

Featured Article

# Opioid use and the presence of Alzheimer's disease and related dementias among elderly Medicare beneficiaries diagnosed with chronic pain conditions

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## Abstract

**Introduction:** There is scant literature on the use of opioids among community-dwelling elderly with Alzheimer's disease and related dementias (ADRD).

**Methods:** We adopted a retrospective, cross-sectional study design using Medicare Current Beneficiary Survey data from 2006 to 2013. The study sample included elderly community-dwelling Medicare beneficiaries who were diagnosed with chronic pain conditions and had Medicare fee-for-service plans for the entire year. We conducted bivariate  $\chi^2$  test and multivariate logistic regression to examine the relationship between opioid use and ADRD status.

**Results:** The study sample included 19,347 Medicare beneficiaries; 7.7% of them had ADRD. We found no statistically significant difference in opioid use by ADRD status in the unadjusted analysis; however, controlling for various factors, those with ADRD had lower odds of opioid use (adjusted odds ratio = 0.81, 95% confidence interval = 0.71, 0.93) than those without ADRD.

**Discussion:** This population-based study suggests that elderly Medicare beneficiaries with ADRD and chronic pain conditions may have undertreatment of pain.

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## Keywords:

Opioid use; Alzheimer's disease and related dementias; Elderly population; Chronic pain conditions; Medicare

## 1. Background

There is a great deal of concern about opioid use and the associated problems such as misuse, abuse, and overdose in the United States and worldwide [1]. Tremendous research efforts have focused on identifying overuse of opioids and individuals at risk of overuse. However, in parallel with the fear of the opioid epidemic, there is also emerging discussion on reduced access to pain medication, especially opioids, for individuals who have legitimate needs [2].

Individuals with Alzheimer's disease and related dementias (ADRD) tend to be one of the patient groups who have access barriers to analgesics [3–5]. ADRD is a cluster of debilitating conditions characterized by impaired memory, thought processes, and functioning among older adults [6]. Elderly adults with ADRD often suffer from multimorbidity and painful conditions [7–9]. Pain has been reported as high as 63% in elderly with ADRD in nursing homes with an average of 46% across different studies [9,10]. Despite these rates, multiple studies have consistently reported lower use of analgesics among individuals with dementia [4,11,12]. This may be partially explained by the challenges associated with assessing pain among individuals with ADRD due to impaired cognition and communication ability, and the

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neuropathological changes associated with the condition [13]. Furthermore, opioids are associated with higher risks of delirium, constipation, and fracture, and other analgesics such as nonsteroidal antiinflammatory drugs (NSAIDs) can have significant cardiac, gastrointestinal, and renal risks among the elderly [14,15]; due to these clinical concerns, physicians may be reluctant to prescribe analgesics, especially opioids, to elderly with ADRD because of their increased risk of adverse drug reactions [16–18].

Pain management is a critical component in the treatment of ADRD. Pain presents a particular challenge for these individuals, as unrecognized and unresolved pain represents one of the most important causal factors of behavioral and psychological symptoms of dementia (BPSD). BPSD, along with physical dysfunctions, have the highest impact on quality of life and care needs among elderly adults with ADRD [19]. Without proper recognition and management of pain, the resulting BPSD such as agitation and aggression can lead to inappropriate prescribing of antipsychotic medications, which are associated with substantial side effects and adverse outcomes [20–22]. In fact, several studies have reported that treating pain might indeed decrease behavioral symptoms in patients with ADRD [23–25]. On the other hand, BPSD triggered by unresolved pain can worsen the health outcomes and quality of life for elderly with ADRD and their families [19]. It is therefore of critical importance to characterize the use of opioids among elderly with ADRD to identify potential unmet care needs in this vulnerable population.

