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Increasing Risk of Cannabis Use Disorder among U.S. Veterans with Chronic Pain: 2005–2019

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Abstract

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This work has not been previously presented.

In the U.S., cannabis is increasingly used to manage chronic pain. Veterans' Health Administration (VHA) patients are disproportionately affected by pain and may use cannabis for symptom management. Because cannabis use increases the risk of cannabis use disorders (CUD), we examined time trends in CUD among VHA patients with and without chronic pain, and whether these trends differed by age. From VHA electronic health records from 2005 to 2019 (~4.3–5.6 million patients/year), we extracted diagnoses of CUD and chronic pain conditions (ICD-9-CM, 2005–2014; ICD-10-CM, 2016–2019). Differential trends in CUD prevalence overall and age-stratified (<35, 35–64, ≥65) were assessed by any chronic pain and number of pain conditions (0, 1, ≥2). From 2005–2014, the prevalence of CUD among patients with any chronic pain increased significantly more (1.11% to 2.56%) than those without pain (0.70% to 1.26%). CUD prevalence increased significantly more among patients with chronic pain across all age groups and was highest among those with ≥2 pain conditions. From 2016–2019, CUD prevalence among patients age ≥65 with chronic pain increased significantly more (0.63% to 1.01%) than those without chronic pain (0.28% to 0.47%) and was highest among those with ≥2 pain conditions. Over time, CUD prevalence has increased more among VHA patients with chronic pain than other VHA patients, with the highest increase among those age ≥65. Clinicians should monitor symptoms of CUD among VHA patients and others with chronic pain who use cannabis, and consider non-cannabis therapies, particularly since the effectiveness of cannabis for chronic pain management remains inconclusive.

Abstract

Veterans with chronic pain have increasing risk of CUD compared to those without pain, with the highest current increase in risk among those age ≥65.

Keywords

pain; chronic pain; cannabis use disorder; veterans; Veterans Health Administration

INTRODUCTION

In the United States (U.S.), ~50.2 million adults have chronic pain [70] (i.e., pain that persists ≥3 months),[61] which is associated with significant morbidity and poor functioning [18,33,52]. Cannabis is now commonly used to treat chronic pain [13,44,66,68], and many adults perceive cannabis as beneficial for pain management [36], although evidence for the effectiveness of cannabis to treat chronic pain is mixed [14,49,50,58,65,67]. While some systematic reviews demonstrate that cannabis is associated with reductions in chronic pain [49,67] and improvements in sleep and physical functioning [65], others show minimal therapeutic benefit for chronic pain [14,50,58]. Many adults can use cannabis with little harm, though for others its use also can have negative consequences, including impaired cognitive functioning [10,46], motor vehicle crashes [55], suicidal ideation [26], and lower quality of life [22]. Additionally, 20%–33% of adults who use cannabis develop cannabis use disorder (CUD) [38], characterized by a problematic and persistent pattern of use that contributes to impaired social and occupational functioning [15]. U.S. rates of CUD are increasing, affecting 5.2% of adults in 2020 [59]. CUD is associated with cardiovascular and respiratory diseases [24,34], other substance use disorders (SUD) [29], psychiatric

conditions [29], and psychosocial adversities including homelessness, legal problems, and interpersonal conflict [25].

Because of the increasing prevalence of chronic pain [48,71] and the increasing perception that cannabis is an effective pain treatment [36], understanding the risk for CUD among people with chronic pain has emerged as an important clinical issue. However, little is known about the relationship between chronic pain and CUD and whether this association is changing over time. A nationally representative survey of U.S. adults suggested that self-reported pain was associated with CUD, a risk that increased from 2001–2013 [31]. Another nationally representative study showed that veterans with pain were more likely to use cannabis frequently (≥3 times a week) [17], which is a strong risk factor for CUD [29]. However, data from these studies are now 10 years old and were collected prior to cannabis legalization in many states, which has been associated with increased prevalence of adult use [9] and reduced perceived risk [36]. Moreover, neither study examined age differences in associations between chronic pain and CUD, even though chronic pain disproportionately affects older adults and CUD disproportionately affects younger adults [28,70]. This information is needed to inform service planning and resource allocation for substance use treatment and pain management.

The Veterans Health Administration (VHA) is the largest U.S. integrated healthcare system. VHA patients are disproportionately affected by chronic pain [42] and rates of CUD have increased considerably since 2005 [28]. The VHA electronic health record (EHR) database can be leveraged to compare CUD diagnosis trends between patients with and without chronic pain. Drawing on yearly VHA EHR data, we examined CUD trends from 2005–2019 among veterans with and without chronic pain. We then examined whether CUD trends differed by the presence of more than one chronic pain condition, which is associated with greater pain intensity [53]. Since the prevalence of CUD and chronic pain varies with age, we also examined overall trends in CUD in age-stratified groups (<35, 35–64, ≥65).

METHODS

Sample & Procedure

Data from 1/1/2005 to 12/31/2019 were obtained from the VA Corporate Data Warehouse (CDW), which is a data repository that contains patient level VA EHR data. Using the CDW outpatient files, patients who were veterans with ≥1 primary care, emergency department, and/or mental health clinic encounters were identified annually. Patients were excluded from a given year if they received hospice/palliative care (range, n=7,774 to 80,440) or resided outside the 50 U.S. states or Washington DC (range, n=53,270 to 66,221). Fifteen serial data sets were created, one for each year (annual sample size ranged from N=4,332,165 to 5,657,277). The Institutional Review Boards at the VA Puget Sound and New York Harbor Healthcare Systems, and New York State Psychiatric Institute approved this study.

Measures

Outcome

Cannabis Use Disorder (CUD): VHA patients with CUD diagnosis were aggregated each year from 2005–2019. CUD was identified using the International Classification of Diseases (ICD)-9-CM from 1/1/2005 to 9/30/2015, and ICD-10-CM from 10/1/2015 to 12/31/2019. CUD was defined by the presence of diagnostic codes for cannabis abuse (ICD-9-CM: 305.2, 305.20, 305.21, 305.22; ICD-10-CM: F12.1X) and cannabis dependence (ICD-9-CM: 304.3, 304.30, 304.31, 304.32; ICD-10-CM: F12.2X). Cannabis abuse and dependence were consolidated into a single variable because their criteria are unidimensional [30] Patients were classified as having CUD in a given year if they received ≥1 diagnoses listed above during either outpatient or inpatient encounters at any VA facility or other setting where healthcare is paid for by the VHA [28]. ICD codes indicating diagnoses in remission (ICD-9-CM: 304.33, 305.33; ICD-10-CM F12.11, F12.21) or unspecified cannabis use (ICD-10-CM: F12.9X) were excluded.

