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# Self-Reported Opioid Use and Driving Outcomes among Older Adults: The AAA LongROAD Study

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## INTRODUCTION

Opioid safety and efficacy for the treatment of chronic non-cancer pain remains an important and contentious topic in the United States (US). This may be particularly true for older adults, who report pain as the most common symptom underlying disability[1,2] but also have unique risk-benefit considerations (e.g. polypharmacy, drug metabolism, comorbidities) for opioid use compared to younger people.[3] Moreover, there has been a marked increase in both the prescribed dose and number of opioid prescriptions from office-based visits for older adults over the past few decades,[1,3] reflecting either an increased need for and acceptance of pain management or other shifting trends in opioid prescribing practices.

Older adults face increased risk of experiencing chronic pain due to the aging process and pain-inducing diseases.[4] Approximately 25-50% of adults ≥ 65 years of age experience pain, typically in multiple sites and for various reasons, including musculoskeletal conditions and cancer.[5,6] Pain may not only interfere with daily activities,[7] but may also decrease quality of life for older adults.[8,9] Chronic pain can also affect mobility - a major predictor of well-being[10] - through effects on cognition (e.g., attentional capacity, processing speed, psychomotor speed)[11] or physical function. One study found that older adults experiencing chronic pain not only had difficulties with driving performance, but also with the physical process of getting into and positioning themselves in a vehicle.[12] Some with chronic pain may choose to reduce or adapt their driving,[13,14] which may have negative impacts such as loss of independence, depression, or decreased life satisfaction.[15,16] Few studies have explored how pain affects driving “self-regulation,” the process of adapting one’s driving by driving less or avoiding situations considered challenging due to declines in functioning.

Treating acute and chronic pain with medications or other modalities is important to mitigate these negative effects on well-being and mobility. Prescription opioid medications are often used to treat pain unresponsive to over-the-counter options. Over the past decade, there has been growing concern over the increases in morbidity and mortality from prescription opioid use in the US. In 2017, the US federal government declared the opioid epidemic a national public health emergency.[17] Older adults comprise an important population group for research on opioid use because they often utilize pain medications to manage their chronic pain and maintain well-being.[5]

Unfortunately, pain medications themselves may be detrimental to driving safety.[18,19] In particular, increased crash risk has been linked to use of opioids,[20,21] along with benzodiazepines, opioid antagonists, and other medications related to pain management.[22,23] Use of multiple medications that act on the central nervous system (i.e., CNS polypharmacy) is of particular concern in older adults and is included in the Beers Criteria for Potentially Inappropriate Medications.[24] Yet, because decreased mobility due to chronic pain may lead to decreased well-being, simply restricting access to pain medications is not necessarily the answer.

The AAA Longitudinal Research on Aging Drivers (LongROAD) study presents the opportunity to examine opioid use in a large cohort of older drivers, and importantly, to consider its relationship to self-reported measures of pain, self-regulation of driving, motor

vehicle crashes, and self-rated driving ability and comfort. In this analysis, we sought to determine, in a sample of older drivers: 1) the prevalence of opioid use; 2) the prevalence and severity of daily pain; and 3) the associations between opioid use, pain levels, and self-reported driving behaviors. Understanding these relationships may inform programs and prescribing practices to better address health, mobility, and quality of life.

## METHODS

### Design and Participants

This cross-sectional analysis used baseline data from the AAA LongROAD study, a multi-site, prospective cohort study designed to evaluate the role of medical, behavioral, and other factors in driving safety in older adults.[25] Participants were recruited from healthcare clinics affiliated with five LongROAD sites. Eligible patients: were aged 65-79 at enrollment; spoke English; had a valid driver's license; drove at least one day per week; drove one motor vehicle (model 1996 or newer with an accessible OBDII port) at least 80% of the time; resided in the site catchment area at least 10 months a year with no plans to move outside the catchment area within the next five years; and passed a Six Item Screener for cognitive function.[26] Informed consent was obtained during the baseline visit by research staff, and the study was approved by each site's institutional review board. The study design and population have been described in detail elsewhere.[25]