While research has focused on the elderly living in nursing homes, studies examining the use of opioids among community-dwelling elderly remain limited. Although ADRD is prevalent among nursing home residents, the majority of elderly patients with ADRD live in the community [26]. Furthermore, elderly adults with ADRD living in the community tend to be less impaired than those in nursing homes. Impairment is important to note as neuropathological and neuroimaging studies examining the brain areas responsible for pain processing indicate that the impact of pain on behavioral changes among patients with ADRD might be mediated by the severity of the ADRD. Behavioral changes caused by pain are thought to be stronger in mild and moderate ADRD, whereas they are likely to be normal or even blunted in severe ADRD [27]. A Finnish study among community-dwelling adults reported that those with ADRD were less likely to use any opioids but more likely to receive strong opioids, than those without ADRD [28]. Opioid use among community-dwelling elderly adults with ADRD in the US has only been characterized in a few studies, predominantly in regional health care settings and in the Veteran Health Care System [4,29,30]. Nationwide, a population-based study is warranted to better characterize the unmet needs for pain management among elderly patients with ADRD. Therefore, we conducted this study with a nationally representative data set on the elderly to examine the association between ADRD status and

utilization of opioids among elderly adults with chronic pain conditions.

## 2. Methods

### 2.1. Study design

We adopted a retrospective cross-sectional design.

### 2.2. Study sample

The study sample was restricted to (1) elderly (age  $\geq 65$  years); (2) community-dwelling Medicare beneficiaries; (3) those enrolled in fee-for-service Medicare for the entire year; (4) those who are alive during the entire calendar year; and (5) those diagnosed with chronic pain conditions. We identified the presence of chronic pain conditions based on a list of International Classification of Diseases, ninth edition Clinical Modification (ICD-9-CM) codes [31]. Pain that is continuous, persistent, and lasting for more than 90 days was considered chronic pain. Individuals with coexisting cancer were not excluded from our study.

### 2.3. Data source

The data source is the Medicare Current Beneficiary Survey (MCBS) from 2006 to 2013.

The MCBS is a nationally representative sample of Medicare beneficiaries and includes aged community-dwelling and institutionalized individuals regardless of disability status [32]. The survey began in 1992 and is released every year. The survey collects data from the respondents and includes self-reported health status, height and weight, activities of daily living (ADL), functional status, living arrangement, history of medical conditions, out-of-pocket expenditures, non-Medicare utilization, expenditures, and other health-related information. Data collected from the beneficiaries are merged with Medicare claims through an extensive and rigorous reconciliation process. The survey is designed with a multistage, stratified, random sampling of Medicare beneficiaries [32].

### 2.4. Measures

#### 2.4.1. Dependent variables: Prescription opioid use (yes/no)

In the MCBS, prescription medication use is obtained from Part D events if covered by Medicare Part D and self-reports for those not covered by Medicare Part D. For those self-reported medication use, the respondents were requested to bring all prescription bottles to the interviews, and medication use during each round of the survey was recorded [33]. There are various ways to classify opioids based on the synthetic process, effect at opioid receptors, type of receptor at which the effect is produced, or the duration of the effects [34]. For the purpose of this study, the effect on pain relief

(i.e., instant release or extended release) is most pertinent. The synthetic process of opioids does not determine the potency or the pain relief effect of opioids. We identified opioid use from drug names (generic and brand). Medicare beneficiaries with at least one prescription for an opioid during the calendar year were considered opioid users.

#### 2.4.2. Key independent variable: Alzheimer's disease and related dementias

The key independent variable in our study was the presence or absence of ADRD. ADRD was ascertained using either Medicare claims or self-reports. We used the ICD-9-CM codes to derive ADRD status from Medicare claims. The following ICD-9-CM codes were used: 3310, 33111, 33119, 3312, 3317, 2900, 29010, 29011, 29012, 29013, 29020, 29021, 2903, 29040, 29041, 29042, 29043, 2940, 29410, 29411, 29420, 29421, 2948, and 797. These codes were derived from the Centers for Medicare and Medicaid Services (CMS) chronic conditions warehouse ICD-9-CM codes [35]. Secondary dementia due to vitamin B12 deficiency and substance use (e.g., alcohol, drugs) were not included in these codes. The list did include some secondary dementia diagnoses due to other disorders (i.e., 331.7, 294.10, 294.11); however, we found only six individuals with these secondary dementia codes. Self-reported ADRD was based on giving an affirmative response to either of the following two questions: "Has a doctor (ever) told [you/(SP)] that (you/he/she) had Alzheimer's disease?" and "Has a doctor (ever) told [(you/(SP)] that (you/he/she) had any type of dementia other than Alzheimer's disease?" As MCBS did not include a pain scale, we could not measure the type of pain. Patients in our study sample might suffer from various types of pain (e.g., neuropathic pain, nociceptive pain, or mixed). For example, individuals with cancer may have neuropathic pain, and those with diagnosed joint pain may have nociceptive pain (e.g., diagnosed joint pain).

