Original Research Article

SAGE Open Medicine

SAGE Open Medicine
Volume 10: 1–12

DOI: 10.1177/20503121221095923
journals.sagepub.com/home/smo
SAGE

Cross-sectional relationship between pain intensity and subjective cognitive decline among middle-aged and older adults with arthritis or joint conditions: Results from a population-based study

Ann L Horgas[1], Amanda L Elliott[2], Shuang Yang[3] and Yi Guo[3,4]

Abstract

Introduction: We investigated cross-sectional relationships between arthritis or joint-related pain intensity and subjective cognitive decline in middle-aged and older adults.

Methods: The sample consisted of 30,150 adults ⩾age 45 years with self-reported arthritis or joint conditions who completed key variables in the 2015 wave of the Behavioral Risk Factor Surveillance System.

Results: Using weighted data, 94.2% of the sample reported experiencing joint pain in the last month (35.9% reported moderate pain and 30.6% reported severe pain) and 17.3% reported subjective cognitive decline. In logistic regression models, pain intensity was associated with significantly higher odds of reporting subjective cognitive decline, after controlling for age, race/ethnicity, sex, education, household income, cardiovascular health, mental health, and history of stroke. Those with moderate pain were two times as likely to report subjective cognitive decline and those with severe pain were more than three times as likely to report subjective cognitive decline relative to those without pain, adjusting for covariates.

Conclusion: The results of this study highlight a significant relationship between pain intensity and subjective cognitive decline in middle-aged and older adults with arthritis or joint conditions typically associated with joint pain. Moderate and severe joint pain is significantly associated with higher risk of subjective cognitive decline, after controlling for personal and health characteristics. Future studies with more comprehensive assessments of pain and cognition are warranted to further elucidate these relationships and their underlying mechanisms.

Keywords

Joint pain, subjective cognitive decline, cognition, arthritis, adults

Date received: 30 September 2021; accepted: 4 April 2022

Introduction

In the United States, persistent pain has been declared a public health problem.[1] The Centers for Disease Control and Prevention (CDC) reported that 50 million adults in the United States have chronic daily pain and that 19.6 million adults experience significant chronic pain that interferes with daily life or work activities.[2] Among adults 65 years of age and older, over half (52.9%) reported experiencing bothersome pain in the preceding month; women were impacted more than men but rates did not differ by age groups.[3] Aging increases the risk of pain due to the high rate of chronic and acute conditions.[4] In 2018, arthritis was second only to

[1]Department of Biobehavioral Nursing Science, College of Nursing, University of Florida, Gainesville, FL, USA
[2]Department of Psychiatry, College of Medicine, University of South Florida, Tampa, FL, USA
[3]Department of Health Outcomes and Biomedical Informatics, College of Medicine, University of Florida, Gainesville, FL, USA
[4]Cancer Informatics Shared Resource, University of Florida Health Cancer Center, Gainesville, FL, USA

Corresponding author:
Ann L Horgas, Department of Biobehavioral Nursing Science, College of Nursing, University of Florida, 1225 Center Drive, PO Box 100197, Gainesville, FL 32610-0197, USA.
Email: ahorgas@ufl.edu

hypertension in prevalence, with 54% of women and 46% of men reporting experiencing this painful condition.[5] Pain is associated with impaired physical functioning (mobility, falls), mental health (depression, anxiety), and social functioning (social withdrawal).[6]

Subjective cognitive decline (SCD) is the self-reported experience of worsening or more frequent confusion or memory loss over the prior 12 months.[7–9] In a report on SCD based on the Behavioral Risk Factor Surveillance System (BRFSS) survey, 11.2% of adults aged 45 years and older reported SCD.[9,10] Rates were higher among those living alone (13.8%) and those with chronic disease (15.2%).[9] The prevalence of SCD increased with age, ranging from 10.4% among those age 45–54 years to 14.3% among those age 75 years and older. SCD is considered one of the earliest noticeable symptoms of Alzheimer's disease, although its predictive value is not certain.[7] Previous studies, however, suggest that more than half of older adults with subjective memory complaints develop more severe cognitive decline within 7–19 years.[7,9,11] Even without progression to more serious impairment, SCD is associated with functional and social limitations; in the 45–54 age group, 10.4% reported SCD and 59.8% of those adults reported SCD-related limitations that affected work, household tasks, or social activities.[9]

There is a growing body of literature that supports the relationship between chronic pain and cognition.[12–14] The relationship is generally hypothesized in one of two ways: (1) the effect of pain on cognitive performance (e.g. attention, memory, and executive function) and (2) the effects of cognitive modulation on pain (e.g. placebo and distraction).[15,16] For the purpose of this article, we focus on the possible effect of pain on cognition.

In a systematic review of 30 published studies, Moriarty, McGuire, and Finn reported that nearly half of people living with persistent pain self-reported cognitive difficulties.[17] The studies included in this review focused on a variety of chronic pain conditions (e.g. back pain, neuropathic pain, fibromyalgia, arthritis, and migraine), measured different pain characteristics (presence, intensity, and locations), and included different age groups (e.g. 18+ or over 60 years). Across all of the reviewed articles, the authors found evidence that chronic pain negatively affected several cognitive domains, including attention, working memory, controlled executive-type functions, as well as general memory. However, the strength and pattern of the relationships differed across studies, chronic pain conditions, and domain of cognition investigated.