### Measures and Analysis

Data included self-reported demographic and health characteristics, functional abilities, healthcare utilization, medication use, and subjective measures of driving collected by research staff at enrollment. Self-reported demographic characteristics included age group, gender, race, ethnicity, highest level of educational attainment, and total household income in the past year. Self-reported health domains were measured by the Patient-Reported Outcomes Measurement Information System (PROMIS), including Physical Function-4a and Pain Intensity.[27] PROMIS Physical Function T-scores were trichotomized as "none to slight limited function" (>55), "mild limited function" (40-55), or "moderate to severe limited function" (<40). PROMIS Numeric Rating Scale v1.0 – Pain Intensity 1A was measured by self-reported average pain in the past seven days, ranging from "no pain" (0) to "worst imaginable pain" (10); for analyses, responses were categorized into four groups: "none" (0), "mild" (1-3), "moderate" (4-6), "severe" (7-10). Additional self-reported measures of health behaviors included alcohol consumption in the last 3 months (Yes/No) and health care utilization in the past 12 months (Yes/No).

Information on current medications (prescribed and over-the-counter) and supplements was collected using a "brown-bag review" method at baseline. Forty-one LongROAD participants (1.4%) without baseline medication review were excluded. For analysis, medications were categorized according to their American Hospital Formulary System (AHFS) classification. Individuals were categorized as currently taking an opioid if they reported taking one or more opiate agonists (codeine, fentanyl, oxycodone, tramadol, hydrocodone, hydromorphone, methadone, morphine). Consistent with the Center for Disease Control and Prevention (CDC) guidelines, morphine milligram equivalents (MME)

per day were calculated by multiplying the total daily dose of each opioid by the requisite conversion factor.[28] For participants taking more than one opioid, MMEs were summed to obtain the total daily MME. Doses listed as PRN were calculated using the maximum prescribed dose and frequency per day.

The five self-reported driving outcomes included: driving ability; driving comfort; driving reduction due to self-regulation; driving lapses, errors, and violations; and crashes or police actions in the past year. Self-rated driving ability averaged participants' responses to five items (ability to see during the day, to see at night, to remember things, to concentrate on more than one thing at time, and their strength, flexibility, and general mobility) rated from "poor" (1) to "excellent" (7). Self-rated driving comfort averaged participants' responses to multiple items assessing comfort in potentially difficult driving conditions (e.g. driving at night, in bad weather, alone, on the freeway), ranging from "not at all comfortable" (1) to "completely comfortable" (7). Participants were asked whether they had reduced their driving in the last year (Yes/No) and, if so, if the reduction was due to self-regulation (Yes/No), i.e. because of difficulty seeing during the day or night; difficulty remembering things; difficulty concentrating on more than one thing at a time; not feeling safe driving as much; not feeling comfortable driving as much; experiencing reductions in strength, flexibility or general mobility; or other reasons related to declines in functioning. These two questions were used to ascertain self-regulated driving reduction (Yes/No). To assess driving lapses, errors, and violations, participants completed the Driving Behavior Questionnaire,[24-28] with six questions pertaining to lapses (e.g. forgetting where you left your car in a parking lot), nine to errors (e.g. failing to check your rear-view mirror before pulling out, changing lanes), and 11 to violations (e.g. crossing an intersection knowing the light has already turned red). Each question was scaled from "never" (0) to "nearly all the time" (5). The mean of each was used in analysis, with higher scores indicating more lapses, errors, or violations (i.e. worse driving). "Crashes or police actions" (Yes/No) were based on participant self-report of having had a crash or police action (i.e., being pulled over by police or receiving a traffic ticket) while driving in the past year.

Characteristics of the study sample were described with means and standard deviations for continuous variables and frequency distributions for categorical variables. Chi-Square tests (or Fisher's exact tests) for categorical variables, or t-tests for continuous variables, were used to assess each covariate's association with opioid use and each driving outcome. The unadjusted associations between opioid use and each self-reported measure of driving were examined using linear or logistic regression, as appropriate.