Exposure

Chronic Pain: Using diagnostic codes from the American Pain Society Taxonomy informed by research from the VHA and Health Care System Research Network, Mayhew and colleagues developed a diagnostic crosswalk that identified chronic pain conditions across ICD-9-CM and ICD-10-CM [45]. Applying this crosswalk, we identified VHA patients with chronic pain using ICD-9-CM or ICD-10-CM codes indicating at least one of the following 11 pain clusters: (1) Back; (2) Neck; (3) Limb/extremity or joint pain and non-systemic non-inflammatory arthritic disorders (4) Fibromyalgia; (5) Headache/migraine; (6) Orofacial/ear/temporomandibular disorders; (7) Abdominal/bowel disorders; (8) Urogenital/pelvic/menstrual disorders; (9) Neuropathy; (10) Systemic disorders; and (11) Other painful conditions. The specific conditions included within each pain cluster are presented in Supplementary Table 1, and the corresponding ICD codes are provided elsewhere (https://github.com/PainResearch/PainCondition_ICD9CM_ICD10CM_Crosswalk). We excluded diagnoses for cancer-related pain, as well as chest pain, fractures, contusions, sprains and strains, and postoperative pain because these conditions might not meet criteria for chronic pain [61]. To increase the likelihood that pain diagnoses were associated with a chronic condition, we required ≥2 outpatient or ≥1 inpatient diagnoses within each study year for specific pain conditions. A dichotomous variable was created indicating any chronic pain condition (yes, no) each year from 2005–2019. We also created a categorical variable indicating diagnosis of 0, 1 or ≥ 2 chronic pain clusters [45] to assess the effect of multiple chronic pain conditions on CUD [53].

Covariates—Demographic characteristics included sex (male, female), age (<35 years, 35–64 years, ≥65 years), and race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic; other/multiple races, and unknown) [29].

Statistical analysis

Given different rates of chronic pain and CUD across younger, middle, and older adults, all analyses were performed for the overall sample and stratified by age (<35, 35–64, ≥65) [28].

Demographic characteristics and unadjusted prevalence of CUD and pain for the overall sample and by age group were presented descriptively for study years 2005 and 2019. Due to the mid-year transition from ICD-9-CM to ICD-10-CM that occurred in 2015, we excluded this year from our analyses and examined adjusted trends in CUD for two periods: 2005–2014 (ICD-9-CM coding) and 2016–2019 (ICD-10-CM coding). To test for changes in CUD over time by any chronic pain condition, multivariate logistic regression models were run that included categorical study year, chronic pain (yes, no) and an interaction term for chronic pain and study year, adjusted for sex, race/ethnicity, and categorical age (<35, 35–64, ≥65). Separate multivariate logistic regression models were then run for each of the three age groups. The predicted diagnostic prevalence of CUD (i.e., adjusted proportion) in each year, the change in the diagnostic prevalence, the difference in those trends between those with chronic pain versus without chronic pain and the associated 95% confidence intervals (CI) were obtained from the margins command for the fitted logistic regression model. Since small absolute differences in low-prevalence conditions may appear large when presented in relative terms, we present between-group comparisons of absolute changes in the prevalence of CUD diagnoses to assess the public health importance of the results and optimize their interpretability [2,3,72]. To further test for differential changes in CUD over time by total pain diagnoses, we ran logistic models identical to those described above using a categorical variable of total chronic pain conditions (0, 1, ≥2) in place of the binary pain indicator. CIs were based on standard statistical methods that assume normal sampling distributions. While full-census data such as the VA EHR data do not necessarily require uncertainty estimates of this type, we present them to provide an indication of the precision of our prevalence estimates.

We also conducted three sets of sensitivity analyses using a statistical approach consistent with our main analyses. Given the greater risk of common psychiatric comorbidities among people with chronic pain and the possibility of higher CUD prevalence in this group [18,33], our first set of sensitivity analyses compared the overall and age-stratified prevalence of CUD diagnoses by any pain condition between patients with and without the following ICD psychiatric diagnoses: anxiety (ICD-9-CM: 300.0X, 300.2X; ICD-10-CM: F40.X, F41.X) depression (ICD-9-CM: 296.20–296.25, 296.30–296.35, 296.82, 296.90, 300.4, 301.12, 311; ICD-10-CM: F32.0-F32.4, F32.8X, F32.9, F32.A, F33.0-F33.3, F33.41, F33.8, F33.9, F34.1, F34.8X, F34.9, F39) or post-traumatic stress disorder (PTSD; ICD-9-CM: 309.81; ICD-10-CM: F43.10, F43.12). For each year from 2005–2019, a binary variable indicated a diagnosis of anxiety, depression, and/or PTSD (0=no, 1=yes). We then re-ran our main analyses further stratified by diagnoses of these psychiatric conditions, adjusting for the covariates included in the main analyses (Supplemental Table 3).

Second, given VHA policies requiring urine drug screenings (UDS) among patients prescribed opioid analgesics [62], we examined overall and age-stratified CUD prevalence by chronic pain status in patients with and without a past-year UDS. We conducted this sensitivity analysis because increased substance use surveillance might lead to patients with chronic pain being more likely to receive a positive indication of cannabis use, which could potentially lead to a CUD diagnosis. For each year from 2005–2019, we coded a variable indicating patients who completed ≥1 UDS that included a test for carboxy tetrahydrocannabinol (1=no, 2=yes), the active metabolite of THC. We then ran analysis

stratified by receipt of UDS using the same approach described in the first set of sensitivity analyses (Supplemental Table 4).

Third, among people with versus without chronic pain, we assessed overall and age-stratified prevalence of cannabis dependence only, since providers may have used codes for "cannabis abuse" to indicate uncomplicated cannabis use during the ICD-9-CM period when there were no specific codes for cannabis use (Supplemental Table 5). Analyses were conducted using Stata version 17.

RESULTS

Demographic Characteristics, Chronic Pain, and CUD: 2005 and 2019

The analytic sample was primarily male (2005: 95.0%, 2019: 90.8%) and non-Hispanic White (2005: 78.7%, 2019: 70.3%). About half were age ≥65 years (2005: 49.2%, 2019: 51.9%). From 2005–2019, the prevalence of any chronic pain increased from 37.3% to 51.9%. The most common pain conditions were limb or joint pain (2005: 22.9%, 2019: 32.1%) and back pain (2005: 11.3%, 2019: 22.0%). The prevalence of any CUD diagnoses increased from 0.85% in 2005 to 1.92% in 2019. Overall and age-stratified sample characteristics for 2005 and 2019 are presented in Supplementary Tables 1 and 2.

