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Health Policy Analysis

Age and Gender Differences in the Relationship Between Chronic Pain and Dementia Among Older Australians

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ABSTRACT

Objectives: Chronic pain is a highly debilitating condition that affects older adults and has the potential to increase their odds of experiencing cognitive impairment. The primary objective of this study was to examine the correlation between chronic pain and dementia. Additionally, this research endeavors to ascertain whether the association between chronic pain and dementia differs by age and gender.

Methods: Cross-sectional data were derived from the Survey of Disability, Ageing, and Carers. A total of 20 671 and 20 081 participants aged 65 years and older in 2015 and 2018, respectively, were included in this study. The pooled association between chronic pain and dementia was assessed using a multivariable logistic regression model. Furthermore, the study also examined the multiplicative interaction effects between chronic pain and age, as well as chronic pain and gender, with dementia.

Results: The pooled analysis demonstrated that chronic pain was associated with a heightened odds of dementia (adjusted odds ratio 1.95; 95% CI 1.85-2.05) among older Australians compared with their counterparts without chronic pain. The interaction effect indicated that individuals with chronic pain across all age groups exhibited increased odds of living with dementia. Additionally, women with chronic pain had higher odds of dementia compared with their counterparts without chronic pain and being male.

Conclusions: A continuous, coordinated, and tailored healthcare strategy is necessary to determine the pain management goals and explore early treatment options for chronic pain in older adults, particularly in groups with the greatest need.

Keywords: Australia, chronic pain, dementia, older adults, SADC.

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Highlights

- Research on chronic pain and cognitive decline shows mixed results. Some studies suggest a positive relationship, with chronic pain potentially increasing the risk of cognitive impairment and dementia. However, other studies have not found a clear connection. No prior study in Australia examined the age and gender differences in the relationship between chronic pain and dementia.
- Our findings demonstrate that chronic pain was associated with an increased odds of dementia among older Australians. We found that this relationship exists across all age groups with varying magnitudes. Additionally, women with chronic pain had higher odds of dementia compared with their male counterparts without chronic pain.
- This article emphasizes the need for a comprehensive healthcare approach for chronic pain management in older adults. It suggests a continuous, tailored strategy to assess pain and explore early treatment options. This proactive approach aims to minimize potential cognitive decline associated with chronic pain, ultimately informing healthcare decisions by prioritizing early intervention and potentially reducing future cognitive complications.

Introduction

Dementia, a pressing and growing public health concern, refers to a range of conditions that impair memory, cognition, and the capacity to perform everyday activities. Dementia is one of the prominent contributors to disability and dependency among older adults, affecting an estimated 55 million individuals globally.[1] Nearly 1 in every 12 people aged 65 years or older in Australia are diagnosed with dementia,[2] and the prevalence of dementia is projected to increase almost 2-fold by 2058, mostly because of the phenomenon of population aging.[3] In 2022, dementia accounted for 4.4% of Australia's disease burden and ranked as the second most prevalent cause of death in the country, contributing to 9.6% of all recorded fatalities.[4]

Despite extensive clinical research spanning many decades, a definitive cure for dementia remains elusive, and the availability of effective disease-modifying medications is still lacking.[5] Currently, there is a growing emphasis on preventive and early intervention strategies, which include rigorous methods to identify and address the modifiable risk factors linked to dementia.[6] According to the Lancet Commission's estimation, approximately 40% of dementia cases globally might be averted or postponed by addressing 12 critical risk factors.[7] The risk factors are lower educational levels, impairment of hearing, midlife hypertension, midlife obesity, excessive intake of alcohol, diabetes, brain injury resulting from a severe and distressing event, tobacco consumption, depression, social exclusion, lack of physical exercise, and exposure to air pollution. However, there is an urgent need to identify and target additional modifiable dementia risk factors for the implementation of preventive strategies.

Chronic pain, defined as prolonged and recurring pain lasting for at least 3 months, is one of the most prevalent and significant worldwide health conditions, particularly among older adults.[8,9] The prevalence of chronic pain among older adults residing in the community is estimated to range from 25% to 50% on a global scale[10] and up to 83% in residential aged-care facilities.[11] Earlier research has indicated that a substantial percentage of older Australians, ranging from 29.9% to 36.2%, experience chronic pain.[12] Prior research also indicated that pain in older adults may impair cognitive performance because of its capacity to demand attention and potentially compete for attentional resources.[13] According to this research, the presence of pain affects other dimensions of cognitive performance as well. There is a potential for pain to coincide with or worsen cognitive decline that is associated with age-related changes in brain function.[14] Because of the potential harm that pain may do to cognition, as well as the increasing awareness of the influence of age-related alterations in brain function on the deterioration of balance and movement,[15,16] it is critical to comprehend the link between chronic pain and cognition in older adults.

