Opioid prescribing patterns for non-malignant chronic pain for rural versus non-rural US adults: a population-based study using 2010 NAMCS data

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Abstract

Background: Non-malignant chronic pain (NMCP) is one of the most common reasons for primary care visits. Pain management health care disparities have been documented in relation to patient gender, race, and socioeconomic status. Although not studied in relation to chronic pain management, studies have found that living in a rural community in the US is associated with health care disparities. Rurality as a social determinant of health may influence opioid prescribing. We examined rural and non-rural differences in opioid prescribing patterns for NMCP management, hypothesizing that distinct from education, income, racial or gender differences, rural residency is a significant and independent factor in opioid prescribing patterns.

Methods: 2010 National Ambulatory Medical Care Survey (NAMCS) data were examined using bivariate and multivariate techniques. NAMCS data were collected using a multi-stage sampling strategy. For the multivariate analysis performed the SPSS complex samples algorithm for logistic regression was used.

Results: In 2010 an estimated 9,325,603 US adults (weighted from a sample of 2745) seen in primary care clinics had a diagnosis of NMCP; 36.4% were prescribed an opioid. For US adults with a NMCP diagnosis bivariate analysis revealed rural residents had higher odds of having an opioid prescription than similar non-rural adults (OR = 1.515, 95% CI 1.513-1.518). Complex samples logistic regression analysis confirmed the importance of rurality and yielded that US adults with NMCP who were prescribed an opioid had higher odds of: being non-Caucasian (AOR =2.459, 95% CI 1.194-5.066), and living in a rural area (AOR =2.935, 95% CI 1.416-6.083).

Conclusions: Our results clearly indicated that rurality is an important factor in opioid prescribing patterns that cannot be ignored and bears further investigation. Further research on the growing concern about the over-prescribing of opioids in the US should now include rurality as a variable in data generation and analysis. Future research should also attempt to document the ecological, sociological and political factors impacting opioid prescribing and care in rural communities. Prescribers and health care policy makers need to critically evaluate the implications of our findings and their relationship to patient needs, best practices in a rural setting, and the overall consequences of increased opioid prescribing on rural communities.

Keywords: NAMCS data, Rural health, Health care disparities, Opioids, Non-malignant chronic pain, NMCP

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Background
Chronic pain, commonly defined as the experience of episodic or continuous debilitating pain over time (weeks to months or longer), is a significant problem in the United States [1-4]. It is a phenomenon with a complex etiology manifest with both physical and psychological components [4-6]. At present nearly 1 in 3 or 100 million adults in the US suffer from chronic pain [4,6]. Chronic pain in the US is estimated to cost approximately $560-$635 billion annually, an amount equal to about $2,000 per capita [6]. This cost estimate includes both direct and indirect costs that are approximately equal to one another.

Chronic pain adversely impacts communities, families, and individuals by significantly contributing to poor mental and physical health resulting in lost work productivity and disability [4-7]. In the US, non-malignant chronic pain (NMCP) is one of the most common reasons for primary care visits [1,3,8,9]. At times when patients visit a healthcare professional for NMCP, inadequate treatment and resources may prevent proper assessment and management [7,10,11]. Pain management healthcare disparities have been documented in relation to patient gender [12,13], race [3,11,14-16], and socioeconomic status [12,17]. Although not studied in relation to chronic pain management, studies have found that living in a rural community in the US is associated with healthcare disparities [18].

Opioids are commonly used in chronic pain management. Opioids are being overprescribed with possible negative consequences for individuals, families and communities. These consequences include: unintended death [7], overdose [7], diversion [7], and crime [7]. There is an upward trend for overprescribing opioids. Rurality as a social determinant of health may influence opioid prescribing [18]. Some research has been conducted on different types of chronic pain and opioid prescribing patterns including a geographic variable in the analysis. However, none of these studies undertook the task of answering a question about opioid prescribing and NMCP in rural versus non-rural adults using patient level health records [19-22]. This has created an epidemiological gap in our knowledge regarding opioid prescribing patterns for rural adults with NMCP.

Rasu, et al. [4] studied chronic pain management (medication and non-medication) in US ambulatory care settings. While they described the characteristics of their patient population, they did not examine the associations between patient characteristics and variations in prescribing patterns. They concluded that additional research should investigate patterns of NMCP management in various populations. Others [23,24] have done this, but with older data. One study included geographic location of physician practice site in their analyses using rural locale as the reference category in multivariate analyses and found no significant relationship to opioid prescribing [25]. In this paper we hypothesize that distinct from patient race, education, income or gender, rural residency is a significant and an independent risk factor for the greater probability of receiving an opioid prescription for NMCP.