Overall trends of CUD in veterans with and without chronic pain

After adjusting for sex, race/ethnicity, and age, trends in the overall prevalence of CUD increased among veterans with chronic pain from 2005–2014 and then from 2016–2019 (Figures 1 and 2). During 2005–2014, VHA patients with any chronic pain had significantly greater increases in CUD (2005: 1.11%, 2014: 2.56%) than those without pain (2005: 0.70%, 2014: 1.26%), a greater absolute increase in percent change of 0.89% among patients with chronic pain (Table 1). During this period, veterans with ≥2 chronic pain conditions had significantly greater increases in CUD, from 1.38% in 2005 to 3.21% in 2014, compared to 0.72% in 2005 to 1.29% in 2014 among veterans with no pain and 0.98% in 2005 to 2.06% in 2014 among veterans with only one pain condition (Table 2).

From 2016–2019, the differences in CUD prevalence among those with and without chronic pain remained, increasing by 0.31% in patients with pain and 0.24% in those without chronic pain. However, these trends did not diverge as markedly as they had between 2005–2014. While CUD prevalence was higher for those with ≥2 chronic pain conditions, rates of increase in CUD did not differ significantly by number of chronic pain conditions (Tables 1 and 2).

In sensitivity analyses, overall trends in CUD by chronic pain status were generally consistent with our main findings. From 2005–2014, there was a disproportionate increases in CUD prevalence in patients with versus without chronic pain notwithstanding anxiety, depression, or PTSD diagnoses. However, among those with psychiatric comorbidity, the increase in prevalence of CUD was even greater in patients with chronic pain than in those without pain. From 2016–2019, the difference in CUD trends between chronic pain groups was attenuated in patients with and without anxiety, depression, or PTSD (Supplemental Table 3). In UDS sensitivity analyses, from 2005–2014, VHA patients with

chronic pain had significantly higher prevalence of CUD than patients without chronic pain irrespective of UDS completion. However, from 2016–2019, VHA patients with versus without chronic pain demonstrated even greater increases in prevalence of CUD if they received a UDS compared to patients who did not receive a UDS. This contrasted with our main findings that showed attenuated effects of chronic pain on CUD during this period (Supplemental Table 4). Lastly, from 2005–2014 and 2016–2019, veterans with chronic pain were disproportionately affected by cannabis dependence, though the difference in the trends of cannabis dependence between those with versus without chronic pain was attenuated during the latter period, as was the case for CUD (Supplemental Table 5).

Age-stratified trends of CUD in veterans with and without chronic pain

From 2005–2014, VHA patients with any chronic pain had significantly greater increases in CUD prevalence than those without pain across all age groups (Table 3). Adults <35 years with any chronic pain demonstrated the largest absolute increase in CUD prevalence from 2005–2014, with CUD increasing by 3.78% among those with chronic pain versus 1.78% among those without chronic pain (difference in prevalence= 2.0%, 95% CI: 1.83, 2.18). The widening CUD differences between pain groups was also observed among VHA patients age 35–64 in whom rates of CUD increased by 1.98% among VHA patients with any chronic pain versus 0.59% among those without chronic pain (difference in prevalence= 1.38%, 95% CI: 1.33, 1.44). This was consistent for patients ≥65 (difference in prevalence= 0.29%, 95% CI: 0.27, 0.30). Veterans with ≥2 pain conditions had significantly greater increases in CUD compared to veterans with no pain or only one pain condition across all three age groups (Table 4).

From 2016–2019, VHA patients age <35 and 35–64 with any chronic pain did not demonstrate significantly greater increases in CUD prevalence than those without chronic pain (Table 3). Among those <35 years, those with chronic pain showed less of an increase in CUD relative to those without pain. However, in veterans age ≥65, those with any chronic pain had significantly greater increases in CUD prevalence than those without chronic pain, with rates of CUD increasing from 0.63% to 1.01%, for an absolute change of 0.38% among those with any chronic pain and 0.19% among those without chronic pain (difference in prevalence=0.19%, 95% CI: 0.17, 0.22). In this group, risk of CUD increased in a dose-dependent manner based on total number of chronic pain conditions, that is, the rates of increase in CUD were significantly greater for veterans with ≥2 pain conditions than those with one condition and no chronic pain, and greater for veterans with one chronic pain condition than no chronic pain (Table 4).

Age-stratified sensitivity analyses were largely consistent with our main findings. From 2005–2014, VHA patients with versus without chronic pain had significantly greater increases in CUD prevalence across all age groups irrespective of anxiety, depression, or PTSD, with even greater increases in those with psychiatric comorbidity. From 2016–2019, the disparity in CUD prevalence in people with versus without chronic pain was attenuated in those with and without anxiety, depression, or PTSD, except for adults age ≥65 years with chronic pain, who demonstrated an even greater increase in CUD prevalence if they had a psychiatric condition (Supplemental Table 3). From 2005–2014, VHA patients with

chronic pain who were 35–64 and ≥65 years of age had significantly greater increases in CUD in both those with and without a UDS. From 2016–2019, CUD disproportionately affected veterans with chronic pain in the <35 and 35–64 age groups if they had a UDS. In veterans ≥65 years of age, those with chronic pain experienced an increase in CUD irrespective of UDS completion, though the increase in CUD was greater among those with a UDS (Supplemental Table 4). The trends in cannabis dependence were also consistent with our main findings. From 2005–2014, veterans with chronic pain in all age groups were disproportionately burdended by cannabis dependence, though the difference in trends of cannabis dependence among those with versus without chronic pain was most prominent in the ≥65 age group from 2016–2019, similar to the patterns seen for CUD (Supplemental Table 5).

DISCUSSION

Using EHR data from 4.3 to 5.6 million VHA patients annually, we examined trends in prevalence of CUD diagnoses among those with and without chronic pain from 2005–2014 and 2016–2019. Between 2005–2014, patients with chronic pain had increasing disparities in CUD trends compared to those without chronic pain. The increase in CUD was especially evident among younger adults (<35 years) with ≥2 pain conditions. However, between 2016–2019, a different trend emerged: older adults (≥65) with chronic pain, particularly those with ≥2 pain conditions, were disproportionately diagnosed with CUD. These findings suggest a recent increased risk of CUD among older patients with chronic pain. To our knowledge, this is the first study to examine national time trends in CUD diagnoses among VHA patients with and without medically diagnosed chronic pain conditions.