There is a growing body of data from observational and experimental studies indicating that chronic pain can be associated with an increased susceptibility to neurocognitive impairment and the development of Alzheimer's disease and related dementia.[9,17-21] Several cross-sectional studies have established a correlation between chronic pain and a decline in overall cognitive abilities. For instance, a prior study reported that the incidence of cognitive impairment was significantly higher (adjusted odds ratio [AOR] 1.88) in people with neuropathic pain compared with the reported prevalence in the general Spanish population.[22] Among other cross-sectional studies, a recent Chinese study found that individuals who frequently report pain exhibit a 1.34 times higher likelihood of developing dementia when compared with those who do not report any pain.[23] Similarly, another study in the United States revealed that adults who experience pain interference, even without osteoarthritis, are more likely to develop Alzheimer's disease and related dementia (ADRD).[24] Furthermore, another United States study identified a statistically significant association between pain interference and overall cognitive impairment.[14] The link between chronic pain and cognitive decline is further studied by a growing number of recent longitudinal cohort studies.[18,25-27] For example, a longitudinal cohort study using a sample of 10 065 older persons in the United States found that those with persistent pain experienced a steeper decline in memory scores (9.2%) over time and had a significantly higher prevalence of dementia (7.7%) compared with those without persistent pain.[25] Likewise, a Taiwanese study showed that people aged over 50 years experiencing pain had a greater risk (adjusted hazard ratio 1.21; 95% CI 1.15-1.26) of developing dementia compared with those without pain.[18] A recent study also found that having more chronic pain sites was linked to an elevated risk of dementia and Alzheimer's disease.[27] It is crucial to highlight that the current evidence on the link between chronic pain and cognitive impairment is not always consistent. Some studies have found no link between pain and cognitive decline or dementia.[26,28] These studies propose that pain might be a related factor or an early symptom rather than a direct catalyst of dementia.[29] Furthermore, 2 recent meta-analyses yielded conflicting results. One of the meta-analyses, which examined 37 study results, discovered a connection between chronic pain and cognitive decline.[30] However, another meta-analysis of 10 longitudinal cohort studies, revealed no association between chronic pain and an increased risk of cognitive decline.[31] Differences in the research design, methods of assessing pain and cognition, composition of the study population, and criteria for diagnosing dementia between studies may contribute to these divergent findings.

The age and gender disparities in the association between chronic pain and the risk of dementia are most likely due to biological factors, such as sex hormones, and pain perception, as well as the cumulative effects of aging. Female sex hormones, particularly estrogen, play a well-established role in both pain perception[32,33] and cognitive function.[34] Estrogens offer various advantages for brain health by acting as antioxidants, promoting DNA repair, stimulating the production of growth factors, and regulating blood flow in the brain.[35] Therefore, the natural decline in estrogen levels following menopause could contribute to a stronger association between chronic pain and dementia in women. Prior research established a connection between the decline in sex hormones after menopause and the higher rates and severity of Alzheimer's disease observed in women compared with men.[36–38] In addition, women typically exhibit a greater pain sensitivity,[39] which may lead to an increase in anxiety and tension.[40] A previous study discovered that women are more likely to experience both depression and anxiety when suffering from chronic pain,[41,42] potentially worsening the pain's impact on the brain and heightening the risk of cognitive decline. Age is another crucial factor influencing the association between chronic pain and dementia risk. Both chronic pain[43] and dementia prevalence[44] rise dramatically with aging. The cumulative burden of chronic pain over a lifetime, particularly in older adults, could exacerbate cognitive decline. A study from Ireland investigated the interaction between age and chronic pain, discovering that older adults with chronic pain experienced more significant cognitive decline than their healthy peers of the same age and younger adults with chronic pain.[45] A separate study determined that the risk of ADRD is elevated by chronic pain (hazard ratio 1.23) and that the incidence of ADRD was substantially higher in women and increased with age.[46]

To the best of our knowledge, there has been limited quantitative study on the relationship between chronic pain and dementia in Australia. The purpose of this research was to investigate the hypothesis that chronic pain is associated with heightened odds of dementia among older Australians. This study also aims to determine whether there are any age or gender differences in the association between chronic pain and the odds of dementia. The research findings will have significant implications in the development of well-informed interventions aimed at promoting independence and healthy aging among older adults in Australia and comparable jurisdictions.

Methods

Data Source and Settings

This article used data obtained from the Survey of Disability, Ageing, and Carers (SDAC) in 2015 and 2018. The SDAC provides data for evaluating the prevalence of disability and the requirement for supporting individuals with disabilities in Australia. Additionally, it provides a comprehensive analysis of the socioeconomic and demographic characteristics of those with disabilities, older adults, and caregivers in comparison with the overall population. SDAC collected data from both household and care accommodations.[47] The information collected from the household settings encompasses many forms of residential accommodation, such as self-care facilities for retired or elderly individuals, as well as other private homes, including houses, apartments, condominiums, garages, tents, and other buildings utilized as personal residences. In contrast, cared accommodation encompasses

several facilities, including hospitals, residential aged-care establishments, components of retirement villages that provide care services, aged-care hostels, psychiatric institutions, and other residential settings, such as group homes catering to those with disabilities. The survey sample was selected using multistage sampling procedures.