Methods
To answer the research question, 2010 National Ambulatory Medical Care Survey (NAMCS) data were examined using bivariate and multivariate techniques. NAMCS is designed to collect data on the utilization and provision of ambulatory care services nationwide. Data are collected from a national sample of ambulatory care visits. The survey employs a complex four-stage probability sampling design. A description of the sampling strategy is discussed elsewhere [25]. The 2010 NAMCS data were used for this study because they were the most recently available data. These data are weighted to be nationally representative of patient health records.

All analyses were performed on weighted data as is recommended by the Center for Disease Control and Prevention’s (CDC) National Center for Health Statistics (NCHS). The weighting, as calculated, uses the most recently available census data to provide a stratified representation of the nation’s patient population. Results report weighted data.

The survey uses a Patient Record Form as the survey instrument. The NAMCS patient record form is completed by ambulatory care staff for a systematic random sample of patient visits during a randomly assigned 1-week reporting period. Data are obtained on demographic characteristics of patients, expected source(s) of payment, patients’ complaints, diagnoses, diagnostic/screening services, procedures, medication therapy, disposition, types of providers seen, causes of injury, and certain characteristics of the facility, such as geographic region and metropolitan status.

Rurality, one of the key independent variables in this analysis, was derived using Metropolitan and Micropolitan Statistical Area (MSA) methodology. This is a definition used by federal level agencies for research purposes. MSA was recoded into the dichotomous categories of rural or non-rural. Rural residents were defined as people living either within an MSA that had no center city or outside an MSA. Non-rural residents included all respondents living in a center city of an MSA, outside the center city of an MSA but inside the county containing the center city, or inside a suburban county of an MSA.

The study population for this research was US adults with NMCP. NMCP is defined as pain lasting 3 months or more or as pain persisting beyond the time of expected healing. The three-digit ICD-9 code for NMCP is 338.2. The covariates or independent variables for this research were: geographic locale (rural/non-rural),...
The Institutional Review Boards (IRBs) at all of the researchers’ institutions recognize that the analysis of de-identified, publicly available data does not constitute human subjects research as defined in federal regulations and as such does not require IRB review. Hence, human subjects’ approval was not necessary since this was a de-identified data only study.

Results
An estimated 9,325,603 US adults with a diagnosis of NMCP were seen in primary care clinics in 2010 in the US. Table 2 displays data describing the study population — US adults with NMCP. The data are displayed by the independent covariates and the dependent variable (opioid prescription) and are those used to perform the complex samples logistic regression analysis. Missing data were removed from the analysis as displayed in Table 2.

The majority of the population 94.4% had health insurance and 66.4% were reported as having seen their primary HCP. Over seventy percent (73.7%) of the study population were women and 79.4% were Caucasian. In terms of the dependent variable 36.4% of the adult population with NMCP had an opioid prescription.

Bivariate analysis performed indicated that all of the study’s independent variables or covariates were significantly associated with the dependent variable (Table 3). Most importantly this bivariate analysis revealed that rural adults with NMCP had higher odds (OR = 1.515, 95% CI = 1.513 – 1.518) than similar non-rural adults of having a prescription for opioids.

Complex samples logistic regression was performed and the results are displayed in Table 4. Based on the bivariate analysis all of the study covariates were entered into the complex samples logistic regression model. Analysis yielded that two covariates were significantly associated with the dependent variable:—rural residency (AOR = 2.935, 95% CI 1.416-6.083) and non-Caucasian race/ethnicity (AOR = 2.459, 95% CI 1.194-5.066).

Discussion
Recently there has been much concern expressed about the over-prescribing of opioids [7,28-30]. This concern arises from the fact that opioids are potentially addictive which can lead to misuse. Opioids have been cited as contributing to unnecessary morbidity and mortality, and in the long-run contribute to potentially unnecessary medical costs [4,28]. We were interested in examining differences in rural and non-rural opioid prescribing patterns for NMCP management, hypothesizing that disparities exist in opioid prescribing patterns for rural populations in the US. Our analyses supported our hypothesis that rural residency is an independent risk factor for a greater probability of patients with NMCP being prescribed an opioid.
## Table 1 Opioid drug codes by generic drug name

