

# Comprehensive analysis of cannabis use and dependence in the setting of total abdominal hysterectomy

Dr. Dalia Rahmon

[drahmon1@hfhs.org](mailto:drahmon1@hfhs.org)

Henry Ford Hospital

**Diana Mansour**

Oakland University

**Megan Guiles**

Oakland University

**Emilia Rodriguez Espinoza**

Oakland University

**Dr. Inaya Hajj Hussein**

Oakland University

**Dr. Lena Carr**

Henry Ford Hospital

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## Research Article

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# Abstract

## Background

Widespread legalization of cannabis has been associated with an increased prevalence of cannabis use and dependence (CUD) among surgical patients. This study examines the demographic characteristics, comorbidities, and inpatient outcomes of patients with CUD undergoing total abdominal hysterectomy (TAH).

## Methods

retrospective cohort study utilized the National Inpatient Sample (2016–2021) to identify patients undergoing TAH. Patients were stratified into CUD and non-CUD cohorts. Demographics, comorbidities, in-hospital complications, and economic outcomes were compared using *t*-tests and chi-square analyses. Propensity score matching was performed to assess postoperative complications.

## Results

Among 557,055 TAH procedures, 0.50% involved patients with CUD. Compared with non-CUD patients, those with CUD were younger (49 vs. 53 years), more often Black (38.7% vs. 23.8%) or Native American (0.5% vs. 0.4%), and more frequently insured by Medicaid (43.1% vs. 15.2%). Patients with CUD experienced longer hospitalizations (4.6 vs. 3.5 days) and higher total charges (\$72,078 vs. \$62,610). They also had higher rates of comorbid substance use, including alcoholism (7.3% vs. 0.5%), opioid use disorder (3.4% vs. 0.2%), and tobacco use disorder (50.8% vs. 9.7%), as well as anxiety (23.9% vs. 11.5%), depression (16.6% vs. 8.8%). After propensity score matching, CUD was not associated with increased risk of postoperative complications.

## Conclusion

As cannabis use rises, understanding the demographic and clinical profile of surgical patients with CUD is increasingly important. Recognition of CUD in patients undergoing hysterectomy may support more individualized perioperative planning, equitable screening practices, and optimized pain management strategies.

## Introduction

Approximately 22% of the United States population uses cannabis, making it the most commonly used illicit drug in the country and worldwide.<sup>1,2</sup> Widespread legalization for recreational and medical use has

contributed to increasing rates of cannabis use and dependence (CUD), particularly among surgical patients, in whom a threefold increase has been observed in recent years.<sup>3</sup>

Cannabis contains multiple active compounds, most notably delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD), which exert physiologic effects through the endocannabinoid system.<sup>4</sup> These compounds have demonstrated potential in modulating nociceptive and inflammatory pathways,<sup>5</sup> and are therefore frequently used in pain management. However, the interaction between cannabis use and postoperative pain control remains incompletely understood, with existing studies yielding conflicting results. Emerging evidence suggests that CUD may be associated with higher postoperative pain scores and increased opioid requirements following major surgery<sup>6-9</sup>, though data specific to gynecologic surgery are limited.

Hysterectomy is among the most frequently performed surgical procedures worldwide, with common indications including abnormal uterine bleeding, leiomyomata, adenomyosis, endometriosis, and gynecologic malignancy.<sup>10</sup> It may be performed using abdominal or minimally invasive approaches, and its prevalence has been associated with increasing age, higher body mass index, Black race, and tobacco use.<sup>11</sup>

As cannabis decriminalization and social acceptance have increased patient disclosure, understanding the impact of CUD on postoperative outcomes following hysterectomy has become increasingly important. While prior studies have broadly examined substance use in surgical populations, large-scale, population-based research focused specifically on CUD in gynecologic surgery remains limited. Therefore, this study aims to evaluate epidemiologic trends, demographic characteristics, comorbidities, and immediate clinical and economic outcomes among patients with CUD undergoing total abdominal hysterectomy (TAH).

## Methods

This retrospective cohort study utilized discharge data from the National Inpatient Sample (NIS), the largest publicly available all-payer inpatient database in the United States. The NIS, developed by the Healthcare Cost and Utilization Project (HCUP), provides nationally representative estimates of inpatient utilization, costs, and outcomes.<sup>12</sup> All analyses were evaluated in accordance with recommendations from the Agency for Healthcare Research and Quality (AHRQ).<sup>13</sup>

Patients who underwent TAH between 2016 and 2021 were identified using ICD-10 procedure codes. The study population was divided into patients with and without CUD. CUD was defined using ICD-10-CM codes F12.1, F12.2, and F12.9, representing cannabis abuse, dependence, and unspecified use. Comorbidities and in-hospital complications were identified using corresponding ICD-10 codes. Patients younger than 40 years were excluded to minimize inclusion of atypical indications for hysterectomy and to improve cohort homogeneity. Patients who underwent laparoscopic hysterectomy were also excluded.

Continuous variables were compared using *t*-tests, whereas categorical variables were analyzed using Rao-Scott chi-square tests. Propensity score matching based on age and medical comorbidities was performed to assess postoperative complications.<sup>14</sup> Statistical significance was set at  $P < 0.05$ . All analyses accounted for the complex survey design of the NIS and were conducted using SAS version 9.4. This study used publicly available, de-identified data from the NIS and was determined to be not human subject research according to institutional policy; therefore, IRB review was not required under 45 CFR 46.104(d)(4).