Study participants

The SDAC 2018 is the ninth nationwide comprehensive survey conducted since its inception in 1981. The surveys carried out in 1988, 1993, 1998, 2003, 2009, 2012, and 2015 were meticulously crafted to systematically collect comparable data pertaining to disability, aging, and carers in Australia. The current research was limited to 2 specific survey rounds conducted in 2015 and 2018 because those were the only rounds for which data on dementia, the outcome variable being studied, were available. The total sample size in 2015 encompassed 74 862 individuals, whereas it comprised 65 487 individuals in 2018. The research specifically targeted persons aged 65 years and older Australian. Therefore, the final sample size for the study was 20 671 individuals in 2015 and 20 081 individuals in 2018. Figure 1 depicts the distribution of the study participants.

Outcome Variable

Data on dementia, the primary outcome variable, were obtained from both households and care accommodations. In the household survey questionnaire, SDAC used a self-reported question "Count persons identified as having dementia/Alzheimer's in the household." The responses to the survey questions were coded in binary form, in which 0 denoted "no," and 1 denoted "yes." Data from the household component, covering both private and nonprivate dwellings, primarily relied on self-reported responses.[48] In cases which the individual in question could not provide the information, a proxy, often a caregiver, may have supplied it. Notably, in the context of cared accommodation, the survey methodology differs because it is not reliant on self-reporting but is instead administered by the carers, who recorded the details related to self-care and chronic medical conditions. In this study, data on dementia were mostly derived from the cared accommodation component. For instance, in 2015, 95.53% of participants with dementia data were from cared accommodation settings, whereas only 4.47% were community dwelling. This distribution remained steady in 2018 (95.57% vs 4.43%). Although the dementia assessment approach in different settings varies somewhat, we expect little variation in dementia measurement throughout the sample owing to the bulk of data coming from cared accommodations that adhere to standardized procedures.

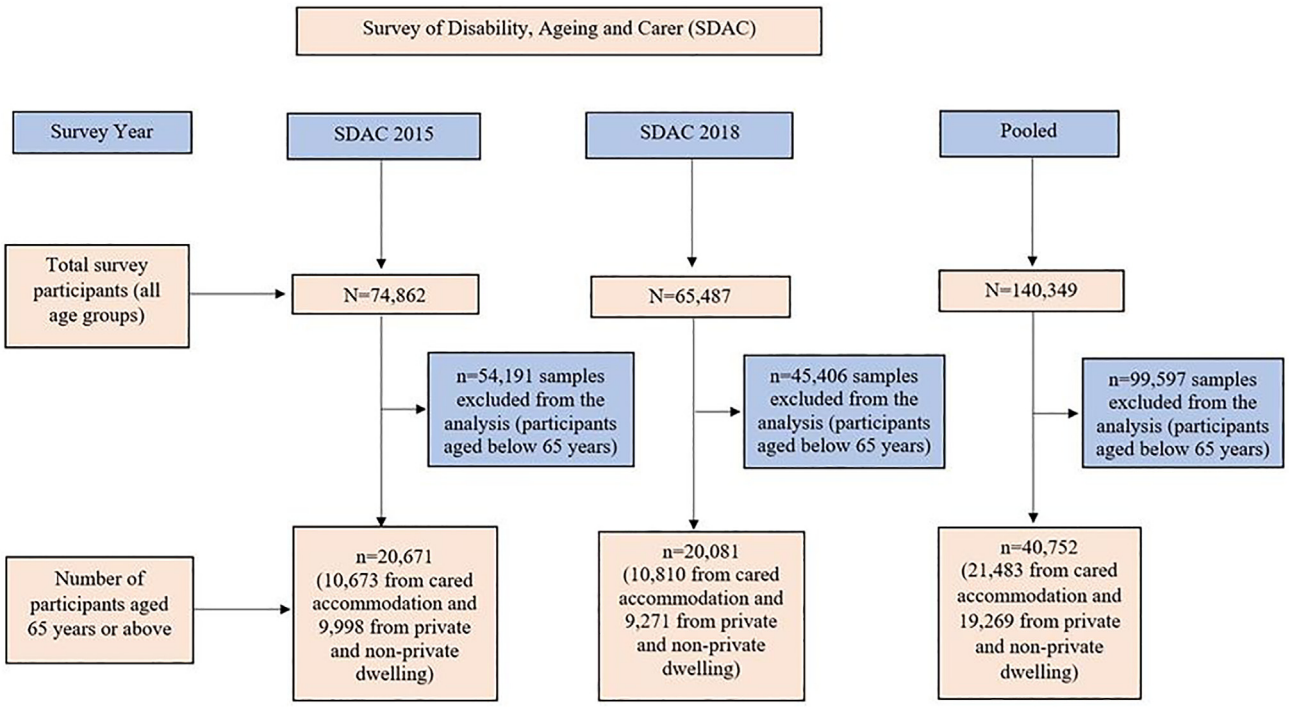
Explanatory Variable

Chronic pain was the exposure of interest and SDAC used the question "Do you/anyone in the household have chronic or recurrent pain or discomfort?" in the household questionnaire to collect the information. The patient must have had recurrent pain during the preceding 12 months to meet the criteria for chronic pain. The answers to the questions were documented in binary form, with 0 indicating "no" and 1 indicating "yes." The responses were collected from both household and care accommodation and were based on self-reported responses or a proxy such as a caregiver or a carer who is required to record any self-care and chronic medical conditions in care accommodation.