#### 2.4.3. Other explanatory variables

The explanatory variables for this study were selected using Andersen's Expanded Behavioral Model [36,37]. Under this model, opioid use is influenced by predisposing, enabling, and need factors, personal health practices, and the external environment. The predisposing characteristics consisted of sex (male/female), age (65–69, 70–74, 75–79, or 80 years and older), and race/ethnicity (white, African American, Latino, other). Marital status (married, widowed, divorced/separated, or never married), education (less than high school, high school, some college, or college), and income relative to the federal poverty line (FPL) (<200% of FPL or at least 200% of FPL) formed the enabling factors domain. Need factors included individual's perceived health status (excellent, very good, good, fair, poor), prescription NSAIDs, and functional limitations measured by ADL limitations (none, 1–2, 3, or more). We also adjusted for personal health practice factors: body mass index (underweight, normal weight,

overweight, or obese) and smoking status (never smoker, former smoker, or current smoker). We also accounted for external environment factors including region of residence (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, Pacific, or Puerto Rico) and urban/rural status (metropolitan area/nonmetropolitan area). We also controlled for year of the MCBS with 2006 serving as the reference group.

#### 2.5. Statistical analyses

We tested for statistically significant group differences in opioid use by Rao-Scott  $\chi^2$  tests. We conducted logistic regressions to evaluate the relationship between ADRD and opioid use. In the first logistic regression (unadjusted model), we included only one explanatory variable: ADRD status. In the second model, we further included general health status. In the full logistic regression, we controlled for age, sex, race/ethnicity, education, poverty status, marital status, perceived general health status, functional limitations including ADL and instrumental daily activities (IADL), body mass index, smoking status, NSAID use, region, metro status, and year of the MCBS. Our measure of ADL was based on the responses to questions on needing help with bathing, dressing, walking, climbing stairs, lifting, or bending. We also measured limitations in IADL such as shopping, making phone calls, and paying bills. The MCBS data we used did not include measurements of daily activity limitations specifically due to pain. Although we did not directly measure ADL limitations due to pain, higher pain severity has been linked to more limitations in ADL and/or IADL [38]. Therefore, the ADL and IADL categories (none, 1–2, 3–6) might serve as proxy measures for the overall disease severity and pain severity in our study. We also controlled for the complex survey design of the MCBS by using survey procedures in SAS in all our statistical analyses.

### 3. Results

Among our sample of elderly Medicare beneficiaries with chronic pain conditions, there were 7.7% with ADRD and 92.3% without ADRD between 2006 and 2013. A majority of our sample were female (62.4%), white (84.0%), and younger than 80 years (65.0%). Only 12.6% reported excellent health and 62.4% reported no limitations in activities of daily living. Nearly 1 in 5 (21.2%) older adults received NSAIDs (data not presented in tabular form but available upon request).