| Opioid drug codes from NAMCS drug database | Generic drug name                                      |
|-------------------------------------------|-------------------------------------------------------|
| 25510, 5660, 8335                         | Propoxyphene                                           |
| 2387, 97062                               | Remifentanil                                           |
| 1187, 50040                               | Sufentanil                                             |
| 9286                                      | Tapentadol                                             |
| 2333, 5081, 5091, 8246, 9582, 22303, 91047, 96109, 97181 | Oxycodone                                             |
| 7117, 7223, 21575                         | Oxymorphone                                            |
| 23285, 30535, 30540                       | Pentazocine                                            |
| 8338                                      | Phenerol                                               |
| 7420, 8475, 8490, 10115                   | Propoxyphene                                           |
| 91046, 92044, 92070, 98144, 99123         | Morphine                                              |
| 21550, 60990                              | Nalbuphine                                             |
| 8606, 98067                               | Narcotic Analgesics                                    |
| 3064, 9969, 21860, 21870, 21875, 21880, 22720, 22845 | Opium                                                 |
| 22850                                     | Opium-Sodium Bicarbonate                               |
| 1288, 1314                                | Oxycodone                                             |
| 95085                                     | Hydroxyzine-Meperidine                                  |
| 17340, 17362                              | Levorphanol                                            |
| 200, 8785, 18760, 96045                   | Meperidine                                             |
| 10130, 19885                              | Methadone                                              |
| 85, 2852, 3228, 8079, 10743, 19650, 19699, 26763, 41420, 60940, 70214 | Morphine                                              |
| 91071                                     | Dezocine                                               |
| 9574                                      | Dihydrocodeine                                         |
| 2067, 3307, 7197, 9508, 29645, 60565, 92024, 94188 | Fentanyl                                              |
| 14770, 92041, 92042                       | Homatropine Methyl Bromide-Hydrocodone                 |
| 7582, 9435, 14955, 94184                  | Hydrocodone                                            |
| 9600, 9641, 15005                         | Hydromorphone                                          |
| 11225, 22415, 27315                       | Aspirin; Caffeine; Codeine; Phenacetin                 |
| 11090, 18425, 24770, 25525                | Aspirin; Caffeine; Phenacetin; Propoxyphene            |
| 8910                                      | Atropine; Opium; Phenacetin; Salicylalide             |
| 5054, 60265, 95036                        | Buprenorphine                                          |
| 5103                                      | Butalbital-Codeine                                     |
| 1021, 29285                               | Butorphanol                                            |
| 1028, 7180, 7185 7190                     | Codeine                                                |
| 25690                                     | Codeine; Sanguinaris; Terpin Hydrate; White Pine Syrup; Wild Cherry Syrup |
| 91012                                     | Dezocine                                               |
| 10715                                     | Acetaminophen; Aspirin; Caffeine; Dihydrocodeine       |
| 42245                                     | Acetaminophen; Aspirin; Caffeine; Hydrocodone          |
| 40765                                     | Acetaminophen; Butalbital; Codeine                     |
| 13152, 24143                              | Acetaminophen; Butalbital; Codeine                     |
| 866, 96145                                | Alfentanil                                             |
| 21095                                     | Alphaprodine                                           |
| 2730, 2735                                | Aluminum Hydroxide; Aspirin; Codeine; Magnesium Antacids |
This research yielded important findings. First, rural residents had higher odds of having an opioid prescription than similar non-rural adults. Rural residency was the strongest predictor for having an opioid prescription and a diagnosis for NMCP. Second, being non-Caucasian was a strong predictor of having an opioid prescription and a diagnosis for NMCP.

Our results clearly indicate that rurality is an important factor in opioid prescribing patterns that cannot be ignored and bears further investigation. This is in stark difference to the finding of an earlier paper [24] that found no relationship between opioid prescription and geographic locale. At first glance one might conclude that this finding indicates an opioid prescribing disparity,