Covariates

The study was unable to include all potential confounders because of data availability constraints because data on dementia were mostly gathered from cared accommodation, and data about certain variables were either proved not appropriate for proxy data or were irrelevant to individuals residing in such care settings.[49] The study incorporated the following covariates: age,

Figure 1. Study participant distribution and survey year.



gender, accessibility remoteness index of Australia, country of birth, and state. Building on prior research, this study classified age into 3 distinct groups: individuals aged 65 to 74 were categorized as the "youngest old," those aged 75 to 84 as the "middle old," and those aged 85 and above as the "oldest old."[50,51] The accessibility remoteness index of Australia was classified by the Australian Bureau of Statistics into 5 categories: (1) "major city," (2) "inner regional area," (3) "outer regional," (4) "remote," and (5) "extremely distant."[52] In this study, because of the small number of individuals in each group, individuals from "outer regional," "remote," and "extremely distant areas" in the SDAC data set were merged as "outer regional or remote area."

Estimation Strategies

This study used basic confidential unit records files extracted from the 2015 and 2018 SDAC data sets for conducting a cross-sectional analysis. Descriptive statistics, encompassing frequencies (n) and percentages (%), along with corresponding 95% confidence intervals (CIs), were utilized to present the pooled characteristics of the study sample. Because of the complexity of the survey design, survey weights were used in this study to generate accurate variance estimates. The study made use of the population weight calculated by the Australian Bureau of Statistics for the data set because it offers a more comprehensive view of any given result by including the entire population. Further details on the SDAC study, including sampling and population weighting, can be found elsewhere.[47] The "svyset" STATA command was used to coordinate the intricate survey design during the analysis.

The study used multivariable logistic regression models to explore the association between chronic pain and dementia. The test outcomes are displayed in the form of odds ratio (OR), accompanied by 95% CIs and the respective *P* values for each variable. A predictor was considered statistically significant if the *P* value associated with a specific exposure was equal to or less than .05 in the multivariate regression analyses. The analysis was conducted using STATA 16 (Stata Corp LLC), which involved performing cross-tabulation, regression, and summary statistics.

Results

Table 1 illustrates the weighted background characteristics of the study participants in 2015, 2018, and pooled data. The pooled prevalence of dementia among older adults in Australia was 5.17%. Between 2015 and 2018, there was an observed increase in the prevalence of dementia, with rates rising from 5.10% to 5.23%. However, the prevalence of chronic pain decreased during this time, from 32.50% in 2015 to 30.38% in 2018. Table 1 (pooled) indicates that 56.81% of the participants were aged 65 to 74 years, 53.26% were female, and 67.08% were living in the major cities in Australia. Most older Australians were born in Australia (64.64%) and residing in New South Wales (33.22%).

Figure 2 represents the weighted changes in the prevalence of dementia by age and gender from 2015 to 2018. There was a consistent rise in dementia prevalence in males across all age groups (youngest old: 13%, middle old: 15%, oldest old: 15%). However, females experienced fluctuating dementia prevalence: a 20% decrease in the youngest-old group, a 2% increase in the middle-old group, and no change in the oldest-old group. Age and gender-stratified prevalence of dementia from 2015 to 2018 is presented in Appendix Figure 1 in Supplemental Materials found at https://doi.org/10.1016/j.jval.2024.07.022.

Figure 3 depicts changes in the prevalence of chronic pain by age and gender from 2015 to 2018. Overall, there was a decrease in chronic pain prevalence for both males and females during this period. The most significant decline occurred in females aged oldest old (9.27%), whereas the least change was observed in middle-aged females (1.57%). In the youngest-old group, there was a significant decline of 8.75% among males.

The weighted prevalence of dementia among individuals with and without chronic pain over time is presented in Appendix Figure 2 in Supplemental Materials found at https://doi.org/10.1016/j.jval.2024.07.022. The results showed an increase in the prevalence of dementia among older Australians living with chronic pain from 9.10% in 2015 to 9.28% in 2018. This study also explored the number of people without dementia and chronic pain for a more comprehensive picture. Appendix Tables 1 and 2 in Supplemental Materials found at https://doi.org/10.1016/j.jval.2024.07.022 detail these findings using bivariate statistics.

Table 2 exhibits both unadjusted and adjusted multivariate logistic regression analyses, investigating the pooled association between dementia and chronic pain. Both the unadjusted and adjusted models demonstrate that older adults suffering from chronic pain exhibited a greater odds of living with dementia. The unadjusted analysis indicated that individuals experiencing chronic pain had 1.07 times elevated odds (OR 1.07; 95% CI 1.02-1.12) of living with dementia in comparison with those without chronic pain. These likelihoods were even higher in the adjusted model in which individuals with chronic pain had 1.95 times (AOR 1.95; 95% CI 1.85-2.05) greater odds of living with dementia compared with those without chronic pain.