Partially adjusted models for each self-reported driving outcome and opioid use were utilized to account for potential differences in age, gender, race, and ethnicity [Table 2]. Covariates which were associated with opioid use and self-reported driving outcomes ($p<0.2$) were considered in multivariable models using forward selection. The model with the lowest Akaike information criterion (AIC) was selected as the final model for each self-reported driving outcome [Table 2]. All models used complete case analysis. Results are reported as beta estimates or odds ratios (ORs), with 95% confidence intervals (CI), using an alpha level of 0.05 for testing statistical significance. Model assumptions and fit were assessed using residuals, adjusted R-square, probability plots, and AIC as applicable.

All analyses were conducted using SAS University Edition software (version 9.04.01, SAS Institute, Inc., Cary, North Carolina).

## RESULTS

Of the 2949 LongROAD participants with medication data, 169 (5.7%) reported currently taking an opioid (Table 1); these participants had a higher self-reported level of pain in the past seven days (5.1 vs. 3.8 out of 10, $p<0.001$) and a median reported dose of 20 MME per day. Most participants were 65 to 69 years of age (41.6%), female (53.1%), white (88.9%), and non-Hispanic (97.2%), with no significant differences in the prevalence of opioid use on the basis of age, gender, race or ethnicity. However, the percentage taking an opioid was more than twice as high among those without a Bachelor's degree (8.9%) than among those with a Bachelor's or higher degree (4.2% and 3.9% respectively; $p<0.001$). Similarly, opioid use was much higher among those with household income less than $50,000 per year (10.2%) than among those with household income greater than $100k per year (3.1%; $p<0.001$). As might be expected, opioid use was significantly higher among those reporting emergency department visits ($p<0.001$ or hospitalizations ($p<0.001$) in the past year, and among those who had spoken to a physician during the past year about driving safety ($p<0.001$). Opioid use was more than 10 times greater among those reporting moderate to severe problems with physical function (21.7%) than among those reporting no or mild limitations (1.7%; $p<0.0001$). However, opioid use was significantly *lower* among those who reported any versus no alcohol use in the past 3 months (4.9% vs. 8.0%, $p=0.002$).

In unadjusted analyses, participants who reported current opioid use were more likely than those not using opioids to report self-regulating their driving (11.2% vs. 5.4%, $p=0.002$; Table 2). Opioid-users also rated their driving ability lower than non-users, 5.7 vs. 5.9 out of 7 ["excellent"], $p<0.001$). There was a 5.4% absolute increase in reported crashes or police action in the last year among opioid users versus non-users (28.4% vs. 23.0%). No statistically significant differences were seen in subset sensitivity analyses by low and high MME dose groups or by PRN and standing dosage groups (data not shown).

Adjusting for age, gender, and race/ethnicity did not significantly alter these main findings (Table 2). However, the findings did change after additional adjustment for income, education, emergency department visits, hospitalizations, alcohol use, and physical function. Specifically, there was no longer a statistically significant difference in self-regulated driving reduction or self-rated driving ability by opioid use. However, in this fully-adjusted model, individuals who reported current opioid use had fewer self-reported driving lapses ($p=0.027$) and higher self-rated driving comfort ($p=0.009$) than individuals who reported no opioid use, although the mean group differences on both two scales were quite small.

## DISCUSSION

In the context of debates about optimizing older adult function and mobility while avoiding the negative effects of opioid use, this study sought to investigate the relationships between opioid use, pain, and driving in a large sample of older drivers. We found that only 5.7% of older drivers reported currently using an opioid, and opioid use varied by education and

income (though not by age, gender, or race/ethnicity). Opioid users had higher rates of self-regulated driving reduction and lower self-rated driving ability, along with a higher (though not significantly so) rate of crashes or police actions. These differences disappeared after adjustment for demographic and health characteristics, highlighting the complexity of the relationship between pain, opioid use and driving among older adults. This cross-sectional analysis generates additional questions for future study as well as key considerations for clinicians caring for older adults.

