, education and poverty level) in addition to demographic factors. Model 3 controlled for general health status in addition to demographic characteristics and socioeconomic factors. Associations between spinal pain and cognitive impairment were estimated with prevalence odds ratios (ORs) and the 95% confidence intervals (CIs).

Results

There were 2975 participants included in this analysis. See Table 1 for study sample description. A description of the study population, with unweighted and weighted percentages and sizes, and the DSST score mean by each demographic group is found in Table 2. Table 3 shows that the proportion of older adults with cognitive impairment increased with age, from the 60 to 64 age group to the 80 to 84 age group ($P < .001$). In those with spinal pain, the proportion of older adults with cognitive impairment also increased with age, in the 60 to 64 age group to the 80 to 84 age group ($P < .001$), which was higher than that noted in both the general population group and the group without spinal pain.

Significant race and ethnic variations in cognitive impairment ($P < .001$) were seen, with Hispanic and non-Hispanic Black elderly having a higher proportion of cognitive impairment than that of the non-Hispanic White elderly. Significant variations in socioeconomic status and cognitive impairment were observed ($P < .001$). Older adults with less than high school education had the highest proportion for cognitive impairment, while those with college or higher education had the lowest. In addition, 18.2% of people with less than high school education had spinal pain, while 7.1% of those with college or higher education had spinal pain ($P < .001$).

All 3 logistic regression models demonstrate a statistically significant association between cognitive impairment and spinal pain (Table 4). Model 1 indicates that older adults with spinal pain had significantly higher odds of cognitive impairment (OR 2.35, 95% CI: 1.54, 3.60), after controlling for demographic characteristics. Model 2 indicates that older adults with spinal pain had significantly increased odds of cognitive impairment (OR 1.86, 95% CI: 1.19, 2.89), after controlling for demographic characteristics and socioeconomic status. Model 3 indicated that older adults with spinal pain had significantly increased odds of cognitive impairment (OR 1.76, 95% CI: 1.12, 2.79), after controlling for demographic characteristics, socioeconomic status, and general health status.

Table 1. *Study Sample*

Questions	1999-2000	2001-2002	Total
Can do exercise without distraction?			
Yes	1609	1733	3342
No	166	74	240
Missing	59	65	124
Completed the sample test			
Completed the sample test	1457	1602	3059
Unable to complete the sample test	92	114	206
Refused	60	17	77
Missing	225	139	364
Reason unable to complete the sample test			
Physical limitations	43	61	104
Cognitive limitations	28	41	69
Other reason	21	12	33
Completed the DSST test			
Yes, completed	1417	1558	2975*
No, stopped before 2 min	32	33	65
Missing	385	281	666

DSST, Digit Symbol Substitution Test.
* n = 2975 particpants included in this anlaysis.

Discussion

This study is the first, large, population-based study of a specifically older (60-85 years) population in the United States to explore the association between spinal pain and cognitive function. Older adults in the United States population with spinal pain had significantly increased odds of cognitive impairment after controlling for demographic

Table 2. *Description of the Study Population by Proportion of Cognitive Impairment and Spinal Pain, Weighted Percentage, Weighted Count, and Weighted Mean of the DSST Score*

Variable	Percent in the Study Population *N* = 2975	Number in the Study Population	Weighted Percentage In Total Population *N* = 39,290,065	Weighted Counts	Weighted Mean of DSST (Std. Err)
Cognitive impairment (by median)					
With cognitive impairment	52.64	1566	39.62	29,000,000	58.33 (0.35)
Without cognitive impairment	47.36	1409	60.38	44,000,000	28.81 (0.33)
Cognitive impairment (by quartile)					
First quartile	26.16	769	15.57	11,000,000	18.39 (0.29)
Second quartile	25.03	736	22.45	16,000,000	34.74 (0.17)
Third quartile	24.86	731	27.33	20,000,000	47.30 (0.14)
Fourth quartile	23.95	704	34.65	25,000,000	66.07 (0.26)
Spinal pain					
With spinal pain	11.73	349	12.71	9300,000	42.59 (1.38)
Without spinal pain	88.27	2626	87.29	6400,000	47.22 (0.61)
Sex					
Female	51.66	1537	56.86	41,000,000	47.50 (0.72)
Male	48.34	1438	43.14	32,000,000	45.50 (0.77)
Age					
60-64	24.77	737	25.78	20,000,000	54.03 (0.96)
65-69	19.50	580	22.23	17,000,000	50.02 (1.16)
70-74	18.92	563	20.17	14,000,000	45.15 (0.80)
75-79	13.85	412	15.51	11,000,000	40.91 (1.13)
80-84	14.49	431	10.63	7200,000	37.44 (0.98)
85	8.47	252	5.68	3900,000	31.60 (1.46)
Race and ethnicity					
Non-Hispanic White	61.28	1823	83.69	61,000,000	48.94 (0.77)
Non-Hispanic Black	14.39	428	6.82	4900,000	33.02 (1.09)
Hispanic	22.55	671	7.20	5400,000	33.02 (1.14)
Other race	1.78	53	2.30	1700,000	46.23 (3.85)