In our sample, one-third (33.3%) of elderly Medicare beneficiaries reported any opioid use (Table 1). A lower percentage of individuals with ADRD reported opioid use compared to those without ADRD (32.8% vs. 33.4%). However, this difference was not statistically significant. We observed significant group differences in opioid use among

Table 1  
Sample characteristics of elderly Medicare beneficiaries with chronic pain conditions by opioid use

Medicare Current beneficiary Survey 2006–2013					
	Opioid use		No opioid use		Sig
	N	Wt%	N	Wt%	
All	6432	100.0	12,915	100.0	
ADRD Status					
Any ADRD	530	32.8	1134	67.2	
No ADRD	5902	33.4	11,781	66.6	
Perceived general health					***
Excellent	509	22.0	1818	78.0	
Very good	1508	26.6	4098	73.4	
Good	2199	33.9	4316	66.1	
Fair	1524	44.3	1984	55.7	
Poor	649	53.6	594	46.4	
Unknown	43	30.3	105	69.7	
Any use of NSAID					***
Yes	1883	46.9	2148	53.1	
No	4549	29.7	10,767	70.3	
Sex					***
Female	4205	34.9	7825	65.1	
Male	2227	30.7	5090	69.3	
Race/ethnicity					*
White	5308	33.0	10,839	67.0	
African American	483	38.3	770	61.7	
Latino	317	31.6	713	68.4	
Other race	309	36.3	558	63.7	
Age in years					***
65–69	1092	37.1	1817	62.9	
70–74	1482	35.8	2607	64.2	
75–79	1352	33.6	2639	66.4	
80+	2506	29.5	5852	70.5	
Marital status					***
Married	3113	31.9	6622	68.1	
Widowed	2473	34.3	4838	65.7	
Divorced/separated	680	39.2	1054	60.8	
Not married	163	28.7	395	71.3	
Metropolitan status					***
Metro	4145	31.7	9164	68.3	
Not metro	2287	37.6	3751	62.4	
Region					***
New England	134	24.8	420	75.2	
Middle Atlantic	606	24.3	1951	75.7	
East North Central	1091	32.4	2316	67.6	
West North Central	561	37.1	971	62.9	
South Atlantic	1489	35.2	2791	64.8	
East South Central	760	37.2	1260	62.8	
West South Central	790	40.2	1199	59.8	
Mountain	405	32.6	846	67.4	
Pacific	573	34.4	1099	65.6	
Puerto Rico	23	29.1	62	70.9	
Education					***
Less than high school	1827	39.4	2838	60.6	
High school	2339	33.3	4766	66.7	
Some college	962	33.6	1969	66.4	
College	1296	28.2	3287	71.8	
Poverty status					***
Less than 200% FPL	3485	36.5	6049	63.5	
At least 200% FPL	2947	30.5	6866	69.5	
Functional limitations					***
None	3183	27.2	8567	72.8	
1–2 ADL	2099	41.4	3057	58.6	

(Continued)

Table 1  
Sample characteristics of elderly Medicare beneficiaries with chronic pain conditions by opioid use (Continued)

Medicare Current beneficiary Survey 2006–2013					
	Opioid use		No opioid use		Sig
	N	Wt%	N	Wt%	
All	6432	100.0	12,915	100.0	
3–6 ADL	1128	49.1	1226	50.9	
Unknown	22	26.7	65	73.3	
Smoking status					***
Current smoker	629	43.4	824	56.6	
Past smoker	3176	34.1	6250	65.9	
Never smoked	2605	30.6	5781	69.4	
Body mass index					***
Underweight	137	32.8	286	67.2	
Normal	1914	29.8	4535	70.2	
Overweight	2351	32.1	4943	67.9	
Obese	1968	39.1	3047	60.9	
Unknown	62	39.1	104	60.9	
Year					**
2006	904	31.4	1956	68.6	
2007	905	34.0	1752	66.0	
2008	826	33.0	1681	67.0	
2009	737	32.4	1531	67.6	
2010	695	32.8	1432	67.2	
2011	751	31.4	1615	68.6	
2012	813	35.8	1476	64.2	
2013	801	35.8	1472	64.2	

Abbreviations: ADRD, Alzheimer's disease and related dementias; NSAID, nonsteroidal antiinflammatory drug; FPL, federal poverty line; ADL, activities of daily living.