In the LongROAD study cohort, only a small proportion of older drivers reported current opioid use (5.7%), despite nearly half of all participants reporting at least mild pain in the past 7 days. According to the CDC, 26.8% of adults over 65 years of age in the US filled at least one prescription for an opioid in 2017, a higher proportion than any other age group.[29] The lower proportion of self-reported opioid use in this LongROAD cohort may reflect the different time frame (current versus annual) or a healthier cohort compared to average individuals over 65 years of age in the US. Despite individuals with higher self-reported pain intensity being more likely to report taking an opioid than individuals who reported no pain in the past 7 days, self-reported levels of pain were comparable to nationally reported experiences of pain in this age group.[2] There has been growing evidence that opioid efficacy for treating chronic pain is not always sustained over the long-term and that the risks garnered by long-term use (e.g., drug dependency or injury) in older adults are serious.[30] However, unmanaged pain can lead to sleep disturbance, impaired quality of life, disability, decreased mobility, and depression,[31] so these decisions necessitate patient-centered shared decision-making about the relative risks and benefits.

While use of prescription opioids by drivers has been found to be associated with increased risk of crash and crash culpability,[20] particularly due to sedating effects,[23] self-reported measures of driving differed very little by self-reported opioid use in this study population. Older drivers who reported currently taking an opioid were more likely to self-regulate and reduce their driving and to report lower self-rated driving ability, regardless of age, gender or race/ethnicity. These differences disappeared after further adjustment for other demographic and health variables, including healthcare utilization and physical function, suggesting that the indication for pain management may affect these driving outcomes more than the opioid use itself. The full model was selected after stepwise examination of associations with opioid use and each outcome, but questions remain concerning the relationships of these potential confounders with the outcome. This complex relationship likely reflects the real-life influences of social determinants of health, with socioeconomic factors affecting mobility and health both directly and indirectly. Older adults with lower incomes may be more likely to use opioids in part because of lesser ability to access alternative pain control modalities such as massage, physical therapy, and acupuncture. It is unclear whether driving ability or safety would differ by opioid use on objective measures of driving, but there is little reason to suspect that self-reporting of these driving outcomes was significantly biased by opioid use.

It is important to note that the median daily dose seen in this study was 20 MME, much lower than the average daily dose in the total US population (45.3 MME),[29] which may also explain the lack of an association between opioid use and reported crashes or police actions.

Since driving impairments may be greatest soon after starting opioid treatment or at higher doses than seen in this study, prescribing practices (e.g., starting low and increasing slowly, avoiding other sedating medications or substances) and prescriber counseling (e.g., to avoid driving during the first week) may mitigate the most significant risks to driving from opioid use.[23] Given the importance of driving to mobility and independence for many older adults, even a 5% reduction in driving could be clinically meaningful – as could the potential 5% increase in crashes or police actions. Thus, while opioids remain an important therapeutic option for older adults with severe pain, our findings should not be interpreted to mean they are without risk.

Limitations of this study include reliance on self-report of both exposures and outcomes, as well as a lack of detail about opioid use when prescribed PRN and timing of use in relation to driving). The LongROAD cohort, recruited in five states, comprises generally healthy, educated older drivers and may not be representative of the general population. Because of the low prevalence of opioids use, the study did not have sufficient power to examine specific types of opioids or polypharmacy. Future work should address these issues.

## CONCLUSION

Driving remains an essential part of independence, mobility, well-being, and maintaining social connectedness. In this large, geographically diverse sample of older drivers, those currently taking an opioid were more likely to report self-regulated reduction of driving, regardless of age, gender, or race/ethnicity. These differences disappeared after further adjustment (including for socioeconomic characteristics, health and healthcare utilization), but they suggest that older adults using opioids may themselves try to mitigate the negative effects of these medications. Clinicians caring for older adults who use – or are considering initiating – opioids should continue to discuss the risks and benefits of these medications, along with recommendations to avoid driving immediately after taking opioids.