Table 1 Opioid drug codes by generic drug name (Continued)

| Code          | Generic Drug Name                                      |
|---------------|--------------------------------------------------------|
| 2740          | Aluminum Hydroxide; Aspirin; Codeine; Magnesium Hydroxide |
| 12560         | Aspirin; Butalbital; Caffeine; Codeine; Phenacetin      |
| 45, 50, 55, 65, 1990, 2815, 2825, 11220 | Aspirin; Codeine; Salicylamide |
| 3520          | Acetaminophen; Caffeine; Codeine; Phenacetin            |
| 6284          | Acetaminophen; Codeine; Salicylamide                    |
| 250, 265, 270, 275, 280, 1758, 2340, 2345, 5151, 5640, 7080, 7165, 7618, 9538, 11265, 11268, 23665, 23670, 23675, 23680, 25635, 28215, 32910, 32915, 32920, 32925, 32929, 32930, 32935, 41245, 91010 | Acetaminophen; Ethanol; Glycerin; Hydrocodone; Parabens |
| 197           | Acetaminophen-Codeine                                   |
| 10128, 40415  | Acetaminophen-Dextropropoxyphene                        |
| 251, 1268, 1995, 2045, 2082, 2132, 2314, 3518, 6059, 7064, 8354, 10105, 14917, 34110, 40860, 60340, 61610, 89038, 89039, 92180, 93077, 93089, 96028, 96047, 98036, 98168 | Acetaminophen-Hydrocodeine |
| 8790          | Acetaminophen-Meperidine                                |
| 283, 2348, 3394, 7251, 7252, 7632, 8248, 22305, 22306, 23385, 26958, 28272, 32945, 91048, 99114 | Acetaminophen-Oxycodone |
| 7701, 30513   | Acetaminophen-Pentazocine                               |
| 156, 6232, 8470, 25530, 25545, 28340, 34985, 61240, 89071, 89072, 93053, 93411 | Acetaminophen-Propoxyphene |
|               | Asa; Buffers; Codeine                                  |
|               | Aspirin; Caffeine; Dover's Powder                       |
|               | Aspirin-Caffeine                                        |
|               | Aspirin-Hydrocodone                                    |
|               | Aspirin-Oxycodone                                      |
|               | Aspirin-Pentazocine                                    |
|               | Aspirin-Prophylene                                     |
|               | Atropine-Meperidine                                    |
|               | Atropine-Morphine                                      |
|               | Belladonna-Opium                                       |
|               | Bupivacaine-Hydromorphone                              |
|               | Buprenorphine-Naloxone                                  |
|               | Droperidol-Fentanyl                                    |
|               | Hydrocodone-Ibuprofen                                   |
|               | Ibufrofen-Oxycodone                                    |
|               | Meperidine-Promethazine                                 |
|               | Naloxone-Pentazocine                                    |
but that may be too simple an explanation. All differences are not disparities. Disparities arise when the differences are avoidable as well as unjust [3,18]. We cannot say with any certainty that these are the characteristics of the differences revealed in prescribing patterns from our analyses. It may be that there are treatment option limitations in rural areas of the US [31]. Ultimately, NMCP is complex and often requires a multifactorial approach for optimal management [32]. For instance, physical therapy, occupational therapy, massage therapy, acupuncture, integrated specialty pain management services, or behavioral modification may be useful approaches for the management of patients with NMCP [33]. These modalities as treatment options may be less available to patients in the rural US [31].

Our findings also identified that non-Caucasian race/ethnicity (African American, Hispanic, Asian, Native American, and multiracial) was an independent risk factor for having NMCP and being prescribed an opioid. Opioid prescribing patterns for non-Caucasian adults is complicated and the differences between our findings and those from a number of other studies are hard to reconcile or explain. Findings from multiple studies have yielded that African American or Black patients were less likely than Caucasian ones to be prescribed opioids for pain [12,15,16,19,34-37]. Other research has revealed that in the US there is little difference in the estimated prevalence of pain across population groups [38]. However, racial/ethnic minorities have often had inadequate pain management despite being more likely to report experiencing severe pain and/or pain that interfered with daily activities [3,38]. One explanation for the variance of our findings from other studies might be the examination of data from a different source. The NAMCS data analyzed in this study is derived from patient health records rather than patient self-report surveys. Patient health record data are based on documented visits to health care providers, while patient self-report data are not. We do not want to make a claim of the veracity of one source of data over the other, only that the analysis of each may yield different findings.

**Study limitations and strengths**

This study does have some limitations, most of which are attributable to how the survey data were collected. First, ICD-9 codes were used to identify patients with NMCP and to limit the population included in the study. Second, opioid prescriptions were then assumed to be linked to the NMCP patient population. Since there is no link in the questionnaire form between prescribed medications (in our case opioids) and diagnosis (ICD-9 codes), we were unable to determine with surety for what diagnosis opioids were being prescribed for. However, this limitation is also present in a previously published study [4], setting precedence for using this methodology. Studies that can determine causality amongst these variables are warranted. Third, the variables of race/ethnicity, education, and household income were derived variables.