Relatively few studies have focused specifically on the relationship between pain and cognitive performance in community-based middle-aged and older adults. Weiner et al.[18] investigated the relationship between pain, cognitive performance, and physical function in older adults with chronic low back pain (CLBP; n = 323). These authors reported that older adults with CLBP had significantly lower performance in several cognitive domains (e.g. memory, delayed memory, language, and mental flexibility). Pain intensity was inversely related to cognitive performance. In a similar study, Karp et al.[11] investigated the relationship of persistent pain and cognition (e.g. mental flexibility) in older adults (n = 56) from a pain clinic. The results were similar to those of Weiner et al.; higher pain intensity was significantly related to decreased performance on cognitive tasks. Participants in this study had a range of pain conditions, with CLBP and osteoarthritis the most common pain source. In a different population, van der Leeuw et al.[14] focused on complex attention in adults age 71–100 years, concluding that pain severity was associated with poorer scores on measures of selective and sustained attention. Berryman conducted a meta-analysis of 22 studies focused on the relationship of chronic pain and executive function and found support for impairment in test performance and reaction time in adults with chronic pain relative to pain-free controls.[19] Baker et al.[20] focused on speed of processing and executive functioning among adults with persistent pain; those with pain scored below standard test scores on Trail Making Test Part B and the Wisconsin Card Sorting Test compared to those without pain. Taken together, these studies support a significant relationship between chronic pain and cognition with caveats related to methodological differences.

To date, cross-sectional studies examining the effect of pain and cognition have focused on different aspects of cognition, included different types of chronic pain, have relatively small sample sizes, and have included varying age groups. To the best of our knowledge, no studies have examined the relationship between pain and SCD. For some middle-aged and older adults, SCD may be a first signal of cognitive changes. Thus, we sought to examine these relations in a population-based cohort study of adults, focusing on: (1) two specific age groups: mid-life and older adults; (2) specific chronic pain conditions: arthritis and/or conditions with joint symptoms; and (3) self-reported cognitive decline. Specifically, we investigated the association of pain intensity and SCD and whether the relationship was influenced by demographic characteristics, cardiovascular (CV) health, mental health, or history of stroke. We addressed the following research questions:

1. What is the prevalence of pain and SCD among middle-age and older adults with arthritis or joint conditions in the United States (age 45+ years)?
2. What is the relationship between pain intensity and SCD among middle-age and older adults with arthritis or joint conditions in the US (age 45+ years)?
3. Is pain intensity associated with SCD, after controlling for age, sex, race/ethnicity, education, household income, mental health, history of stroke, and CV health?

Methods

Data source and study population

This cross-sectional study was conducted using the 2015 wave of the BRFSS survey.[10] The BRFSS is a set of health-related

telephone surveys administered to non-institutionalized US civilian residents 18 years of age or older. Coordinated by the CDC, the BRFSS survey is administered by State health departments to randomly selected households. All 50 states, the District of Columbia, Guam, and Puerto Rico, administer a standardized core questionnaire and have the option to include additional modules and state-specific questions. The SCD module was optional and administered only to participants age 45 years or older in 33 states and the District of Columbia. Due to the nature of study, the requirement of informed consent was waived by the Institutional Review Board. The BRFSS data are de-identified and publicly available on the CDC website using this link: https://www.cdc.gov/brfss/annual_data/annual_2015.html.

Sample

This article focused on BRFSS respondents age 45 years of age and older with self-reported arthritis or joint conditions. Participants age 45 years and older were selected because that was the cut-off age for administration of the SCD module. Figure 1 shows a diagram of the sample selection. The total BRFSS sample consisted of 441,456 adults over age 18 years, of whom 318,778 were age 45 years or older. A total of 135,414 participants reported that they had been diagnosed with some form of arthritis or condition that is associated with joint symptoms. A total of 88,767 participants were subsequently excluded due to missing data on the optional cognitive decline module (e.g. module was not administered in 17 states) or missing pain variables. This study cohort consisted of participants with arthritis or joint conditions and complete pain and SCD data, yielding a sample size of 48,220. An additional 18,070 participants were excluded due to missing data on the covariates (e.g. demographic characteristics and health indicators). Thus, the analytical sample consisted of 30,150 middle-aged and older adults with arthritis or joint conditions who had complete data on all study variables.

Measures

Arthritis or joint conditions. In the Chronic Health Conditions section of the BRFSS questionnaire (Q 6.9), participants were asked whether a doctor, nurse or other health professional "ever told you that you had some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" Response choices were yes or no. Interviewer notes state that arthritis diagnoses include rheumatism or polymyalgia rheumatica; osteoarthritis (not osteoporosis); tendonitis, bursitis, bunion, tennis elbow; carpal tunnel syndrome or tarsal tunnel syndrome; joint infection, and so on. In the BRFSS codebook, this variable is referred to as arthritis. We refer to it as arthritis or joint condition to acknowledge the fact that this variable includes more than arthritis.

Pain. If arthritis or joint conditions were reported in Q 6.9, the Arthritis Burden module was administered. We focused specifically on the pain intensity variable (Q 12.4), which was assessed with the following question: "Please think about the past 30 days, keeping in mind all of your joint pain or aching and whether or not you have taken medication. DURING THE PAST 30 DAYS, how bad was your joint pain ON AVERAGE?" A scale of 0–10 was used where 0 = no pain or aching and 10 is pain or aching as bad as it can be. We categorized this variable into four pain intensity categories using commonly used conventions: 0 = none, 1–3 = mild, 4–6 = moderate, and 7–10 = severe.

SCD. In the BRFSS survey, SCD is defined as mild cognitive changes that do not rise to the level of diagnosable conditions such as Mild Cognitive Impairment or dementia. We focused on responses to the following question: "During the past 12 months, have you experienced confusion or memory loss that is happening more often or is getting worse?" Response choices were yes or no. This module also included two additional questions about the effect of confusion or memory loss on the ability to perform day-to-day household activities or to engage in activities outside the home. Fewer than 7500 respondents completed these two additional questions, thus they were not included in our analyses.