NOTE. \*\*\* $P < .001$ ; \*\* $.001 \leq P < .01$ ; and \* $.01 \leq P < .05$ .

all our subgroups. For example, a lower percentage of those with excellent health reported opioid use as compared to older adults with poor health (22.0% vs. 53.6%). A higher percentage of prescription NSAID users were also opioid users (46.9% vs. 29.7%). Opioid use increased from 31.4% in 2006 to 35.8% in 2013. In the overall study sample that includes both elderly adults with ADRD and those without ADRD, approximately 62.4% reported no limitations in ADL. A significantly higher percentage of elderly adults with at least one limitation in ADL were found among those with ADRD relative to those without ADRD (61.5% vs. 35.6%,  $P < .001$ ).

Unadjusted odds ratios and adjusted odds ratios (AORs) and their 95% confidence intervals (CIs) from logistic regressions on opioid use are presented in Table 2. In model 1, without any adjustments, ADRD was not significantly associated with opioid use (unadjusted odds ratio = 0.98, 95% CI = 0.86, 1.12). However, when we adjusted for self-reported health status, the association between ADRD and any opioid use became statistically significant. Adults with ADRD had lower odds of opioid use than those without ADRD (AOR = 0.82, 95% CI = 0.71, 0.94). In the fully adjusted model, after controlling for predisposing, enabling, need, and other factors, individuals with ADRD had lower odds of opioid use than those without ADRD

**Table 2**  
Logistic regressions of opioid use among elderly Medicare beneficiaries with chronic pain conditions

Medicare Current Beneficiary Survey 2006–2013			
	OR	95% CI	Sig
<b>Model 1—Unadjusted</b>			
ADRD status			
Any ADRD	0.98	0.86, 1.12	
No ADRD			
<b>Model 2—ADRD + perceived general health</b>			
ADRD status			
Any ADRD	0.82	0.71, 0.94	**
No ADRD			
Perceived general health			
Excellent			
Very good	1.30	1.14, 1.48	***
Good	1.85	1.62, 2.10	***
Fair	2.90	2.54, 3.33	***
Poor	4.24	3.52, 5.09	***
Unknown	1.66	1.02, 2.71	*
<b>Model 3—Full</b>			
ADRD status			
Any ADRD	0.81	0.71, 0.93	**
No ADRD			
Perceived general health			
Excellent			
Very good	1.22	1.06, 1.39	**
Good	1.55	1.36, 1.77	***
Fair	2.10	1.79, 2.46	***
Poor	2.68	2.19, 3.27	***
Unknown	1.64	0.91, 2.93	
Any use of NSAIDs			
Yes	1.95	1.77, 2.14	***
No			
Sex			
Female			
Male	0.82	0.75, 0.89	***
Race/ethnicity			
White			
African American	0.99	0.85, 1.16	
Latino	0.71	0.59, 0.87	***
Other race	0.92	0.75, 1.11	
Age in years			
65–69			
70–74	1.00	0.88, 1.14	
75–79	0.90	0.78, 1.02	
80+	0.72	0.64, 0.82	***
Marital status			
Married			
Widowed	1.04	0.95, 1.14	
Divorced/separated	1.09	0.96, 1.25	
Not married	0.89	0.69, 1.14	
Metropolitan status			
Metro			
Not metro	1.14	1.02, 1.27	*
Region			
New England	0.73	0.47, 1.14	
Middle Atlantic	0.59	0.49, 0.70	***
East North Central	0.83	0.69, 0.99	*
West North Central	1.00	0.78, 1.28	
South Atlantic	0.94	0.78, 1.13	
East South Central	0.97	0.79, 1.21	
West South Central	1.16	0.97, 1.40	
Mountain	0.95	0.79, 1.12	

(Continued)

**Table 2**  
Logistic regressions of opioid use among elderly Medicare beneficiaries with chronic pain conditions (Continued)