Table 3 displays the results from the adjusted logistic regression models, which aim to elucidate the group comparison in the interaction effect between chronic pain and age, and chronic pain and gender, with dementia. The findings from model 1 indicate that individuals with chronic pain across all age groups exhibited significantly increased odds of living with dementia compared with those without chronic pain and the youngest old counterparts, and the magnitude of this association was higher with advancing age. For example, the youngest-old, middle-old, and oldest-old individuals with chronic pain, had a 3.40 (AOR 3.40; 95% CI 2.98-3.87), 12.60 (AOR 12.60; 95% CI 11.25-14.10), and staggering 19.99 times (AOR 19.99; 95% CI 17.94-22.28) higher odds of living with dementia, respectively, compared with their counterparts with youngest old and no chronic pain. Model 2 additionally showed that women with chronic pain had 2.41 times higher odds (AOR 2.41; CI 2.24-2.60) of living with dementia compared with those without chronic pain and being male.

Discussion

Key Findings

This study offered novel insights into the association between chronic pain and dementia in at-risk Australian communities, specifically among older Australians. Using a multivariable logistic regression model, this article investigates the pooled association between chronic pain and dementia from a nationally representative data set. According to SDAC, the cross-sectional study found that around 31% of older Australians had chronic pain in 2018. During both study periods of 2015 and 2018, the prevalence of chronic pain was higher among women than men. The pooled association revealed that older Australians who experienced chronic pain had a greater odds of living with dementia compared with those without chronic pain. The study also found that individuals with chronic pain across all age groups had higher odds of living with dementia compared with those without chronic pain and the youngest old counterparts, and this magnitude of

Table 1. Background characteristics of the study participants in 2015, 2018, and pooled data.

Parameters	2015			2018			Pooled		
	Unweighted n = 20 671	Weighted n = 3 546 360	Weighted % (95% CI)	Unweighted n = 20 081	Weighted n = 3 909 217	Weighted % (95% CI)	Unweighted n = 40 752	Weighted n = 7 455 577	Weighted % (95% CI)
Outcome variable									
Dementia									
No	15 009	3 365 573	94.90 (94.54-95.24)	14 209	3 704 791	94.77 (94.36-95.15)	29 218	7 070 364	94.83 (94.56-95.09)
Yes	5662	180 787	5.10 (4.76-5.46)	5872	204 426	5.23 (4.85-5.64)	11 534	385 213	5.17 (4.91-5.44)
Exposures and covariates									
Chronic pain									
No	9928	2 393 742	67.50 (66.50-68.48)	9363	2 721 548	69.62 (68.59-70.63)	19 291	5 115 291	68.61 (67.89-69.32)
Yes	10 743	1 152 618	32.50 (31.52-33.50)	10 718	1 187 669	30.38 (29.37-31.41)	21 461	2 340 286	31.39 (30.68-32.11)
Age									
Youngest old (65-74)	6958	2 008 677	56.64 (55.47-57.80)	6763	2 226 825	56.96 (55.75-58.17)	13 721	4 235 502	56.81 (55.97-57.65)
Middle-old (75-84)	6155	1 073 990	30.28 (29.24-31.35)	5910	1 191 633	30.48 (29.39-31.60)	12 065	2 265 622	30.39 (29.63-31.16)
Oldest old (85 and above)	7558	463 693	13.08 (12.40-13.78)	7408	490 759	12.55 (11.84-13.30)	14 966	954 453	12.80 (12.30-13.32)
Gender									
Male	8033	1 654 433	46.65 (45.95-47.36)	7831	1 830 346	46.82 (46.07-47.58)	15 864	3 484 779	46.74 (46.22-47.26)
Female	12 638	1 891 927	53.35 (52.64-54.05)	12 250	2 078 871	53.18 (52.42-53.93)	24 888	3 970 798	53.26 (52.74-53.78)
Accessibility and remoteness index									
Major cities in Australia	13 505	2 378 783	67.08 (65.86-68.27)	13 472	2 622 707	67.09 (65.80-68.35)	26 977	5 001 490	67.08 (66.20-67.96)
Inner regional Australia	4535	760 614	21.45 (20.39-22.54)	4448	883 523	22.60 (21.48-23.76)	8983	1 644 138	22.05 (21.28-22.85)
Outer regional and remote area	2631	406 963	11.48 (10.72-12.27)	2161	402 987	10.31 (9.54-11.13)	4792	809 949	10.86 (10.32-11.43)
Country of Birth									
Australia	13 872	2 285 906	64.46 (63.29-65.61)	13 228	2 533 537	64.81 (63.58-66.02)	27 100	4 819 442	64.64 (63.79-65.48)
English Speaking Countries	2853	523 733	14.77 (13.97-15.60)	2709	557 465	14.26 (13.44-15.13)	5562	1 081 198	14.50 (13.92-15.10)
Non-English-speaking countries	3946	736 721	20.77 (19.78-21.80)	4144	818 215	20.93 (19.88-22.03)	8090	1 554 937	20.86 (20.13-21.61)
State or territory									
New South Wales	5470	1 189 051	33.53 (32.26-34.82)	5901	1 287 503	32.94 (31.65-34.25)	11 371	2 476 554	33.22 (32.31-34.14)
Victoria	4543	892 056	25.15 (24.03-26.31)	4761	991 202	25.36 (24.19-26.55)	9304	1 883 258	25.26 (24.45-26.09)
Queensland	2994	680 240	19.18 (18.16-20.25)	3144	765 485	19.58 (18.56-20.64)	6138	1 445 725	19.39 (18.66-20.14)
South Australia	2979	293 550	8.28 (7.75-8.84)	2030	318 212	8.14 (7.18-9.21)	5009	611 762	8.21 (7.63-8.82)
Western Australia	2403	336 270	9.48 (8.86-10.15)	2800	373 252	9.55 (8.97-10.16)	5203	709 522	9.52 (9.09-9.96)
Tasmania	1260	93 610	2.64 (2.39-2.91)	895	103 695	2.65 (2.34-3.00)	2155	197 304	2.65 (2.44-2.87)
Northern Territory	225	14 076	0.40 (0.33-0.47)	133	16 137	0.41 (0.29-0.58)	358	30 212	0.41 (0.33-0.49)
Australian Capital Territory	797	47 508	1.34 (1.20-1.49)	417	53 732	1.37 (1.17-1.61)	1214	101 240	1.36 (1.23-1.50)