Covariates. Sociodemographic characteristics of age, race, sex, household income, and education were considered covariates. In the publicly available data set, age was categorized into age groups: 45–54, 55–64, 65–74, and 75 years and older. Level of education was categorized into four groups: <high school, high school graduate, some college, or college graduate or higher. Race/ethnicity was coded into 4 groups: White/non-Hispanic, Black/non-Hispanic, Hispanic, or Other race/ethnicity. Household income was coded into 4 categories: <$15,000, $15,000-$25,000, $25,000-$50,000, and >$50,000 US dollars.

We also controlled for three indicators of health: mental health, CV health, and history of stroke. In the BRFSS survey, respondents were asked "Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?" Scores could range from 0 to 30. This variable was categorized into two groups: poor mental health (⩾14 poor mental health days) and better mental health (<14 poor mental health days) according to prior research with the BRFSS mental health data.[21]

To control for physical health, we created a CV health index based on 7 core American Heart Association risk indicators: diabetes, obesity, hypertension, current smoking, hypercholesterolemia, physical activity, and consumption of fruits and vegetables.[22] Each indicator was scored as 0 (adequate) or 1 (poor). We used procedures outlined by Gebreab et al.[23] using the BRFSS data. Self-reported diabetes,

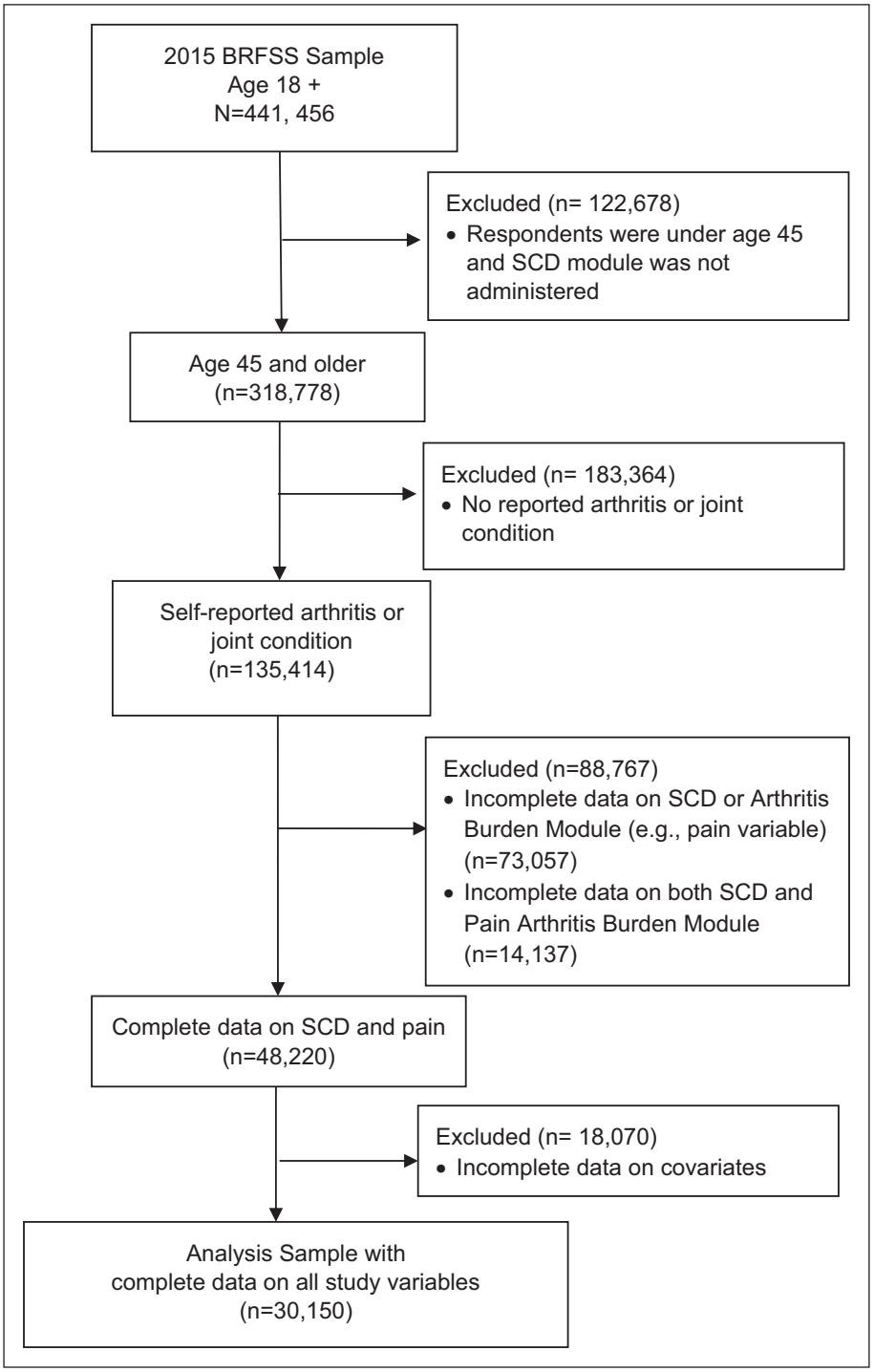

Figure 1. Sample selection.