From 2005–2014, overall rates of CUD diagnoses in VHA patients nearly doubled, and age-stratified analyses showed an increasing disparity in CUD prevalence between those with versus without chronic pain across all age groups. During this period, U.S. military in Operations Iraqi Freedom and Enduring Freedom were exposed to high rates of musculoskeletal injury and concussion [40]. Military service members who returned from these wars may have used cannabis to manage combat-related musculoskeletal pain, migraine/headache, and comorbid psychiatric symptoms, increasing their risk of developing CUD [8,34,42]. Increases in CUD diagnoses among veterans with chronic pain may also have been related to VHA initiatives that expanded access to mental health and SUD treatment services in primary care and specialty clinics in the mid 2000’s [6]. Additionally, risk of CUD diagnosis may have been higher after the 2010 publication of VHA Guideline of Opioid Therapy for Chronic Pain [62] and implementation of the 2013 Opioid Safety Initiative (OSI) [20], policies that aimed to reduce risks associated with prescription opioids by including mandated UDS for patients using long-term opioid therapy. Our sensitivity analysis demonstrated disproportionate increases in CUD among veterans with versus without chronic pain irrespective of UDS from 2005–2014 and 2016–2019. However, in the latter period, patients across all age groups with chronic pain and a UDS had an even greater increase in the prevalence of CUD diagnoses compared to those without a UDS. These findings suggest that the increasing prevalence of CUD among patients with chronic pain during this period is partly attributable to substance use surveillance, along with important risk factors, including anxiety, depression, and PTSD. The OSI was also associated with

a 64% reduction in opioid prescribing [63] and could have led to use of alternative pain management strategies such as cannabis, though the trends we found did not indicate any sharp breaks in the rates of increase at these two time points.

From 2016–2019, the disparity in CUD between those with versus without chronic pain continued; however, this was primarily due to the older patients as those with chronic pain had twice the risk of developing CUD than those without chronic pain. Among older adults in the U.S., the prevalence of cannabis use has doubled since 2016 [27]. Findings from our study suggest that chronic pain, especially multiple chronic pain conditions, may contribute to these rising rates, particularly among those with comorbid anxiety, depression, or PTSD. Vietnam-era veterans, now older adults, experience high prevalences of chronic pain [4], depression [11], and PTSD [4], conditions for which self-medication with cannabis is common [7] and is now approved for medical use in many states [43,49,69]. Further, these risks may be exacerbated by medical frailty caused by pain and comorbid chronic health conditions [5,41,42,47]. Use of many analgesic medications is contraindicated by kidney or liver disease and prescription psychotropic medications or anticoagulants [16,64], which may limit pain management options for older VHA patients and thus lead to cannabis use. Cannabis use for managing symptoms of pain and arthritis is increasing among adults age ≥65 [66] and may be associated with higher risk of CUD [21].

Although many adults use cannabis without developing CUD or other harms [38], we demonstrated that veterans with chronic pain have experienced disproportionately greater increases in the prevalence of CUD diagnoses than veterans without chronic pain. Clinicians should provide patients with balanced information on empirically-supported health benefits of cannabis and potential harms [50,58], including the risk of CUD. Cannabis use, particularly orally-administered cannabis, has shown therapeutic benefits for chronic pain [49,67] and associated insomnia and disability [65], but patients should also be educated on the limitations of cannabis for chronic pain management [14,58,65]. Clinicians should also monitor patients for frequent cannabis use [38] and consumption of high potency cannabis products [54], which are strong risk factors of CUD. Male sex, unmarried status, and other SUD and psychiatric conditions are also risk markers of CUD [8] and can affect the safety of cannabis as a pain management intervention [50]. It is important to consider chronic pain therapies other than cannabis use when its health risks outweigh the benefits, especially for patients with underlying cardiovascular or respiratory disease, for whom cannabis use can pose increased risks [24,34]. Pharmacologic treatments, such as gabapentinoids, acetaminophen and non-steroidal anti-inflammatory drugs are effective treatments of nociceptive or neuropathic pain, though they are also associated with sedation, cognitive risks, and other adverse effects [16,56]. Non-pharmacologic therapies (e.g., physical rehabilitation, cognitive-behavioral therapies [CBT]), are recommended by the CDC and VHA as first-line alternatives to opioids for chronic pain, despite some barriers to their access [42]. These treatments are effective for improving chronic pain outcomes in older adults [60], and have fewer health and psychosocial risks than cannabis [64]. Because older adults with chronic pain and psychiatric comorbidity were the most burdened by CUD in our study, CBT, which is effective in treating chronic pain and psychiatric symptoms [57], may be particularly beneficial for reducing the risk of CUD in this population.

Study limitations are noted. First, VHA patients are largely White, middle age or older, males with high rates of medical comorbidities. Therefore, our findings may not be generalizable to other patient populations, although our results are consistent with earlier general population findings using a measure of self-reported pain [31]. Second, as with other studies using EHR data, our measures of chronic pain and CUD used ICD codes. Though these diagnostic codes provide a clinical marker of chronic pain and CUD, underdiagnosis is possible, particularly for less severe cases. Further, patients with ICD codes for chronic pain or CUD may no longer meet diagnostic criteria for these conditions and be misclassified. To limit misclassification, we included only chronic pain conditions that were highly associated with longstanding pain and disability and excluded CUD "in-remission" and unspecified cannabis use. ICD-9-CM codes for CUD may be particularly susceptible to miscoding because there was no code for cannabis use during the 2005–2014 period, and among patients with uncomplicated cannabis use that clinicians wished to note, they may have indicated an "abuse" diagnosis. While we do not know how often clinicians document behaviors that are not related to a presenting clinical complaint (e.g., uncomplicated cannabis use), our sensitivity analyses with only cannabis dependence as the outcome yielded trends consistent with our main results, suggesting that our findings were robust to miscoding of cannabis abuse among patients with uncomplicated cannabis use. Third, the transition from ICD-9-CM to ICD-10-CM necessitated examining trends within two time periods: 2005–2014 and 2016–2019. During the transition, changes occurred in how some conditions were diagnosed and documented [45], which may have affected the prevalence estimates of chronic pain and CUD. Fourth, we were unable to assess pain intensity. However, we examined the risk of CUD as a function of two or more chronic pain conditions, which is associated with more severe pain [53]. Fifth, VHA patients with pain may be more likely than other patients to be prescribed opioids or have SUD and psychiatric symptoms [32], which may have increased CUD clinical surveillance in this group. However, our overall findings were largely consistent with the results from sensitivity analyses accounting for psychiatric diagnoses and UDS. Sixth, the VA EHR does not have measures of cannabis use, including potency of products consumed, duration or frequency, and route of administration or motive of use (i.e., recreational vs. medical) and we therefore cannot assess patterns of use in relation to CUD or trends in their associations with chronic pain.