(*continued*)

Table 2. (*Continued*)

Variable	Percent in the Study Population $N = 2975$	Number in the Study Population	Weighted Percentage In Total Population $N = 39{,}290{,}065$	Weighted Counts	Weighted Mean of DSST (Std. Err)
Education					
Less than high school	40.09	1190	29.84	22,000,000	34.62 (0.68)
High	24.53	728	29.19	21,000,000	48.37 (0.73)
Some college	19.68	584	21.95	16,000,000	51.16 (0.68)
College and more	15.70	466	19.01	14,000,000	57.77 (0.91)
Poverty income ratio (PIR)					
PIR < 1	16.05	417	12.44	8000,000	32.43 (1.11)
PIR < 2	31.18	810	27.87	18,000,000	39.25 (0.70)
PIR < 3	28.68	745	30.97	20,000,000	49.26 (0.65)
PIR > 4	7.24	188	8.18	5400,000	50.21 (1.63)
PIR > 5	16.86	438	20.55	13,000,000	58.43 (0.86)
General health status					
Excellent	10.13	145	12.12	4300,000	56.33 (1.17)
Very good	25.63	367	28.79	10,000,000	52.51 (0.89)
Good	36.80	527	36.47	13,000,000	46.98 (1.35)
Fair or poor	27.44	393	22.62	8100,000	38.94 (1.14)

DSST, Digit Symbol Substitution Test; *PIR*, poverty income ratio.

characteristics, socioeconomic status, and general health status. The findings of this study complement previously published data, which demonstrate that chronic back pain is associated with diminished cognitive functions.[18,19] However, these have been in samples of people who were young to middle-aged.

Variation Within Special Populations

The demographic variations in spinal pain and cognitive impairment were complex. The proportion of people with cognitive impairment increased with age, while the proportion of spinal pain decreased with age, which is consistent with parts of current the literature.[34,35] Older women with spinal pain had a higher proportion of cognitive impairment among those without spinal pain, and a substantially higher risk for cognitive impairment compared with men, after controlling for spinal pain and confounders. Significant variations in the proportion of cognitive impairment by socioeconomic status were observed, with cognitive impairment less common among non-Hispanic Whites, individuals with higher education, excellent general health status, and higher income levels. It was found non-Hispanic blacks were 5.41 times more likely to have cognitive impairment after controlling for demographic characteristics, socioeconomic status, and general health status, which is consistent with a higher prevalence of dementia among African American and Latino/Hispanic populations than in the non-Hispanic White population.[36] Ethno-racial differences, race-specific cultural factors and racial biases influence the way dementia manifests in minority populations,[37] and as racial and ethnic disparities lead to the under treatment of spinal pain and the development of high-impact chronic pain[38] outreach efforts within minority populations should seek to educate and empower people with a better understanding of spinal pain and its impact.

Mechanisms that explain the associations between spinal pain and cognitive impairment are still unknown

It is not clear what mechanism explains the association between spinal pain and cognitive impairment.[39]

Table 3. *Weighted Percentage of Cognitive Impairment, Spinal Pain, and Weighted Percentage of Cognitive Impairment Among Those With Spinal Pain, and Without Spinal Pain*

Variable	% With Cognitive Impairment	*P*	% With Spinal Pain	*P*	% With Cognitive Impairment Among Those With Spinal Pain	*P*	% With Cognitive Impairment Among Those Without Spinal Pain	*P*
Sex		.135		.0003		.8681		.06
Female	37.84		15.25		51.69		35.35	
Male	41.94		9.40		52.68		40.83	
Age		<.001		.48		<.001		<.001
60-64	22.50		15.01		32.64		20.71	
65-69	32.59		12.97		50.57		29.91	
70-74	41.97		11.97		56.32		40.02	
75-79	52.24		9.95		56.34		51.79	
80-84	60.33		13.05		88.55		56.09	
85	77.43		9.26		93.83		75.76	
Race and ethnicity		<.001		<.001		<.001		<.001
Non-Hispanic White	34.47		12.43		47.78		32.58	
Non-Hispanic Black	69.34		10.07		64.70		69.86	
Hispanic	70.67		19.10		76.15		69.37	
Other race	40.37		10.38		57.98		38.34	
Education		<.001		<.001		.001		<.001
Less than high school	68.21		18.18		69.15		68.00	
High	35.98		12.70		45.80		34.55	
Some college	26.00		9.91		39.90		24.47	
College and more	15.64		7.13		17.68		15.49	
PIR		<.001		.002		.0002		<.001
PIR < 1	70.51		22.24		68.39		71.12	
PIR < 2	59.77		14.14		71.38		57.86	
PIR < 3	32.25		10.32		39.99		31.36	
PIR > 4	26.97		12.78		27.64		26.87	
PIR > 5	13.98		9.03		20.75		13.30	