hypertension, and hypercholesterolemia were assessed by the questions, "Has a doctor or other health professional ever told you that you have high blood pressure, blood sugar, or cholesterol?" Responses were coded as 0=no and 1=yes. Women who were told that they had hypertension or diabetes only while pregnant were included in the "no" category. Body mass index was calculated based on self-reported weight (kg) divided by height in square meters; obesity was defined as BMI of ⩾30 and coded as 1 (else=0). Participants who reported that they had smoked 100 or more cigarettes during their lifetime or who currently smoked every day or some days were considered current smokers and coded as 1 (else=0). Sufficient physical activity was evaluated based on self-report of ⩾150 total minutes of moderate activity per week, the equivalent in vigorous activity or a combination of moderate and vigorous activity. Insufficient activity was

coded as 1 (else = 0). Dietary intake of fruits and vegetables was assessed based on participants' self-report of how many times per day they consumed the following categories of food over the past month: 100% fruit juice, fruit, beans or lentils, dark green vegetables, orange-colored vegetables, and other vegetables. Responses were used to create a composite index of average daily fruit and vegetable consumption; those who consumeded fewer than five servings per day were coded as inadequate (1; adequate = 0).

The seven dichotomized variables were summed to create a CV health index score for each participant (potential scores ranged from 0 to 7 points). Participants with a score of ⩾5 met the criteria for poor CV health and were coded as 1 (else = 0).[22,23]

In addition, we controlled for history of stroke. Participants were asked if they were "ever told you had a stroke?" Response choices were yes or no.

Statistical analysis. The BRFSS uses a complex multistage sampling design, and all analyses were conducted using the weights provided in the data set. Analyses were conducted using the Complex Samples module of SPSS version 25. Weighted prevalence estimates were obtained for sociodemographic characteristics, pain, SCD, and health variables. Weighted chi-square tests were used to compare the distributions of age, race, sex, education, household income, pain intensity, mental health, and CV health by SCD. Logistic regression was used to predict SCD from pain intensity, adjusting for age, sex, race/ethnicity, education level, household income, CV health, stroke, and mental health.

As noted in the sample section and shown in Figure 1, there were considerable missing data. We selected the sample based on (1) age ⩾ 45 years for whom the SCD module was administered, (2) self-reported arthritis or joint conditions, and (3) complete data in the arthritis burden module about joint pain intensity. We focused on the pain intensity question as this is consistent with the literature on this topic. Based on this definition, we had a sample of 48,220 adults. Of these respondents, 37.5% of cases were dropped due to missing values on the covariates. To identify the sources of missingness, we examined the number of missing values for each covariate variable used in data analysis. All missing values were within reasonable range, with the large missing rate of 17.2% for income and 11.8% for fruit/vegetable consumption (included in computation of CV health index). We chose not to perform missing data imputation because all missing rates were reasonable and comparative to other publications using the BRFSS data. In addition, without knowing the mechanism (random vs non-random) of the missingness, we sought to avoid further biasing the results.

Results

Sample characteristics

The sample was predominantly non-Hispanic White (77.3%), female (56.4%), and educated (32.4% graduated high school and 52.2% had some college or higher). Table 1 shows the demographic characteristics.

Descriptive and bivariate findings

Self-reported pain. Pain questions were only asked of participants who reported that they had been diagnosed with arthritis or joint condition. Because arthritis/joint condition was a key selection variable, 100% of the analysis sample had some type of arthritis or joint condition typically associated with pain. Almost all of the respondents (94.1%) reported experiencing pain during the past 30 days. The majority (66.5%) reported moderate or severe pain intensity (Table 1).

As shown in Table 2, pain intensity was significantly associated with all study variables. Middle-aged adults (age 45–54 years) and females were significantly more likely to report severe pain whereas older adults (age 65–74 and 75 years+) were more likely to report moderate pain levels. Non-Hispanic Black and Hispanic respondents, as well as those with low income, poorer mental health, poorer CV health, and history of stroke were significantly more likely to report severe pain intensity relative to others.

SCD. Approximately 17% (17.3%) of the study respondents reported that they experienced SCD (Table 1), defined as self-reported memory or cognitive difficulties that worsened over the past year. As shown in Table 2, significant associations were observed between all of the study variables and SCD, except sex and race/ethnicity. Middle-aged adults (age 45–54 years) and those with lower educational levels, lower income, poorer mental health, poorer CV health, and stroke history were more likely to report SCD than other respondents. There was a non-significant trend for race/ethnicity in that non-Hispanic Black respondents and those of other races were more likely to report SCD than White or Hispanic respondents.

Relationship between pain intensity and SCD

The results revealed a significant association between pain intensity and SCD (χ^2 (df=3) = 503.22, $p < 0.001$)) (Table 2). Among participants with arthritis or joint condition, 16.3% of those with moderate pain reported SCD and 28.5% of those with severe pain reported SCD.

Predicting SCD from pain intensity, controlling for age, sex, race, education, and mental health

Table 3 shows the results of a logistic regression model predicting SCD from pain intensity. In a model with no covariates, participants with any level of pain intensity had significantly higher odds of SCD than those with no pain.

In a second model, age, sex, race/ethnicity, education, household income, mental health, CV health, and stroke history were included as covariates. Pain intensity was associated with significantly higher odds of reporting cognitive decline; those with moderate pain had twice the odds (OR = 2.04,

Table 1. Sample characteristics of adults with arthritis or joint conditions age ⩾45 years, behavioral risk factor surveillance system, 33 states and the District of Columbia, 2015 (30,150).