association increased with age. Additionally, women with chronic pain had a higher odds of living with dementia compared with those without chronic pain and being male.

The study's findings, which indicate an association between chronic pain and dementia, are consistent with earlier research demonstrating an increased odds of dementia among persons experiencing chronic pain or pain-related disorders.[18,22-24,45,53] Using comparable analytic methods to this study, a cross-sectional study conducted in the United States revealed that adults who experience pain interference, even without osteoarthritis, are more likely to develop ADRD.[24] Specifically, individuals with pain interference alone have 1.44 times higher odds of developing ADRD, whereas those with both pain interference and osteoarthritis have 1.37 times higher odds, compared with individuals without pain or osteoarthritis. A recent Chinese cross-sectional study also found that individuals who frequently report pain exhibit a 1.34 times higher likelihood of developing dementia when compared with those who do not report any pain.[23] Furthermore, another cross-sectional study discovered that the incidence of cognitive impairment was significantly greater (AOR: 1.88) in patients with neuropathic pain compared with the reported prevalence in the general Spanish population.[22] The negative association between chronic pain and dementia has also been established in longitudinal settings. For instance, in 2 retrospective United States cohort studies, it was shown that people with non-cancer chronic pain conditions had an increased

Figure 2. Changes in the prevalence of dementia by age and gender from 2015 to 2018.

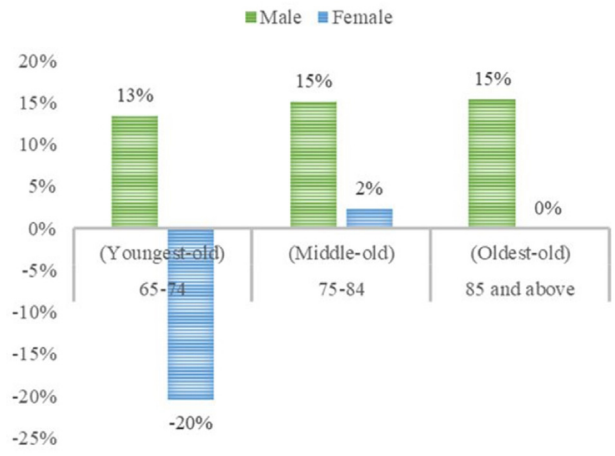
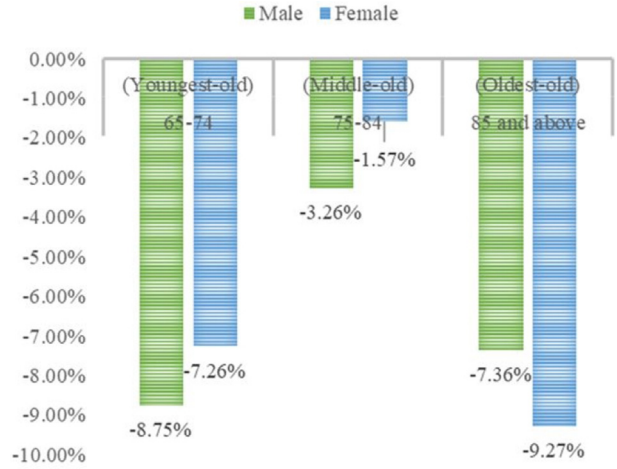


Figure 3. Changes in the prevalence of chronic pain by age and gender from 2015 to 2018.



risk of Alzheimer's disease and associated dementias over the course of 2 years of follow-up than people without pain conditions.[19,20] Another study, spanning a median period of 8.6 years, revealed an association between chronic pain and accelerated deterioration of memory function, as well as an elevated risk of developing dementia.[25] A recent study showed that having more chronic pain locations was linked to an elevated risk of dementia and Alzheimer's disease.[27] On the contrary, a study with a small sample conducted over a period of 24 years revealed that the existence of chronic pain did not exhibit any significant association with the occurrence of all-cause dementia.[26] Likewise, another research found no statistically significant association between pain and cognitive deterioration throughout a 4-year period of observation.[28] Differences in the research design, methods of assessing pain and cognition, composition of the study population, and criteria for diagnosing dementia between this study and previous research may contribute to these divergent findings.