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**Table 1.**

Characteristics of AAA LongROAD Cohort (n = 2,949) by Opioid Use

| | Any Opioid Use (n = 169) | | No Opioid Use (n = 2780) | | Prevalence Ratio | 95% CI |
|---|---|---|---|---|---|---|
| | n | % | n | % | | |
| **Age Group (years)** | | | | | | |
| 65-69 | 69 | 5.6 | 1153 | 94.4 | - | - |
| 70-74 | 60 | 5.8 | 967 | 94.2 | 1.04 | 0.73, 1.48 |
| 75-79 | 40 | 5.7 | 660 | 94.3 | 1.01 | 0.68, 1.51 |
| **Gender** | | | | | | |
| Male | 73 | 5.3 | 1309 | 94.7 | 0.86 | 0.63, 1.17 |
| Female | 96 | 6.1 | 1471 | 93.9 | - | - |
| **Race** | | | | | | |
| White/Caucasian | 143 | 5.5 | 2440 | 94.5 | - | - |
| Non-White | 22 | 6.9 | 297 | 93.1 | 1.26 | 0.79, 2.01 |
| **Ethnicity** | | | | | | |
| Hispanic/Latino | 5 | 6.3 | 75 | 93.7 | 1.12 | 0.45, 2.81 |
| Non-Hispanic/Latino | 155 | 5.6 | 2600 | 94.4 | - | - |
| **Highest Level of Education** | | | | | | |
| Less than Bachelor's Degree | 93 | 8.9 | 949 | 91.1 | 2.42 | 1.69, 3.47 |
| Bachelor's Degree | 29 | 4.2 | 662 | 95.8 | 1.08 | 0.68, 1.74 |
| Master's or Higher Degree | 47 | 3.9 | 1161 | 96.1 | - | - |
| **Total Household Income Past Year** | | | | | | |
| Less than $50,000 | 78 | 10.2 | 686 | 89.8 | - | - |
| $50,000 - <$80,000 | 42 | 5.9 | 668 | 94.1 | 0.55 | 0.38, 0.82 |
| $80,000 - <$100,000 | 17 | 4.0 | 410 | 96.0 | 0.37 | 0.21, 0.63 |
| $100,000 or more | 29 | 3.1 | 913 | 96.9 | 0.28 | 0.18, 0.43 |
| **ED Visit in the Past Year** | | | | | | |
| None | 98 | 4.3 | 2161 | 95.7 | - | - |
| At Least One | 71 | 10.5 | 607 | 89.5 | 2.58 | 1.88, 3.55 |
| **Hospital Visit in the Past Year** | | | | | | |
| None | 115 | 4.6 | 2371 | 95.4 | - | - |
| At Least One | 53 | 11.8 | 398 | 88.2 | 2.74 | 1.95, 3.87 |
| **Ever Spoken to Doctor About Driving Safety** | | | | | | |
| No | 145 | 5.1 | 2675 | 94.9 | - | - |
| Yes | 24 | 14.5 | 141 | 85.5 | 3.14 | 1.98, 4.99 |
| **Alcohol Use Past 3 Months** | | | | | | |
| None | 64 | 8.0 | 738 | 92.0 | 1.68 | 1.22, 2.33 |
| Any | 105 | 4.9 | 2041 | 95.1 | - | - |
| **4+ Drinks on One Occasion Past 3 Months** | 12 | 4.1 | 295 | 95.9 | 0.65 | 0.36, 1.18 |
| **Limited Physical Function** | | | | | | |
| None to Slight (T-Score > 55) | 27 | 1.7 | 1548 | 98.3 | - | - |