	Unweighted (n (%))	Weighted %[a] (% [95% CI])
Age group (years)		
45–54	4404 (14.6)	22.5 [21.6–23.4]
55–64	9077 (30.1)	32.3 [31.4–33.2]
65–74	9956 (33.0)	27.3 [26.5–28.1]
75+	6713 (22.3)	17.8 [17.2–18.5]
Sex		
Male	11,399 (37.8)	43.6 [42.7–44.6]
Female	18,751 (62.2)	56.4 [55.4–57.3]
Race/ethnicity		
White, non-Hispanic	24,083 (79.9)	77.3 [76.5–78.1]
Black, non-Hispanic	3116 (10.3)	13.0 [12.3–13.8]
Hispanic	1221 (4.8)	6.1 [5.7–6.6]
Other race	1510 (5.0)	3.5 [3.2–3.9]
Education level		
Less than high school	2751 (9.1)	15.5 [14.7–16.3]
High school graduate	9456 (31.4)	32.4 [31.5–33.3]
Some college	8631 (28.6)	31.4 [30.6–32.3]
College graduate+	9312 (30.9)	20.7 [20.0–21.3]
Household income (annual)		
<$15,000	4208 (14.0)	13.9 [13.2–14.6]
$15,000–$25,000	6152 (20.4)	20.2 [19.4–21.0]
$25,000–$50,000	8395 (27.8)	26.7 [25.9–27.5]
>$50,000	11,395 (37.8)	39.2 [38.3–40.1]
Subjective cognitive decline		
Yes	4663 (15.5)	17.3 [16.6–18.1]
No	25,487 (84.5)	82.7 [81.9–83.4]
Joint pain intensity (last month)		
None	1779 (5.9)	5.9 [5.4–6.4]
Mild	9069 (30.1)	27.6 [26.8–28.4]
Moderate	10,890 (36.1)	35.9 [35.0–36.8]
Severe	8421 (28.0)	30.6 [29.7–31.5]
Mental Health		
Poor mental health	4243 (14.1)	15.7 [14.9–16.4]
Better mental health	25,907 (85.9)	84.3 [83.6–85.1]
CV health index		
Poor CV health	8086 (26.8)	28.9 [28.0–29.8]
Adequate CV health	22,064 (73.2)	71.1 [70.2–72.0]
Stroke		
Yes	2249 (7.5%	7.4 [6.9–7.9]
No	27,901 (92.5%)	92.6 [92.1–93.1]

CI: confidence interval; CV: cardiovascular.
[a]All estimates are weighted.

95% CI=1.52–2.74, $p<0.001$) and those with severe pain had more than three times the odds (OR=3.15, 95% CI=2.34–4.22, $p<0.001$) of reporting SCD relative to those without pain, adjusting for the covariates. Younger age was significantly associated with higher odds of having SCD; participants aged 65–74 years had 28% decrease in the odds of reporting SCD relative to those age 45–54 years (OR=0.72, 95% CI=0.61–0.85, $p<0.001$). Being female was associated with a 23% decrease in the odds of reporting SCD (OR=0.77, 95% CI=0.69–0.87, $p<0.001$). We also observed a significant education effect in SCD. Participants who graduated high school (OR=0.83, 95% CI=0.69–0.99, $p<0.05$) or graduated college or more (OR=0.78, 95% CI=0.63–0.96, $p<0.05$) were 17%–22% less likely to report SCD compared to participants with less than high school education. In addition, having higher annual household income (>$50,000) was associated with a 29% decrease in the odds (OR=0.71, 95% CI=0.58–0.87, $p<0.001$) of SCD relative to those with the lowest income (<$15,000). Mental health, CV health, and history of stroke were significantly associated with odds of SCD; better

Table 2. Bivariate associations between demographic characteristics, health, subjective cognitive decline and pain intensity among adults with arthritis or joint conditions age ⩾45 years, Behavioral Risk Factor Surveillance System, 33 states and the District of Columbia, 2015 (N = 30,150).