There are several potential mechanisms that could explain the link between chronic pain and dementia. These include disruptions in attention and memory,[13,54,55] impaired decision-making abilities, decreased processing speed and psychomotor speed,[56,57] increased stress levels that may trigger the release of cortisol, which is associated with degeneration of the hippocampus and memory problems,[58-60] and the presence of other underlying health conditions.[61-63] During instances of chronic pain, nerve endings provide quick pain signals to the brain to prompt necessary remedial responses, and this process depletes the neuronal resources that are also engaged in cognitive activities.[64,65] Furthermore, the existence of chronic pain disorders has been connected to the dysregulation of noradrenergic-modulated endogenous pain autoinhibition,[65] which has been linked to unfavorable cognitive consequences, such as loss of working and long-term memory.[64]

Our findings also indicate that individuals with chronic pain across all age groups exhibited significantly increased odds of living with dementia compared with those without chronic pain and the youngest old counterparts, and the magnitude of this association increased with advancing age. The results of this study are consistent with a previous study conducted in Ireland, in which the authors examined the relationship between age and chronic pain.[45] They found that older adults with chronic pain experienced a greater pronounced cognitive decline compared with their healthy peers of the same age, as well as younger adults with chronic pain. Likewise, another study revealed that chronic pain elevated the risk of ADRD (hazard ratio = 1.23) and that the incidence of ADRD was substantially greater in women and escalated with age.[46] The cumulative burden of chronic pain over a lifetime, particularly in older adults, may aggravate cognitive deterioration.

Researchers believe that estrogen levels, a key female sex hormone, may be a critical factor influencing the disparities observed between men and women in terms of brain aging and neurodegeneration.[34] A link has been suggested between the decrease in sex steroid hormones after menopause and the increased prevalence and severity of Alzheimer's diseases in women compared with men.[36-38] Thus, a decrease in estrogen levels during menopause might make elderly women more susceptible to the damaging effects of chronic pain on cognitive function. Moreover, there are gender differences in pain response, with women generally showing greater sensitivity to pain.[39] This heightened pain sensitivity may result in increased stress and anxiety.[40] For example, earlier research found that women are more prone to co-occurring depression and anxiety with chronic pain.[41,42] This complex interplay can exacerbate the effects of pain on the brain and increase the risk of cognitive decline.

Strengths, Limitations, and Avenues for Further Research

One of the key strengths of this study lies in its utilization of the SDAC data set, which is a nationally representative large sample of the population.[66] To the best of our knowledge, this study represents one of the first Australian investigations into the association between chronic pain and dementia.

This study is not without limitations. First, the cross-sectional research design hinders the determination of causal relationships between chronic pain and dementia. Moreover, it did not allow this study to explore the temporality and reverse causality. In older adults, the link between chronic pain and cognitive decline might be bidirectional. Chronic pain could heighten the risk of cognitive issues, whereas brain degeneration linked to cognitive decline may, in turn, worsen pain perception. Second, since most of the data on long-term conditions were collected from aged-care facilities, it was not possible to incorporate all

Table 2. Multivariate logistic regression examining the association between dementia and chronic pain, pooled data.

Parameters	Model 1	Model 2
	Dementia (yes vs no)	Dementia (yes vs no)
	OR (95% CI)	AOR (95% CI)
Chronic pain		
No (ref)		
Yes	1.07* (1.02-1.12)	1.95* (1.85-2.05)
Age		
Youngest old (65-74) (ref)		
Middle-old (75-84)		4.32* (4.00-4.66)
Oldest old (85 and above)		8.50* (7.90-9.14)
Gender		
Male		
Female		1.14* (1.08-1.20)
Accessibility and remoteness index		
Major cities in Australia		1.13* (1.04-1.23)
Inner regional Australia		1.08 (0.99-1.18)
Outer regional and remote area (ref)		
Country of birth		
Australia (ref)		
English speaking countries		0.98 (0.91-1.05)
Non-English-speaking countries		1.21 (1.14-1.29)
State or territory		
New South Wales (ref)		
Victoria		0.94 (0.88-1.01)
Queensland		0.88* (0.82-0.95)
South Australia		1.14* (1.05-1.23)
Western Australia		0.86* (0.79-0.93)
Tasmania		0.88† (0.78-1.01)
Northern Territory		1.48‡ (1.12-1.97)
Australian Capital Territory		0.81‡ (0.70-0.94)

Note. Model 1 shows the unadjusted association between chronic pain and odds of dementia.
AOR indicates adjusted odds ratio; CI, confidence interval; OR, odds ratio; ref, reference.
*$P < .001$.
†$P < .01$.
‡$P < .05$.