Studies examining the health risks of chronic pain are important to inform clinical practice and public health policy, particularly as cannabis legalization proliferates and treatment of chronic pain shifts to non-opioid interventions [19,23]. VHA patients with chronic pain were increasingly susceptible to CUD over time, with veterans age ≥65 disproportionately affected in recent years. Healthcare providers should monitor patients with chronic pain for symptoms of CUD, and consider non-cannabis pain treatments, particularly since the effectiveness of cannabis for the treatment of chronic pain remains inconclusive. Future investigations would benefit from examining the effects of chronic pain on cannabis use patterns (e.g., frequency, duration, consumption methods) and whether risk of CUD differs by sex, race and ethnicity or motive of cannabis use. Given widening disparities in CUD prevalence among those age ≥65 with and without chronic pain, further research is needed to identify consequences of CUD in this particularly vulnerable group of cannabis

users. Lastly, as national rates of chronic pain increase [48,71] accompanied by significant reductions in use of prescribed opioids to treat chronic pain, studies are needed to determine the safety of cannabis use for chronic pain management and the most effective non-opioid treatments of chronic pain.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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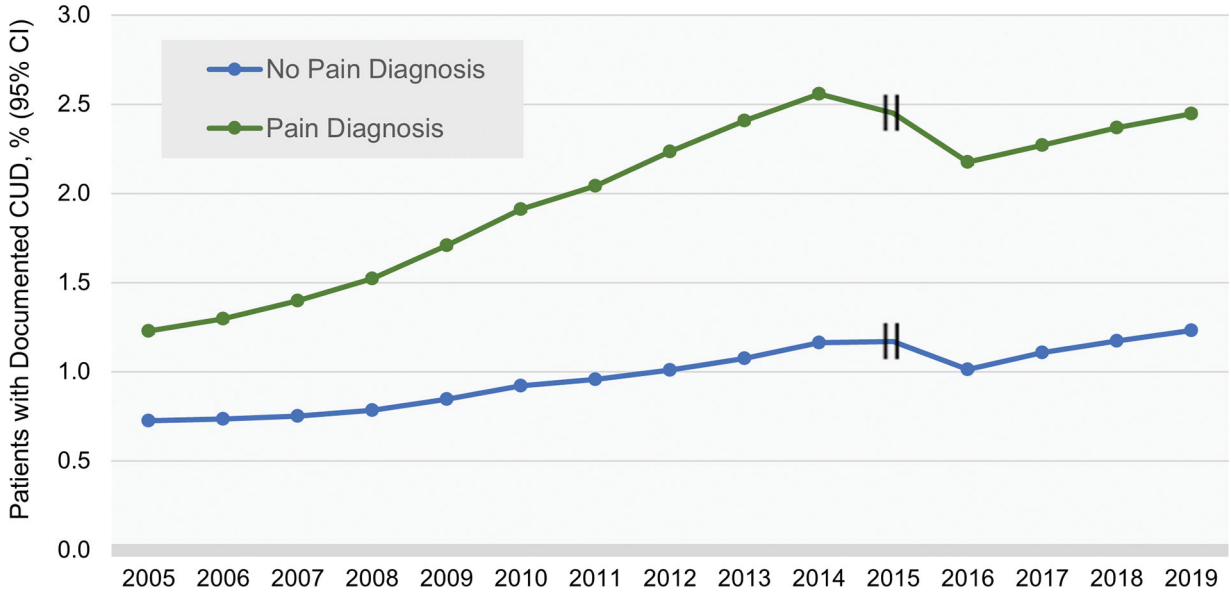

Figure 1.

Overall Trend in CUD by Any Chronic Pain in VHA patients, 2005–2019

Change in CUD prevalence from 2005–2019 among people with chronic pain diagnosis and people without chronic pain diagnosis. Hatch marks at 2015 indicate that predicted diagnostic prevalence of CUD is an aggregate across some patients coded with ICD-9-CM and others with ICD-10-CM due to change in ICD coding mid-year. Models included study year, pain diagnosis (Y/N), year X pain, categorical age, sex, and race/ethnicity.

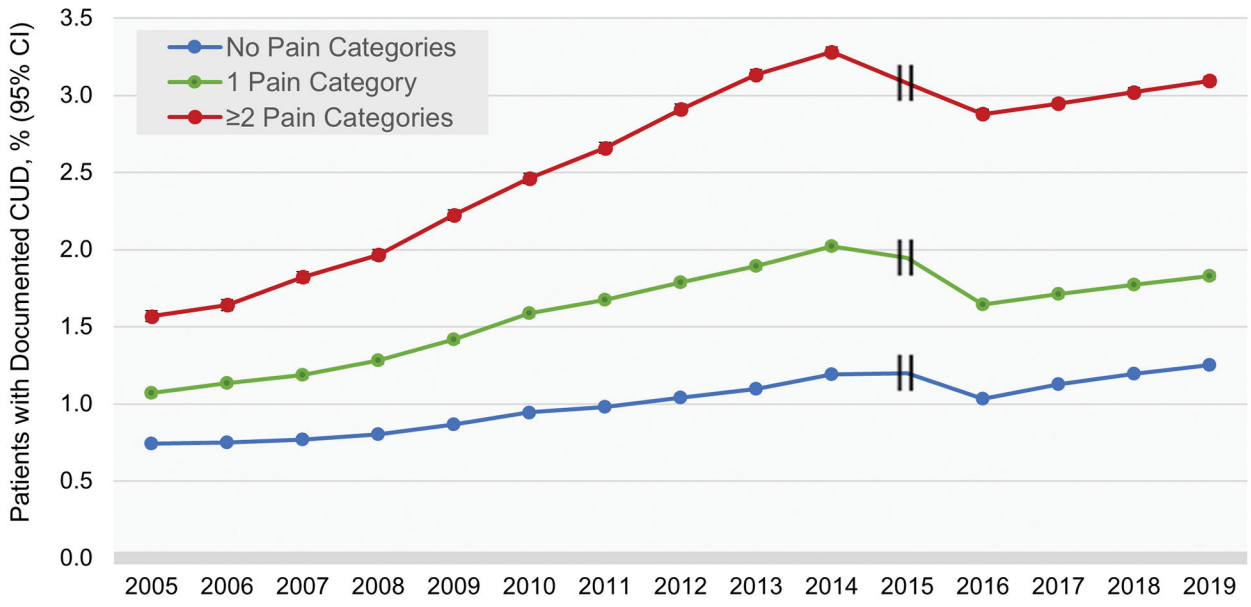

Figure 2.