	Subjective cognitive decline		Pain intensity				
	% Yes [95% CI]	p[a]	% [95% CI]				p[a]
			None	Mild	Moderate	Severe	
Age group (years)							
45–54	21.5 [19.5–23.4]	<0.001[b]	6.0 [4.8–7.3]	24.8 [22.8–26.8]	32.6 [30.4–34.9]	36.6 [34.3–38.9]	<0.001[c]
55–64	18.7 [17.3–20.1]		5.1 [4.3–5.8]	27.3 [25.8–28.8]	34.1 [32.5–35.7]	33.5 [31.9–35.1]	
65–74	13.6 [12.5–14.8]		5.6 [4.9–6.3]	30.5 [29.1–32.0]	38.7 [37.1–40.2]	25.2 [23.8–26.7]	
75+	15.4 [13.0–16.9]		7.6 [6.5–8.8]	27.3 [25.6–29.0]	39.0 [37.1–40.9]	26.1 [24.3–27.8]	
Sex							
Male	17.9 [16.7–19.2]	0.180[d]	6.9 [6.1–7.7]	32.0 [30.6–33.3]	35.9 [34.3–37.3]	25.3 [23.9–26.7]	<0.001[e]
Female	16.9 [15.9–17.8]		5.1 [4.6–5.7]	24.2 [23.3–25.3]	35.9 [34.8–37.0]	34.7 [33.5–35.9]	
Race/ethnicity							
White, non-Hispanic	16.8 [15.9–17.6]	0.065[f]	5.7 [5.2–6.2]	30.8 [29.8–31.7]	37.8 [36.8–38.8]	25.7 [24.8–26.6]	<0.001[g]
Black, non-Hispanic	19.6 [17.2–22.1]		6.4 [4.7–8.0]	15.9 [13.6–18.2]	27.7 [24.9–30.5]	50.1 [46.9–53.2]	
Hispanic	18.6 [14.9–22.3]		5.1 [3.3–6.9]	15.0 [12.1–17.9]	31.2 [27.5–34.9]	48.7 [44.6–52.8]	
Other race	19.8 [15.8–23.8]		9.1 [4.9–13.5]	23.8 [19.6–28.1]	31.8 [26.9–36.6]	35.2 [30.4–40.1]	
Education level							
Less than high school	24.7 [22.1–27.4]	<0.001[h]	3.7 [2.7–4.7]	12.6 [10.7–14.4]	30.3 [27.7–33.1]	53.3 [50.4–56.2]	<0.001[i]
High school graduate	17.3 [16.0–18.5]		6.0 [5.2–6.9]	23.9 [22.5–25.3]	37.6 [36.0–39.2]	32.5 [30.9–34.0]	
Some college	17.7 [16.4–19.1]		5.8 [5.0–6.7]	29.2 [27.7–30.8]	37.7 [36.0–39.4]	27.3 [25.7–28.8]	
College graduate+	11.3 [10.3–12.4]		7.3 [6.4–8.2]	42.4 [40.7–44.0]	34.5 [32.9–36.1]	15.9 [14.7–17.1]	
Household income (annual in US$)							
<$15,000	27.8 [25.3–30.2]	<0.001[j]	3.4 [2.4–4.3]	9.3 [7.7–10.8]	26.4 [24.2–28.6]	61.0 [58.4–63.6]	<0.001[k]
$15,000–$25,000	21.6 [19.8–23.3]		4.2 [3.4–5.1]	17.8 [16.2–19.5]	35.5 [33.5–37.5]	42.5 [40.4–44.6]	
$25,000–$50,000	16.9 [15.5–18.3]		5.7 [4.9–6.5]	26.6 [25.1–28.1]	40.1 [38.3–41.8]	27.6 [25.9–29.3]	
>$50,000	11.8 [10.7–12.8]		7.7 [6.9–8.6]	39.9 [38.4–41.3]	36.6 [35.1–38.1]	15.8 [14.7–17.0]	

(Continued)

Table 2. (Continued)

	Subjective cognitive decline		Pain intensity				
	% Yes [95% CI]	p[a]	% [95% CI]				p[a]
			None	Mild	Moderate	Severe	
Subjective cognitive decline							
Yes			2.5 [1.9–3.2]	13.4 [11.9–14.9]	33.8 [31.4–36.1]	50.3 [47.9–52.7]	<0.001[l]
No			6.6 [6.0–7.1]	30.6 [29.7–31.5]	36.3 [35.3–37.3]	26.5 [25.5–27.4]	
Joint pain intensity (last month)							
None	7.5 [5.6–9.4]	<0.001[m]					
Mild	8.4 [7.5–9.3]						
Moderate	16.3 [15.1–17.6]						
Severe	28.5 [26.8–30.2]						
Mental health							
Poor mental health	42.3 [39.7–44.8]	<0.001[n]	2.4 [1.6–3.3]	10.4 [8.9–11.8]	31.9 [29.5–34.3]	55.3 [52.8–57.8]	<0.001[o]
Better mental health	12.7 [12.0–13.4]		6.5 [6.0–7.0]	30.8 [29.9–31.7]	36.6 [35.6–37.6]	26.0 [25.1–27.0]	
CV health index							
Poor CV health	21.7 [20.1–23.3]	<0.001[p]	4.6 [3.7–5.4]	19.6 [18.2–21.0]	35.8 [34.0–37.5]	40.1 [38.3–42.0]	<0.001[q]
Adequate CV health	15.7 [14.7–16.4]		6.4 [5.9–7.0]	30.9 [29.9–31.9]	36.0 [34.9–37.0]	26.8 [25.7–27.8]	
History of stroke							
Yes	34.4 [32.0–37.7]	<0.001[r]	3.9 [2.7–5.1]	15.8 [13.4–18.1]	35.4 [32.0–38.9]	45.0 [41.5–48.5]	<0.001[s]
No	16.0 [15.2–16.8]		6.0 [5.5–6.5]	28.6 [27.7–29.4]	35.9 [35.0–36.9]	29.5 [28.5–30.4]	

CI: confidence interval; CV: cardiovascular.
[a]All estimates based on the weighted chi-square test.
[b]χ^2 (df = 3) = 61.77, $p < 0.001$.
[c]χ^2 (df = 9) = 126.43, $p < 0.001$.
[d]χ^2 (df = 1) = 1.80, $p > 0.05$.
[e]χ^2 (df = 3) = 134.00, $p < 0.001$.
[f]χ^2 (df = 3) = 7.33, $p > 0.05$.
[g]χ^2 (df = 9) = 386.76, $p < 0.001$.
[h]χ^2 (df = 3) = 111.83, $p < 0.001$.
[i]χ^2 (df = 9) = 792.59, $p < 0.001$.
[j]χ^2 (df = 3) = 205.86, $p < 0.001$.
[k]χ^2 (df = 9) = 1411.44, $p < 0.001$.
[l]χ^2 (df = 3) = 503.22, $p < 0.001$.
[m]χ^2 (df = 3) = 503.22, $p < 0.001$.
[n]χ^2 (df = 1) = 768.79, $p < 0.001$.
[o]χ^2 (df = 3) = 578.24, $p < 0.001$.
[p]χ^2 (df = 1) = 50.59, $p < 0.001$.
[q]χ^2 (df = 3) = 214.31, $p < 0.001$.
[r]χ^2 (df = 1) = 164.63, $p < 0.001$.
[s]χ^2 (df = 3) = 115.01, $p < 0.001$.