Table 3. Group comparison in the interaction effect between chronic pain and age, chronic pain and gender, with dementia, pooled data.

Multiplicative interaction	Model 1	Model 2
	Chronic pain and age	Chronic pain and gender
	AOR (95% CI)	AOR (95% CI)
Group comparison in the interaction between chronic pain status and age		
No chronic pain and youngest old (65-74 years) (ref)		
No chronic pain and middle old (75-84 years)	4.93* (4.37-5.56)	
No chronic pain and oldest old (85 years and over)	14.98* (13.32-16.83)	
Has chronic pain and youngest old (65-74 years)	3.40* (2.98-3.87)	
Has chronic pain and middle old (75-84 years)	12.60* (11.25-14.10)	
Has chronic pain and oldest old (85 years and over)	19.99* (17.94-22.28)	
Group comparison in the interaction between chronic pain status and gender		
No chronic pain and male (ref)		
No chronic pain and female		1.41* (1.30-1.52)
Has chronic pain and male		2.43* (2.24-2.64)
Has chronic pain and female		2.41* (2.24-2.60)

Note. Models 1 and 2 were adjusted for accessibility and geographic remoteness, country of birth, and state.
AOR indicates adjusted odd ratio; CI, confidence interval; ref, reference.
*$P < .001$.

the confounding socioeconomic factors into the adjusted model and conduct a comprehensive case analysis. Therefore, systematic bias, such as unmeasured confounders, is possible. Third, the assessment of chronic pain presents difficulties because of its subjective characteristics and inconsistencies in the design of survey items utilized for evaluating chronic pain. Moreover, various types of pain can be experienced by individuals, including cancer-related pain, neuropathic pain, and musculoskeletal pain. The survey data analyzed in this study do not evaluate these particular categories separately but instead combine them, which presents difficulties in examining the many forms of chronic pain that are widespread in Australia. Fourth, because the SDAC data lack information on pain treatment, pain's interference with daily activities, and pain severity, the study was unable to determine whether pain treatment increases the risk of dementia or mitigates it by lessening pain's impact on attention and other mechanisms. Finally, the process of self-reporting or proxy-reporting presents a considerable challenge, especially when individuals exhibit reduced cognitive capacities, leading to a prolonged and indeterminate diagnostic procedure. Furthermore, the existence of social stigma may serve as a deterrent for individuals to openly disclose their conditions and/or identities. The prevalence of mild and moderate dementia among the household population may be underestimated by the SDAC. The identification of patients with dementia, particularly of advanced age, is a complex task because of the presence of concurrent health disorders that might mask the signs of dementia. The difficulties listed above are expected to have an impact on the data obtained through self-reported or proxy-reporting surveys. Nevertheless, previous studies conducted on population-based research often relied on self-reported data.[67-69]

Implications for Policy and Practice

The study's findings have major implications for public health policy because they demonstrate a statistically significant association between chronic pain and dementia. In 2010, Australia was the first country to adopt a national framework for pain, outlining the management of acute, chronic, and cancer pain. However, despite having a huge influence on people's lives, pain has not yet been prioritized in national health policies. Many people who experience pain are unable to access best practices in pain management, either because of financial constraints or a lack of knowledge about available alternatives, and the disparity is even more pronounced in rural and remote regions.[70] In the context of rural and regional Australia, it is imperative to undertake measures such as evaluating current models of "mini pain programs" that may facilitate the delivery of coordinated care packages and enhance the capabilities of healthcare professionals operating in these areas.[70] Moreover, a continuous, aligned, and personalized healthcare strategy is needed to establish pain management priorities, especially in groups with the greatest need.

Conclusion

Using a nationally representative data set, this cross-sectional study revealed that older adults with chronic pain were associated with a higher odds of living with dementia compared with those without chronic pain. The study also found that individuals with chronic pain across all age groups had higher odds of dementia compared with those without chronic pain and the youngest old counterparts, and this magnitude of association increased with age. Additionally, women with chronic pain had higher odds of dementia compared with their counterparts without chronic pain and being male. Further investigation is necessary to enhance estimations about chronic pain in the elderly population, to understand the underlying processes of pain in the context of aging and dementia, and to foster the development and progression of safer and more effective treatment options. Additionally, the research also proposes the use of an early assessment and management strategy for chronic pain to minimize the potential cognitive consequences.

Author Disclosures

Author disclosure forms can be accessed below in the Supplemental Material section.

Supplemental Material

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Data Availability: Data for this study are available to registered users of Australian Bureau of Statistics microdata (https://www.abs.gov.au/statistics/microdata-tablebuilder). For information about eligible organizations, see https://www.abs.gov.au/statistics/microdata-tablebuilder/absuniversities-australia-agreement

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