Nevertheless, this study has a number of strengths. Since we used national patient record population-level survey data, we had a large data set that was weighted to ensure that our findings could be more easily and accurately generalized to the US population. Another strength is the magnitude of the effect sizes for rural and non-rural opioid prescribing patterns as well as those detected for race/ethnicity. The effect sizes, derived from the logistic regression odds ratios, ranged from nearly two to three times greater than the reference categories. Much has been studied in reference to age and race/ethnicity, but these findings lend vigorous support to the conceptualization of rurality as a social determinant of health.
Conclusions

This study fills an important epidemiological knowledge gap regarding opioid prescribing patterns for rural adults with NMCP. Further research on the growing concern about the over-prescribing of opioids in the US should now include rurality as a variable in data generation and analysis in addition to the variable of race/ethnicity that are commonly included. In order to provide the best level of care to all patients regardless of geographic location or race/ethnicity, another level of analysis should capture data on opioid dosing and health care provider perceptions of patients. Future research should also attempt to document the ecological, sociological and political factors impacting opioid prescribing and care in rural communities. Prescribers and health care policy makers need to critically evaluate the implications of our findings and their relationship to patient needs, best practices in a rural setting, and the overall consequences of increased opioid prescribing on rural communities.

Abbreviations

AOR: Adjusted odds ratios; CDC: Centers for disease control and prevention; HCP: Health care provider; IRB: Institutional Review Board; MSA: Metropolitan Statistical Area; NAMCS: National Ambulatory Medical Care Survey; NCHS: National Center for Health Statistics; NMCP: Non-Malignant Chronic Pain; OR: Odds ratios; SPSS: Statistical Package for Social Scientists.

Competing interests

The authors declare that they have no competing interests.

Authors’ contributions

JPP, KDH, AML, MTs, CASH, GWA and MNL all made substantial contributions to the conception and design of the manuscript, contributed to the interpretation of the data, were involved in revising the manuscript critically for important intellectual content, and have given final approval of this version of the manuscript to be published. Additionally, MNL oversaw the statistical analyses and the acquisition of the data.

Table 3 Bivariate analysis of US adults with a diagnosis of chronic pain and an opioid prescription as dependent variable by covariates

| Variable | Factor | Unadjusted odds ratio (95% CI) |
| --- | --- | --- |
| Patient sex (vs. Male) | Female | 1.107 (1.104, 1.109) |
| | Male | --* |
| Patient Race/Ethnicity (vs. Non-Caucasian) | Caucasian | .643 (.642, .644) |
| | Non-Caucasian | 2.459 (1.194, 5.066) |
| Education percent university graduate in patient zip code (vs. > = 20%) | <20% | 1.010 (1.008, 1.012) |
| | > = 20% | 1.036 (1.034, 1.037) |
| Poverty percent in patient zip code (vs. > = 10%) | <10% | 1.010 (1.006, 1.014) |
| | > = 10% | 1.192 (1.190, 1.194) |
| Health Insurance status (vs. Do Not Have Health Insurance) | Have Health Insurance | 1.192 (1.190, 1.194) |
| | Do Not Have Health Insurance | --* |
| Primary HCP visit (vs. No) | Yes | 885 (.883, .886) |
| | No | 1.299 (1.295, 1.302) |
| Patient now has arthritis (vs. Yes) | Yes | 1.309 (.514, 3.333) |
| | No | --* |
| Patient now has depression (vs. Yes) | Yes | .518 (.246, 1.089) |
| | No | --* |
| Geographic locale (vs. Non-Rural) | Rural | 2.935 (1.416, 6.083) |
| | Non-Rural | --* |

2010 NAMCS (weighted n =9,325,603).

Table 4 SPSS complex samples logistic regression analysis of US adults with NMCP (study dependent variable = opioid prescription)

| Variables | Factors | Adjusted odds ratio (95% CI) |
| --- | --- | --- |
| Patient sex | Female | 1.310 (1.311, 1.720) |
| | Male | --* |
| Patient age | 18-39 | 1.094 (0.297, 4.027) |
| | 40-64 | 1.949 (0.977, 3.887) |
| | > = 65 | --* |
| Patient now has arthritis | Yes | 1.309 (1.104, 1.509) |
| | No | --* |
| Patient now has depression | Yes | .518 (.246, 1.089) |
| | No | --* |
| Geographic locale | Rural | 2.935 (1.416, 6.083) |
| | Non-Rural | --* |

*Reference category.

NAMCS 2010 data (weighted n =9,325,603).
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