Table 3. Logistic regression predicting subjective cognitive decline from pain intensity, controlling for demographic characteristics and health, among adults with arthritis or joint conditions age ⩾45 years, Behavioral Risk Factor Surveillance System, 33 states and the District of Columbia, 2015 (N = 30,150).

	LR model[a]		LR model[a]	
	Adjusted OR [95% CI]	p	Adjusted OR [95% CI]	p
Pain intensity				
Mild vs none	1.13 [0.84–1.53]	<0.001	1.18 [0.88–1.59]	0.275
Moderate vs none	2.41 [1.80–3.22]	<0.001	2.04 [1.52–2.74]	<0.001
Severe vs none	4.92 [3.69–6.56]	<0.001	3.15 [2.34–4.22]	<0.001
Age group (years)				
55–64 vs 45–54			0.89 [0.76–1.05]	0.165
65–74 vs 45–54			0.72 [0.61–0.85]	<0.001
75+ vs 45–54			0.84 [0.74–1.01]	0.066
Sex				
Female vs male			0.77 [0.69–0.87]	<0.001
Race/ethnicity				
Black, non-Hispanic vs White, non-Hispanic			0.91 [0.75–1.10]	0.318
Hispanic vs White, non-Hispanic			0.77 [0.59–1.00]	0.052
Other Race vs White, non-Hispanic			1.00 [0.75–1.34]	0.995
Education				
High school graduate vs less than high school			0.83 [0.69–0.99]	0.049
Some college vs less than high school			0.96 [0.79–1.16]	0.671
College graduate+ vs less than high school			0.78 [0.63–0.96]	0.018
Household income				
$15,000–$25,000 vs <$15,000			0.94 [0.78–1.12]	0.466
$25,000–$50,000 vs <$15,000			0.85 [0.73–1.07]	0.189
>$50,000 vs <$15,000			0.71 [0.58–0.87]	<0.001
Mental health				
Better mental health vs poor mental health			0.28 [0.24–0.32]	<0.001
CV health index				
Adequate CV health vs poor CV health			0.87 [0.77–0.98]	0.022
Stroke				
History of stroke vs none			2.14 [1.80–2.55]	<0.001

LR: logistic regression; OR: odds ratio; CI: confidence interval; CV: cardiovascular.
[a]All estimates are weighted.

mental health (e.g. fewer than 14 poor mental health days/month) was associated with a 72% decrease in the odds of SCD (OR = 0.28, 95% CI = 0.24–0.32, $p < 0.001$) relative to those with poorer mental health and adequate CV health was associated with a 13% decrease in odds of SCD relative to those with poor CV health (OR = 0.87, 95% CI = 0.77–0.98, $p < 0.001$), after controlling for other variables in the model. History of stroke was associated significantly higher odds of SCD; those who reported having had a stroke had more than two times the odds (OR = 2.14, 95% CI = 1.80–2.55, $p < 0.001$) of reporting SCD relative to those with no stroke history, adjusting for the covariates.

Discussion

Among middle-aged and older adults in the United States, representing 33 states and the District of Columbia, with arthritis or a joint condition, almost all (94.1%) of respondents reported pain within the past 30 days. This pain prevalence is higher than found in another nationwide survey in the United States in which 50% of respondents reported bothersome pain in the preceding month.[3] This difference likely reflects the fact that we focused specifically on people who reported that they had been diagnosed with some form of arthritis or joint condition which are associated with pain in most people. Age, sex, race/ethnicity, educational attainment, household income, CV health, stroke history, and mental health were all significantly related to pain intensity. Middle-aged adults (age 45–64 years), females, non-Hispanic Black participants, those with lower education levels and lower household income, and those with stroke history, poorer mental, and physical health more likely to report severe pain intensity over the past month than other respondents.

In addition, about 17% of the middle-aged and older adults in this study reported that memory or cognitive difficulties worsened over the past year. This finding is slightly higher than other studies that investigated SCD using the BRFSS data. Both Taylor and Omura reported that

11.2%–11.5% of their sample reported SCD.[8,9] Our higher prevalence rate is likely due to the fact that our analytical samples were different. We selected respondents who had arthritis or joint conditions and had complete data on SCD, pain, and all covariates (N = 30,150), whereas their samples selected for different variables and were less restrictive (N = 128,925).[8] Other studies, however, have reported higher rates of self-reported cognitive difficulties in the range of 20%–50%; one study found that 95% older adults self-reported at least one cognitive complaint.[24–26] These studies, however, did not use nationally representative data and may over-estimate the prevalence of SCD.

Notably, as this study included diverse diagnoses of arthritis and joint conditions, it is important to note the high rate of cognitive symptoms found in previous studies among people with conditions such as ankylosing spondylitis, fibromyalgia, and psoriatic arthritis. Previous researchers have found that, in populations with ankylosing spondylitis and psoriatic arthritis, over 90% of participants were classified as cognitively impaired based on the Montreal Cognitive Assessment (MOCA) and performed worse on cognitive tests compared to controls.[27,28] Among patients with fibromyalgia, cognitive performance on a variety of tests of different domains of cognition was significantly lower than controls.[29] These findings suggest that the prevalence rates of SCD in our sample may be under-reported or that our sample did not contain a large number of people with these specific conditions. It is not possible to discern the prevalence of the specific conditions reported in the BRFSS survey since they were all consolidated into the general "arthritis" variable name.