Overall Trend in CUD by Total Chronic Pain Conditions, 2005–2019

Change in CUD prevalence from 2005–2019 among people with 0,1, or ≥2 chronic pain diagnoses. Hatch marks at 2015 indicate that predicted diagnostic prevalence of CUD is an aggregate across some patients coded with ICD-9-CM and others with ICD-10-CM due to change in ICD coding mid-year. Models included study year, pain category count, year X pain count, categorical age, sex, and race/ethnicity.

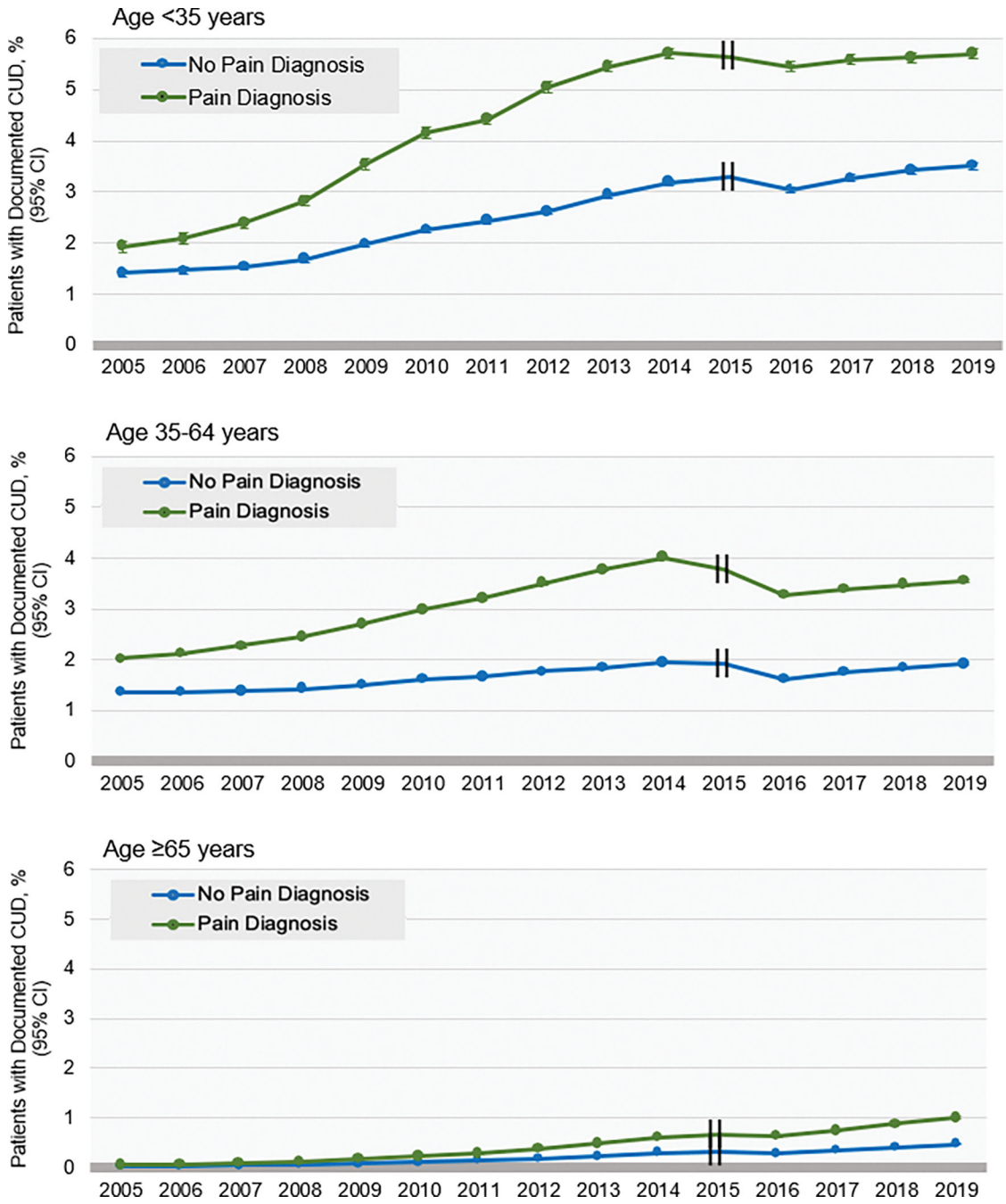

Figure 3.

Age-stratified Trends in CUD by Any Chronic Pain Condition, 2005–2019

Change in CUD prevalence from 2005–2019 among people with chronic pain diagnosis and people without chronic pain diagnosis. Hatch marks at 2015 indicate that predicted diagnostic prevalence of CUD is an aggregate across some patients coded with ICD-9-CM and others with ICD-10-CM due to change in ICD coding mid-year. Models included study year, pain diagnosis (Y/N), year X pain, sex, and race/ethnicity.