(*continued*)

Table 3. (*Continued*)

Variable	% With Cognitive Impairment	*P*	% With Spinal Pain	*P*	% With Cognitive Impairment Among Those With Spinal Pain	*P*	% With Cognitive Impairment Among Those Without Spinal Pain	*P*
General health status		<.001		<.001		.0021		<.001
Excellent	16.90		4.92		25.01		16.48	
Very good	24.71		8.03		27.79		24.45	
Good	40.00		11.17		36.62		40.43	
Fair or poor	60.55		25.24		65.36		58.93	

PIR, poverty income ratio.

Table 4. *Logistic Regression Models of Association Between Cognitive Impairment and Spinal Pain*

	Model 1			Model 2			Model 3		
	OR	(95% CI)	*P* > *t*	OR	(95% CI)	*P* > *t*	OR	(95% CI)	*P* > *t*
Variables									
Spinal pain	2.35	(1.54, 3.60)	<.001	1.86	(1.19, 2.89)	.01	1.76	(1.11, 2.77)	.02
Sex									
Male	1.00			1.00			1.00		
Female	1.52	(1.13, 2.05)	.01	2.04	(1.51, 2.77)	<.001	2.07	(1.53, 2.79)	<.001
Age									
60-64	1.00			1.00			1.00		
65-69	2.01	(1.34, 3.01)	<.001	2.11	(1.36, 3.31)	<.001	2.07	(1.32, 3.34)	<.001
70-74	3.17	(2.36, 4.26)	<.001	2.93	(2.07, 4.15)	<.001	2.90	(2.02, 4.16)	<.001
75-79	5.72	(4.13, 7.92)	<.001	4.88	(3.39, 7.04)	<.001	4.91	(3.38, 7.15)	<.001
80-84	8.49	(6.29, 11.47)	<.001	9.01	(6.16, 13.17)	<.001	8.82	(5.97, 13.02)	<.001
85	21.74	(12.95, 36.5)	<.001	23.58	(13.52, 41.12)	<.001	23.65	(13.21, 42.35)	<.001
Race and ethnicity									
Non-Hispanic White	1.00			1.00			1.00		
Non-Hispanic Black	7.30	(5.58, 9.54)	<.001	5.57	(4.11, 7.55)	<.001	5.41	(3.95, 7.41)	<.001
Hispanic	7.05	(4.71, 10.57)	<.001	4.21	(2.75, 6.42)	<.001	4.03	(2.63, 6.19)	<.001
Other race	1.77	(0.66, 4.78)	.25	1.79	(0.68, 4.72)	0.23	1.83	(0.69, 4.85)	.22

(*continued*)

Table 4. (*Continued*)

	Model 1			Model 2			Model 3		
	OR	(95% CI)	*P* > *t*	OR	(95% CI)	*P* > *t*	OR	(95% CI)	*P* > *t*
Education									
Less than high school				1.00			1.00		
High school				0.33	(0.27, 0.41)	<.001	0.34	(0.28, 0.43)	<.001
Some college				0.19	(0.14, 0.25)	<.001	0.19	(0.14, 0.26)	<.001
College and more				0.14	(0.09, 0.21)	<.001	0.15	(0.10, 0.23)	<.001
Poverty income ratio (PIR)									
PIR < 1				1.00			1.00		
PIR < 2				1.50	(0.99, 2.27)	.06	1.48	(0.97, 2.25)	.07
PIR < 3				0.66	(0.46, 0.96)	.03	0.67	(0.46, 0.98)	.04
PIR > 4				0.65	(0.32, 1.30)	.21	0.67	(0.33, 1.35)	.25
PIR > 5				0.41	(0.28, 0.61)	<.001	0.42	(0.29, 0.61)	<.001
General health status									
Excellent							1.00		
Very good							0.70	(0.47, 1.30)	.07
Good							1.10	(0.78, 1.55)	.58
Fair or poor							1.57	(1.04, 2.37)	.03

CI, confidence interval; *DSST*, Digit Symbol Substitution Test; *OR*, odds ratio; *PIR*, poverty income ratio.