Medicare Current Beneficiary Survey 2006–2013			
	OR	95% CI	Sig
Pacific			
Puerto Rico	0.92	0.57, 1.49	
Education			
Less than high school	1.30	1.14, 1.47	***
High school	1.13	1.02, 1.25	*
Some college	1.16	1.02, 1.31	*
College			
Poverty status			
Less than 200% FPL	1.00	0.92, 1.10	
At least 200% FPL			
Functional limitations			
None			
1–2 ADL	1.61	1.46, 1.78	***
3–6 ADL	2.01	1.77, 2.28	***
Unknown	1.06	0.44, 2.57	
Smoking status			
Current smoker	1.49	1.29, 1.73	***
Past smoker	1.21	1.11, 1.33	***
Never smoked			
Body mass index			
Underweight	0.96	0.72, 1.27	
Normal			
Overweight	1.04	0.95, 1.13	
Obese	1.11	0.99, 1.23	
Unknown	1.26	0.80, 1.97	
Year			
2006			
2007	1.13	1.01, 1.25	*
2008	1.06	0.94, 1.20	
2009	1.09	0.95, 1.24	
2010	1.06	0.93, 1.20	
2011	0.97	0.83, 1.13	
2012	1.21	1.06, 1.38	**
2013	1.21	1.04, 1.40	*

Abbreviations: ADRD, Alzheimer's disease and related dementias; NSAID, nonsteroidal antiinflammatory drug; FPL, federal poverty line; ADL, activities of daily living.

NOTE. \*\*\* $P < .001$ ; \*\* $.001 \leq P < .01$ ; \* $.01 \leq P < .05$ .

(AOR = 0.81; 95% CI = 0.71, 0.93). Another interesting finding from the adjusted analysis is that elderly adults with any prescription NSAIDs use were 95% more likely to use opioids than those without NSAIDs use (AOR = 1.95; 95% CI = 1.77, 2.14;  $P < .001$ ) after controlling for ADRD status and other factors in Andersen's Expanded Behavioral Model. It is plausible that elderly adults with opioid use had higher pain severity and/or less response to pain treatments and thereby used both prescription opioids and NSAIDs to improve pain relief.

#### 4. Discussion

In this article, we examined the association between ADRD status and opioid use among elderly Medicare beneficiaries with chronic pain conditions. We found that 7.7% of community-dwelling Medicare beneficiaries (age

≥65 years) had ADRD. This figure is comparable to a study by Koller et al., who used data from a 20% sample of Medicare beneficiaries in 2008 [39]. We observed that approximately one in every three Medicare beneficiaries received prescriptions for opioids during our observation period. Although not directly comparable, researchers from the Office of the Inspector General recently reported that one in three Medicare beneficiaries enrolled in the Part D program were prescribed an opioid [40]; other researchers using Part D data found that 21.9% of Medicare beneficiaries used strong opioids in 2013 [41]. It is important to note that these studies focused on elderly Medicare beneficiaries with Part D insurance and were not specific to those with pain conditions. In general, our results are in line with the literature on the prevalence of opioid use in Medicare beneficiaries.

When we examined the relationship between opioid use and ADRD, the unadjusted analyses indicated that there was no significant association. However, controlling for general health status in the analyses, we found that those with ADRD were less likely to receive opioids than those without ADRD. Similarly and not unexpectedly, in the analyses adjusted for general health status, Medicare beneficiaries who reported excellent health were less likely to receive a prescription for opioids than those with poor health. There were 12.7% of patients with ADRD who reported poor health compared to 5.9% of patients without ADRD. Taken together, these findings suggest that perceived general health is worse among individuals with ADRD, and *given the same level of perceived health, people with ADRD were less likely to have opioid use for their pain conditions*. Thus, adjusting for health status is important to understand the relationship between ADRD and opioid use. In the fully adjusted model, the findings regarding ADRD and opioid use remained significant and similar, suggesting undertreatment of older adults with ADRD.