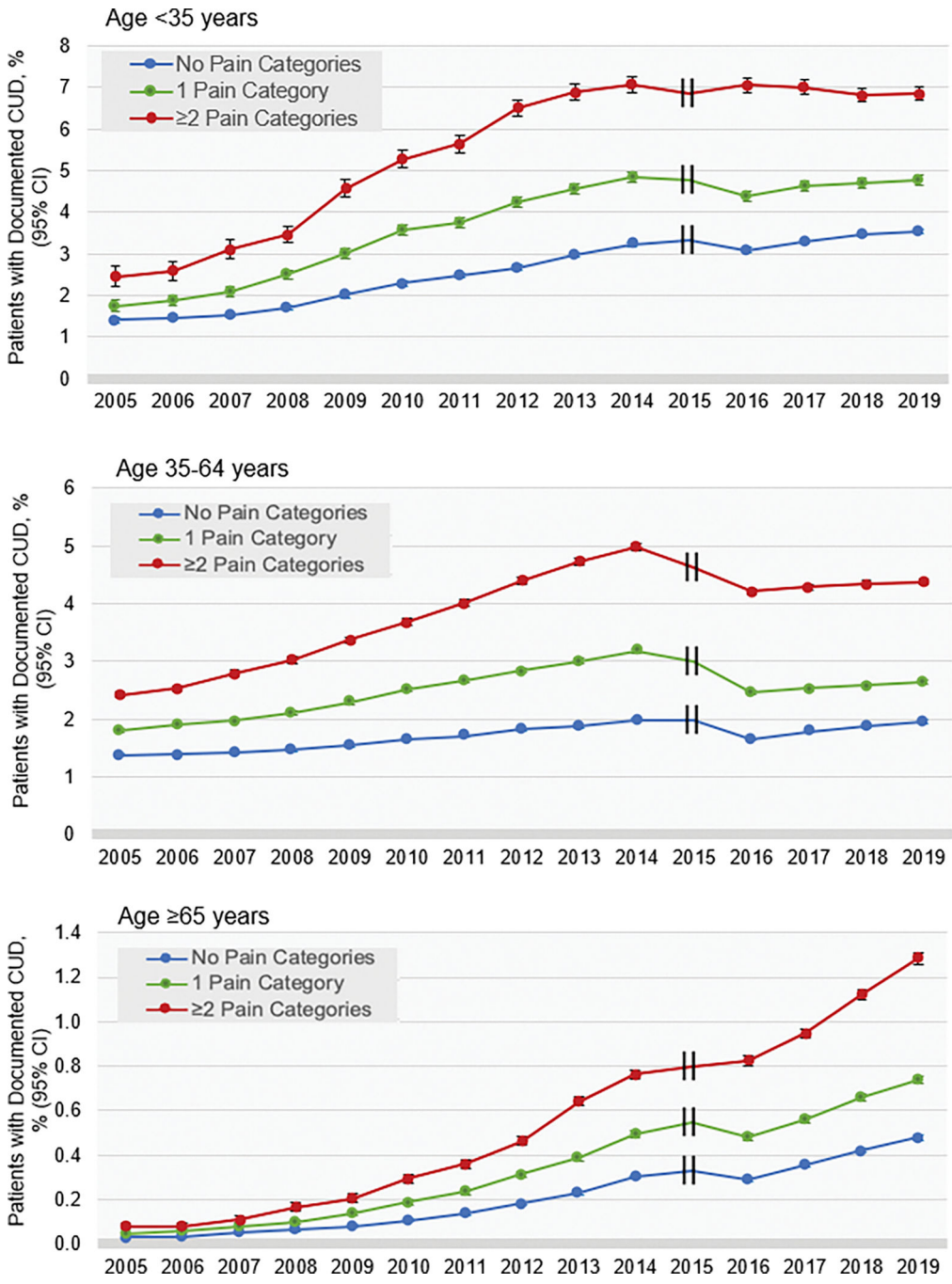

Figure 4.

Age-stratified Trends in CUD by Total Chronic Pain Conditions, 2005–2019

Change in CUD prevalence from 2005–2019 among people with 0,1, or ≥2 chronic pain diagnoses. Hatch marks at 2015 indicate that predicted diagnostic prevalence of CUD is an aggregate across some patients coded with ICD-9-CM and others with ICD-10-CM due to change in ICD coding mid-year. Models included study year, pain category count, year X pain count, sex, and race/ ethnicity.

Table 1.

Overall Change in the Predicted Diagnostic Prevalence of CUD by Any Chronic Pain Condition in VHA patients, 2005–2019

	Predicted Prevalence of ICD-9-CM CUD diagnoses, 2005–2014			Predicted Prevalence of ICD-10-CM CUD diagnoses, 2016–2019		
	2005 % (95% CI)	**2014 % (95% CI)**	**Change (95% CI)**	**2016 % (95% CI)**	**2019 % (95% CI)**	**Change (95% CI)**
Overall						
No Pain	0.70 (0.69–0.71)	1.26 (1.25–1.28)	0.56 (0.54–0.58)	1.12 (1.11– 1.13)	1.36 (1.35– 1.38)	0.24 (0.22–0.26)
Any Chronic Pain	1.11 (1.09–1.13)	2.54 (2.54–2.58)	1.45 (1.43–1.47)	2.22 (2.21–2.24)	2.53 (2.51–2.55)	0.31 (0.28–0.33)
Difference	0.41 (0.39–0.42)	1.30 (1.27–1.32)	**0.89 (0.86–0.92)**	1.11 (1.09–1.13)	1.17 (1.15–1.19)	**0.06 (0.03–0.10)**

Models include year, chronic pain, year X chronic pain, sex, race/ethnicity, and categorical age. Statistical significance indicated by positive difference in differences and confidence intervals that did not include 0. Bolded values indicate statistically significant differences between those with chronic pain versus those without chronic pain.

Table 2.

Overall Change in the Predicted Diagnostic Prevalence of CUD by Total Chronic Pain Conditions in VHA patients, 2005–2019

	Predicted Prevalence of ICD-9-CM CUD diagnoses, 2005–2014			Predicted Prevalence of ICD-10-CM CUD diagnoses, 2016–2019		
	2005 % (95% CI)	**2014 % (95% CI)**	**Change (95% CI)**	**2016 % (95% CI)**	**2019 % (95% CI)**	**Change (95% CI)**
Overall						
No Pain	0.72 (0.71–0.73)	1.29 (1.28–1.30)	0.57 (0.55–0.59)	1.14 (1.12–1.15)	1.38 (1.37–1.39)	0.24 (0.22–0.26)
1 Pain Condition	0.98 (0.96–1.00)	2.06 (2.04–2.08)	1.08 (1.05–1.11)	1.71 (1.69–1.73)	1.93 (1.90–1.95)	0.21 (0.18–0.25)
≥2 Pain Conditions	1.38 (1.35–1.41)	3.21 (3.18–3.24)	1.83 (1.78–1.87)	2.88 (2.85–2.91)	3.14 (3.11–3.17)	0.26 (0.22–0.30)
Difference						
1 Pain Condition vs None			**0.51 (0.47–0.54)**			−0.03 (−0.06–0.01)
≥2 Pain Conditions vs None			**1.26 (1.21–1.30)**			0.02 (−0.03–0.06)
≥2 Pain Conditions vs One			**0.75 (0.69–0.80)**			0.05 (0.00–0.10)

Models include year, chronic pain, year X chronic pain, sex, race/ethnicity and categorical age. Statistical significance indicated by positive difference in differences and confidence intervals that did not include 0. Bolded values indicate statistically significant differences between those with chronic pain versus those without chronic pain.

Table 3.