| | Any Opioid Use (n = 169) | | No Opioid Use (n = 2780) | | Prevalence Ratio | 95% CI |
|---|---|---|---|---|---|---|
| | n | % | n | % | | |
| Mild (T-Score 40 - 55) | 88 | 7.9 | 1020 | 92.1 | 4.95 | 3.19, 7.67 |
| Moderate to Severe (T-Score < 40) | 52 | 21.7 | 188 | 78.3 | 15.86 | 9.73, 25.86 |
| **Average Pain Past 7 Days** | | | | | | |
| 0 | 29 | 1.9 | 1510 | 98.1 | - | - |
| 1-3 | 37 | 5.6 | 623 | 94.4 | 3.09 | 1.89, 5.07 |
| 4-6 | 70 | 12.2 | 506 | 87.8 | 7.20 | 4.62, 11.23 |
| 7-10 | 33 | 19.3 | 138 | 80.7 | 12.45 | 7.34, 21.12 |
| **Morphine Milligram Equivalents (MME) per Day** median (IQR) | 20.0 | 20.0 | - | - | - | - |

**Table 2.**

Associations between Opioid Use and Self-Reported Driving Outcomes

| | Any Opioid Use (n = 169) | | No Opioid Use (n = 2821) | | Unadjusted OR | | Partially Adjusted OR | | Fully Adjusted OR† | |
|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | OR | 95%CI | AOR | 95%CI | AOR | 95%CI |
| **Self-Regulated Driving Reduction** | | | | | | | | | | |
| Yes | 19 | 11.2 | 151 | 5.4 | 2.21 | 1.33, 3.66 | 2.38 | 1.42, 3.99 | 0.99[adg] | 0.55, 1.80 |
| No | 149 | 88.2 | 2615 | 94.1 | - | - | - | - | - | - |
| **Any Crash or Police Action in Past Year** | | | | | | | | | | |
| Yes | 48 | 28.4 | 640 | 23.0 | 1.31 | 0.94, 1.87 | 1.34 | 0.93, 1.91 | 1.25[bcg] | 0.86, 1.83 |
| No | 120 | 71.0 | 2119 | 76.2 | - | - | - | - | - | - |

†In addition to age, gender, race and ethnicity, models may be adjusted for: total household income [a]; highest level of education [b]; emergency department visit in the past year [c]; hospital visit in the past year [d]; alcohol use in the past 3 months [e]; had four or more drinks on one occasion in the past 3 months [f]; physical function [g].

**Table 3.**

Associations between Opioid Use and Self-Reported Driving Outcomes

| | | | | | Unadjusted Beta Estimate | | Partially Adjusted Beta Estimate* | | Fully Adjusted Beta Estimate† | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | sd | Mean | sd | β | 95% CI | β | 95% CI | β | 95% CI |
| **Self-Rated Driving Ability** | 5.7 | 0.7 | 5.9 | 0.7 | −0.18 | −0.29, −0.08 | −0.19 | −0.30,−0.08 | 0.04[ag] | −0.08, 0.15 |
| **Self-Rated Driving Comfort** | 5.8 | 0.9 | 5.8 | 1.0 | −0.02 | −0.17, 0.13 | <0.00 | −0.15, 0.15 | 0.21[adg] | 0.05, 0.36 |
| **Lapses** | 1.8 | 0.4 | 1.8 | 0.4 | −0.03 | −0.09, 0.04 | −0.04 | −0.11, 0.03 | −0.08[befg] | −0.15, −0.01 |
| **Errors** | 1.4 | 0.3 | 1.4 | 0.3 | <0.00 | −0.04, 0.06 | <0.00 | −0.05, 0.06 | −0.03[befg] | −0.09, 0.02 |
| **Violations** | 1.6 | 0.4 | 1.6 | 0.4 | −0.02 | −0.08, 0.04 | −0.03 | −0.10, 0.03 | −0.02[abef] | −0.08, 0.04 |

*Adjusted for age, gender, race, and ethnicity

†In addition to age, gender, race and ethnicity, models may be adjusted for: total household income [a]; highest level of education [b]; emergency department visit in the past year [c]; hospital visit in the past year [d]; alcohol use in the past 3 months [e]; had four or more drinks on one occasion in the past 3 months [f]; physical function [g].