Our results are consistent with a previous observational study in which there was a report of undertreatment of pain after hip fracture among 38 adults with ADRD [42]. Elderly with ADRD and pain may be less likely to receive opioids for many reasons, including difficulties in identifying and measuring pain [29,43–45], generally poor health status due to ADRD as well as coexisting conditions [46,47], and exacerbation of ADRD symptoms [48]. As opioids may further erode cognitive functioning, physicians may be reluctant to prescribe opioids for adults with ADRD [49]. Furthermore, many people with ADRD are on other medications, such as benzodiazepines, which may interact with opioids and slow respiration, induce anxiety, and in extreme cases result in death; therefore, physicians may avoid prescribing opioids in consideration of possible adverse effects [16–18]. As many factors are involved in physician-prescribing practices, further research is warranted to determine the barriers to prescribing opioids to community-dwelling ADRD patients for pain management.

There are some limitations of this study that need to be considered. Owing to the observational nature of our study, we were unable to ascertain the potential causality between general health status and opioid use. For example, Medicare

beneficiaries with opioid use may report poor health because of adverse effects of opioids and inadequate pain control. The severity of ADRD, type of pain, and severity of pain were not available in our data and may affect the relationship between opioid use and ADRD.

The impact of clinical characteristics of ADRD on pain processing and pain perception remains unclear. Benedetti et al (2004) reported that detection and threshold of pain were not affected by Alzheimer's disease progression; however, pain anticipation and the reaction to pain were associated with cognitive status and brain electrical activity [50]. In a systematic review of the pain experience of individuals with Alzheimer's disease, Binnekade et al. (2017) concluded that there was a reduction in clinical pain among individuals with Alzheimer's disease as compared with controls, whereas studies in which the primary caregivers rated the pain did not show diminished pain. These mixed findings with regard to pain perception comparing ADRD with non-ADRD patients from neuropathological, neuroimaging, experimental, and clinical research [29] suggest the need for better strategies for pain assessment and management among adults with ADRD.

Furthermore, differences in pain processing and perception may vary among subtypes of dementia with similar neuropathological attributes and even individuals with the same type of dementia due to the degrees of change in brain function and affected pain-related areas [51]. However, it is challenging to identify secondary dementia based on diagnostic codes from administrative claims due to lack of validated algorithms; and the low sample sizes in our present study did not allow for detailed subgroup analyses to further explore the opioid use among subtypes of ADRD disorders. Future studies with more detailed clinical data (e.g., electronic health records) are needed to confirm our findings.

We could not distinguish between long-term inappropriate/appropriate use of opioids from the available data or distinguish between chronic and short-term use of opioids from the available data. Future studies using a prospective cohort design may be able to differentiate between long-term use for chronic pain and short-term use for acute conditions such as postsurgical pain and pain from trauma. Furthermore, we could not distinguish among types of opioids (i.e., long-acting opioids, short-acting opioids) based on available data. Therefore, we were not able to examine the association between ADRD and use of different types of opioids.

In summary, this is the first study, to the authors' knowledge, to examine opioid use in community-dwelling elderly Medicare beneficiaries with chronic pain conditions. We used a representative sample and included a comprehensive list of factors that comprised individual determinants of medical care utilization (i.e., predisposing, enabling, and need). Claims data across multiple providers and settings were used to detect diagnosed medical conditions, and data on medication use among those who were not enrolled in Part D were included. Our results show that elderly

Medicare beneficiaries with ADRD had lower odds of opioid use than those without ADRD after controlling for other patient demographic, socioeconomic, environmental, and personal health practice factors. To gain insight on mechanisms involved in the lower use of opioids in patients with ADRD, future research directions may include prospective cohort studies and studies with measures of pain level as well as type, strength, and duration of opioid use.

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### RESEARCH IN CONTEXT

1. Systematic review: The authors reviewed the literature using traditional (e.g., PubMed) sources and meeting abstracts and presentations. There are few studies on the relationship between opioid use and Alzheimer's disease and related dementia (ADRD) status. We included appropriate citations of a Finnish study and a few small-scale US studies.
2. Interpretation: We observed that elderly with ADRD had lower odds of opioid use than those without ADRD when controlling for general health and other patient and external environment factors, suggesting potential unmet needs for pain management in elderly patients with ADRD.
3. Future directions: Future research directions include prospective cohort studies and studies with measures of pain level as well as type, strength, and duration of opioid use.

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