Age-stratified Change in the Predicted Diagnostic Prevalence of CUD by Chronic Pain Condition in VHA patients, 2005–2019

	Predicted Prevalence of ICD-9-CM CUD diagnoses, 2005–2014			Predicted Prevalence of ICD-10-CM CUD diagnoses, 2016–2019		
	2005 % (95% CI)	**2014 % (95% CI)**	**Change (95% CI)**	**2016 % (95% CI)**	**2019 % (95% CI)**	**Change (95% CI)**
Age <35 years						
No Pain	1.41 (1.34–1.47)	3.19 (3.12–3.24)	1.78 (1.68–1.87)	3.05 (2.99–3.11)	3.51 (3.43–3.57)	0.46 (0.36–0.55)
Any Chronic Pain	1.93 (1.82–2.04)	5.71 (5.60–5.81)	3.78 (3.63–3.93)	5.44 (5.34–5.54)	5.70 (5.60–5.79)	0.26 (0.12–0.39)
Difference	0.52 (0.39–0.65)	2.52 (2.40–2.64)	**2.00 (1.83–2.18)**	2.39 (2.28–2.51)	2.19 (2.07–2.31)	**−0.20 (−0.36- −0.03)**
35–64 years						
No Pain	1.36 (1.33–1.38)	1.95 (1.92–1.97)	0.59 (0.56–0.63)	1.62 (1.60–1.64)	1.92 (1.90–1.95)	0.30 (0.27–0.34)
Any Chronic Pain	2.03 (2.00–2.06)	4.01 (3.97–4.04)	1.98 (1.93–2.02)	3.27 (3.23–3.30)	3.55 (3.51–3.58)	0.28 (0.23–0.32)
Difference	0.67 (0.64–0.71)	2.06 (2.01–2.10)	**1.38 (1.33–1.44)**	1.65 (1.61–1.69)	1.62 (1.58–1.66)	−0.02 (−0.08–0.03)
≥65 years						
No Pain	0.03 (0.03–0.03)	0.29 (0.28–0.30)	0.26 (0.26–0.27)	0.28 (0.28–0.29)	0.47 (0.46–0.48)	0.19 (0.17–0.20)
Any Chronic Pain	0.05 (0.05–0.06)	0.61 (0.59–0.62)	0.55 (0.54–0.57)	0.63 (0.61–0.64)	1.01 (0.99-–1.02)	0.38 (0.36–0.40)
Difference	0.02 (0.02–0.03)	0.31 (0.30–0.33)	**0.29 (0.27–0.30)**	0.34 (0.33–0.36)	0.53 (0.51–0.55)	**0.19 (0.17–0.22)**

Models include year, chronic pain condition, year X chronic pain condition, sex, and race/ethnicity. Statistical significance indicated by positive difference in differences and confidence intervals that did not include 0. Bolded values indicate statistically significant differences between those with chronic pain versus those without chronic pain.

Table 4.

Age-stratified Change in the Predicted Diagnostic Prevalence of CUD by Total Chronic Pain Conditions in VHA patients, 2005–2019

	Predicted Prevalence of ICD-9-CM CUD diagnoses, 2005–2014			Predicted Prevalence of ICD-10-CM CUD diagnoses, 2016–2019		
	2005 % (95% CI)	**2014 % (95% CI)**	**Change (95% CI)**	**2016 % (95% CI)**	**2019 % (95% CI)**	**Change (95% CI)**
Age <35 years						
No Pain	1.41 (1.34–1.47)	3.23 (3.16–3.29)	1.82 (1.73–1.91)	3.09 (3.03–3.15)	3.54 (3.47–3.61)	0.45 (0.35–0.54)
1 Pain Condition	1.75 (1.63–1.88)	4.85 (4.72–4.97)	3.09 (2.91–3.27)	4.40 (4.28–4.51)	4.79 (4.67–4.92)	0.40 (0.23–0.57)
≥2 Pain Conditions	2.45 (2.21–2.70)	7.07 (6.89–7.25)	4.61 (4.31–4.92)	7.05 (6.88–7.23)	6.85 (6.69–7.01)	−0.21 (−0.44 –0.03)
Differences						
1 Condition vs None			**1.27 (1.08–1.47)**			−0.05 (−0.24–0.14)
≥2 Conditions vs None			**2.80 (2.48–3.11)**			**−0.65 (−0.90- -0.40)**
≥2 Conditions vs One			**1.52 (1.17–1.87)**			**−0.60 (−0.89- -0.31)**
35–64 years						
No Pain	1.38 (1.36–1.40)	1.99 (1.96–2.02)	0.61 (0.58–0.65)	1.65 (1.63–1.67)	1.95 (1.93–1.98)	0.30 (0.27–0.34)
1 Pain Condition	1.81 (1.78–1.85)	3.18 (3.13–3.22)	1.37 (1.31–1.42)	2.47 (2.43–2.51)	2.64 (2.60–2.68)	0.17 (0.12–0.23)
≥2 Pain Conditions	2.42 (2.37–2.48)	4.99 (4.93–5.05)	2.57 (2.48–2.65)	4.21 (4.15–4.26)	4.38 (4.33–4.43)	0.17 (0.10–0.25)
Differences						
1 Condition vs None			**0.75 (0.69–0.82)**			**−0.13 (−0.20- −0.06)**
≥2 Conditions vs None			**1.96 (1.87–2.04)**			**−0.13 (−0.21- −0.05)**
≥2 Conditions vs One			**1.20 (1.10–1.30)**			0.00 (−0.09– 0.09)
≥65 years						
No Pain	0.03 (0.03–0.03)	0.30 (0.29–0.31)	0.27 (0.26–0.28)	0.29 (0.28–0.30)	0.48 (0.47–0.49)	0.19 (0.17–0.20)
1 Pain Condition	0.04 (0.04–0.05)	0.49 (0.48–0.51)	0.45 (0.44–0.47)	0.48 (0.47–0.50)	0.74 (0.72–0.76)	0.26 (0.23–0.28)
≥2 Pain Conditions	0.08 (0.07–0.09)	0.76 (0.74–0.78)	0.68 (0.66–0.71)	0.82 (0.80–0.85)	1.28 (1.26–1.31)	0.46 (0.43–0.49)
Differences						
1 Conditions vs None			**0.18 (0.16–0.20)**			**0.07 (0.04–0.10)**
≥2 Conditions vs None			**0.41 (0.38–0.44)**			**0.27 (0.24–0.31)**
≥2 Conditions vs One			**0.23 (0.20–0.26)**			**0.20 (0.16–0.25)**

Models include year, chronic pain condition, year X chronic pain condition, sex, and race/ethnicity. Statistical significance indicated by positive difference in differences and confidence intervals that did not include 0. Bolded values indicate statistically significant differences between those with chronic pain versus those without chronic pain.