Neuroimaging is a possible tool to explore the complex network of brain regions associated with chronic pain and its association to other sensory, motor, and cognitive functions.[40-42] Functional neuroimaging of brain structure suggests that chronic pain can be considered a separate disease entity and can change activities in brain regions that are responsible for attention and memory control.[40-42] Brain regions, including the bilateral dorsolateral prefrontal cortex and the medial prefrontal cortex, process both cognitive functions and chronic pain in parallel.[43,44] For example, a functional magnetic resonance imaging study found abnormal cingulo-frontal-parietal network function during attention-demanding condition in patients with chronic low back pain.[45] A scoping recent review summarized evidence from 34 studies and concluded there are potential mechanisms underlying the accelerated cognitive decline observed in people with chronic low back pain. These included altered activity in the cortex and neural networks; grey matter atrophy; microglial activation and neuroinflammation; comorbidities associated with chronic low back pain; and gut microbiota dysbiosis.[22] Given that this study adds population-based evidence that in older adults, those with spinal pain were 1.76 times more likely to have cognitive impairment, prevention and treatment strategies for spinal pain, that influence the possible mechanisms that accelerate cognitive decline are paramount.

Future Research

This study identified a significant association between cognitive impairment and chronic nonspecific low back pain and neck pain in the older adult population in the United States and builds on an expanding body of basic and applied research. Therefore, longitudinal studies exploring casual relationships between spinal pain and cognitive impairment are warranted. Future research could determine whether spinal pain is a risk factor for cognitive impairment, or vice versa. New information may lead health care professionals who manage spinal pain to consider the assessment of cognitive symptoms and interprofessional management when appropriate. As structural brain abnormalities related to chronic back pain may be reversible, treating chronic spinal pain could possibly help in restoring cognitive function. Two studies have suggested that the loss in brain grey matter associated with chronic pain is reversible after successful relief of the pain through treatments.[46,47] Another study noted that relief of pain following spine surgery or facet joint injection resulted in increased cortical thickness in the left dorsolateral prefrontal cortex, which correlated with the reduction of both pain and physical disability. Research has shown a normalization of cognitive task-related brain activity when a patient's chronic low back pain was reduced,[48] and that abnormal brain function activity in patients with chronic low back pain was altered after a period of spinal manipulation.[49] Given the increased odds of cognitive decline in the older US population with spinal pain, research is needed to determine whether prevention and treatment strategies can reduce the level of disability associated with mild cognitive changes.

Strengths

The strengths of this study include that a large dataset (n = 2975) was used with a nationally representative sample of older adults in the United States, and that a valid and sensitive measure of cognitive function, the DSST, was used to assess overall cognitive impairment.[30]

Limitations

The data used in this study were over 20 years old. It is possible that measurements and classifications could have changed. Historical data may be considered inaccurate, however the definition of low back pain and neck pain is relatively crude, and widely used[50] including in other large population-based samples.[51] As well, these data did not include the most current aging population in the US, therefore it is possible that the findings may be more or less substantial if the current population was measured. Another limitation of this study is the cross-sectional design of NHANES, which makes it impossible to examine the directionality of the association between cognitive impairment and spinal pain. Thus, causation cannot be determined. Furthermore, this analysis only included the population in the United States; thus, the generalizability of our study findings may not apply to people in other countries. Another limitation is the assessment of global cognitive impairment, without an assessment of individual aspects of cognitive functions, such as memory, learning, attention, and executive function. This makes it difficult to compare the findings of this study with other studies that focus on individual aspects of cognitive impairment. Although health behavior-related factors, such as physical activity, and mental health conditions may impact the association,[52,53] it was beyond the scope of this study to consider these additional factors. Thus, this study is limited to the variables that were assessed.

Conclusions

This study identified a significant association between cognitive impairment and chronic nonspecific low back pain and neck pain in the older adult population in the United States. Within this population, there were vulnerable subgroups for which spinal pain and cognitive impairment had a greater impact, namely people who are older, female, and those with less education.

These findings suggest that there is a need to further explore these relationships and to measure whether management strategies for vulnerable subgroups and treatment of spinal pain can possibly improve cognitive function. Future research needs to be conducted to identify the directionality of the association between spinal pain and cognitive impairment.

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Contributorship Information

Concept development (provided idea for the research): S.H., H.Y., K.D., E.H.
Design (planned the methods to generate the results): S.H., H.Y., K.D., E.H.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): S.H., H.Y., K.D.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): H.Y.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): S.H., H.Y., K.D., E.H., B.N.G.
Literature search (performed the literature search): S.H., H.Y., K.D., P.T., H.D.
Writing (responsible for writing a substantive part of the manuscript): S.H., H.Y., K.D., E.H., B.N.G., P.T., H.D.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): S.H., P.T., H.Y., K.D., H.D., E.H., B.N.G.

Practical Applications

- This study identified a significant association between cognitive impairment and chronic non-specific low back pain and neck pain in the older adult population in the United States.
- There were vulnerable subgroups for which spinal pain and cognitive impairment had a greater impact, namely people who are older, female, and those with less education.

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