Study participants reported experiencing moderate (35.9%) or severe pain (30.6%), on average, over the prior month. The prevalence of severe joint pain in our sample approximates findings by Barbour et al.[30] who reported 27% using a different national data set. Middle-aged adults (age 45–64 years) were more likely to report severe pain intensity relative to older age groups; those 65 years and older were more likely to report moderate pain. This contradicts the common expectations that older adults have more pain due to the increase in age-related painful medical conditions in this age group.[31] This finding may be due to the fact that only arthritis or joint-related pain was assessed and pain types differ across age groups.[31]

Middle-aged adults also reported higher rates of SCD relative to the older age groups in the sample. Cognitive changes are non-normative in middle-aged adults and less common than among adults in their 70s and 80s. Thus, when signs of worsening memory or confusion are experienced, middle-aged adults may be more attentive to these changes out of worry or fear of cognitive decline compared to older adults. The finding that severe pain and SCD are higher in middle-aged adults may also reflect that fact that people in the 45–64 age range are likely to still be in the workforce. Physical work demands may exacerbate arthritis or joint-related pain or may increase awareness of pain as they engage in daily activity. Similarly, social and mental aspects of employment may increase awareness of memory or cognitive changes. This is speculative, however, as we do not have data about employment status or occupation. Older adults may be more likely to attribute SCD to aging, be less aware of changes, or be hesitant to report it due to stigma or fear of loss of independence.

Based on data from a national survey of community-residing adults, this study supports the relationship between arthritis or joint-related pain and self-reported cognitive decline in middle-aged and older adults. Experiencing moderate or severe arthritis-related joint pain was associated with two to three times higher odds of reporting SCD, adjusting for the covariates. This finding is consistent with other studies that reported significant effects of pain on cognitive functioning when measured with more sophisticated neuropsychological cognitive tests.[12,18] It is interesting to note that this relationship was supported even when assessing subjective, mild cognitive changes that do not rise to the level of diagnosable conditions such as Mild Cognitive Impairment or dementia.

Given the cross-sectional design and the survey-type questions, it is not possible to draw conclusions about a causal relationship between pain and SCD. However, a review of clinical and preclinical research supports the theory that pain is associated with impaired cognitive function and highlights the role of pain-induced and treatment-related cognitive impairment (e.g. opioids and other analgesic medications).[17] These authors propose a model to explain the potential mechanisms involved in pain-related cognitive impairment. The model posits that (1) competing limited resources (e.g. everyday functioning), (2) neuroplasticity, and (3) dysregulated neurochemistry impact pain-related cognitive functioning.[17] However, more research is needed to elucidate the causal mechanisms that mediate the relationship between pain and cognition.

There are several limitations that must be mentioned. First, the BRFSS survey relies solely on self-report and the findings related to pain and SCD may have been influenced by recall and social-desirability bias. Second, the response rates, sample selection process, and missing data may have resulted in response bias. Third, the variables used in this study reflect survey-type questions that assess one domain of cognition (e.g. self-reported memory changes) and one dimension of pain (e.g. pain intensity). We do not have comprehensive or objective measures of cognitive performance, and information about the temporal association between pain and onset of cognitive symptoms. Pain is, by definition, a subjective experience; thus, self-report measures are appropriate for measuring pain. However, the BRFSS study measures do not reflect a comprehensive pain assessment; no data are available about the location, duration, treatment, onset, pattern, or other important characteristics of pain. The BRFSS pain question asked about arthritis or joint pain,

but included a number of conditions in the "arthritis" category. Thus, we could not differentiate the specific type, severity, or chronicity of conditions that participants considered in their response to this question. Fourth, we adjusted for an array of important covariates, but data on other potential confounders (e.g. analgesics, psychiatric illness, sleep, and fatigue) were not available. Fifth, the results may not be truly representative of the prevalence of pain or SCD across the United States.[9] People with known cognitive impairment or those residing in long-term care settings were excluded from the BRFSS survey. The sample was restricted to those who reported the presence of arthritis, very broadly defined. Thus, people with other types of pain were not included in the study. In addition, the BRFSS SCD module was administer in 2015 to respondents in 33 states and the District of Columbia. Finally, we did not conduct a power analysis because the sample size was large for the comparisons made in these analyses.

Conclusion

The results of this study highlight a significant relationship between pain intensity and SCD in middle-aged and older adults. Moderate and severe joint pain is significantly associated with higher risk of SCD, after controlling for personal and health characteristics. Contrary to expectation, both moderate and severe pain and SCD were more prevalent in middle-aged adults with arthritis than among older adults. While cross-sectional in nature, this study is unique in assessing the prevalence of both joint pain and SCD at a national level. Our findings highlight the potential public health impact of managing pain for cognitive health in the United States.

Among adults with arthritis or joint conditions, this finding suggests that it may be important to assess both pain and cognitive symptoms in middle-age as well as among older adults. This may allow opportunities for earlier intervention to improve pain care and reduce risk factors for cognitive decline. Future studies with more comprehensive assessments of pain and cognition are warranted to further elucidate these relationships and their underlying mechanisms.

Acknowledgements

The authors acknowledge the CDC for providing access to the Behavioral Risk Factor Surveillance System (BRFSS) data set. The data are publicly available and downloadable at the following website: https://www.cdc.gov/brfss/annual_data/annual_2015.html. The questionnaire is available via this link: https://www.cdc.gov/brfss/questionnaires/index.htm. The conducted research reported in this manuscript was not preregistered.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

This study used de-identified, publicly available data from the CDC. The University of Florida IRB 01 (Health Science Center IRB) approved this project as Exempt, Protocol # IRB201901229.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Informed consent

Due to the nature of study, the requirement of informed consent was waived off by the Institutional Review Board.

ORCID iD

Ann L Horgas https://orcid.org/0000-0002-0447-8402

Supplemental material

Supplemental material for this article is available online.

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