## Results

### Trends in CU by Year

From 2016 to 2021, an estimated 557,055 patients underwent TAH, of whom 0.50% were identified with CUD. Although the total number of TAH procedures decreased by 33.7% during the study period, no significant association was observed between CUD prevalence and year ( $P = 0.906$ ). Annual CUD prevalence remained stable, ranging from 0.51% to 0.53% (Table 1).

Table 1  
Trends in CUD rate per year

Year	CUD (%Rate) (n = 2,805)	Non-CUD (%Rate) (n = 554,250)	<i>P</i> -value
2016	615 (0.53%)	114,500	0.906
2017	540 (0.51%)	104,400	
2018	495 (0.52%)	95,305	
2019	415 (0.46%)	90,270	
2020	350 (0.47%)	73,875	
2021	390 (0.51%)	75,900	

### Demographic Factors

Patients with CUD were significantly younger than those without (mean age 49.4 vs. 53.0 years,  $P < 0.001$ ). While White patients constituted the largest racial group in both cohorts, patients with CUD were more likely to be Black (38.7% vs. 23.8%,  $P < 0.001$ ) or Native American (0.5% vs. 0.4%,  $P < 0.001$ ). CUD patients were also more frequently insured by Medicaid (43.1% vs. 15.2%,  $P < 0.001$ ) or self-pay (8.2% vs. 3.6%,  $P < 0.001$ ) (Table 2).

Table 2  
Demographic factors, stratified by CUD vs. non-CUD

Variable	CUD (n = 2,805)	Non-CUD (n = 554,250)	P-value
Average age of patient (years)			
Mean (standard error)	49.4 (0.34)	53.0 (0.06)	< 0.001
Race*			
White	45.10%	51.19%	< 0.001
Black	38.68%	23.75%	
Hispanic	9.63%	13.78%	
Asian/Pacific Islander	0.36%	4.54%	
Native American	0.53%	0.43%	
Other	1.96%	3.55%	
Primary Payor			
Medicare	13.01%	18.36%	< 0.001
Medicaid	43.14%	15.24%	
Private Insurance/HMO	31.91%	59.43%	
Self-Pay	8.20%	3.56%	
Other	3.74%	3.41%	
*Race was reported as documented in administrative records and may be subject to misclassification.			

## Comorbidities Stratified by CUD

Patients with CUD had substantially higher rates of polysubstance use, including alcohol use disorder (7.3% vs. 0.5%,  $P < 0.001$ ), opioid use disorder (3.4% vs. 0.2%,  $P < 0.001$ ), and tobacco use disorder (50.8% vs. 9.7%,  $P < 0.001$ ). They also demonstrated increased prevalence of anxiety (23.9% vs. 11.5%,  $P < 0.001$ ), depression (16.6% vs. 8.8%,  $P < 0.001$ ), COPD (7.5% vs. 2.6%,  $P < 0.001$ ), hepatitis (2.3% vs. 0.5%,  $P < 0.001$ ), and obesity (26.6% vs. 22.7%,  $P = 0.032$ ). Conversely, CUD was associated with lower prevalence of atrial fibrillation (0.9% vs. 2.2%,  $P = 0.037$ ), diabetes (9.5% vs. 13.3%,  $P = 0.008$ ), and endometrial hyperplasia (3.7% vs. 6.4%,  $P = 0.01$ ), likely reflecting the younger age of this cohort (Table 3).

Table 3  
Comorbidities, stratified by CUD vs. non-CUD

<b>Variables</b>	<b>CUD (n = 2,805)</b>	<b>Non-CUD (n = 554,250)</b>	<b>P-value</b>
Abnormal uterine bleeding	13.90%	12.41%	0.283
Atrial fibrillation	0.89%	2.18%	0.037
Alcoholism	7.31%	0.47%	< 0.001
Anxiety	23.89%	11.48%	< 0.001
Chronic obstructive pulmonary disease	7.49%	2.61%	< 0.001
Depression	16.58%	8.82%	< 0.001
Diabetes mellitus (Type 1 or 2)	9.45%	13.29%	0.008
Endometrial hyperplasia	3.74%	6.39%	0.01
Endometriosis	10.16%	11.71%	0.266
Fibroids	59.00%	57.19%	0.387
Hepatitis	2.32%	0.46%	< 0.001
Hypertension	36.72%	34.71%	0.315
Obesity	26.56%	22.70%	0.032
Opioid use disorder	3.39%	0.24%	< 0.001
Renal disease	3.21%	2.66%	0.413
Tobacco use disorder	50.80%	9.73%	< 0.001

## Complications, Economic, and Discharge Dispositions

Unadjusted analyses showed higher rates of blood transfusion and respiratory complications among patients with CUD; however, these differences were not sustained after propensity score matching (Table 4). Patients with CUD experienced significantly longer hospitalizations (4.6 vs. 3.5 days,  $P < 0.001$ ) and higher total hospital charges (\$72,078 vs. \$62,610,  $P < 0.003$ ). Although discharge disposition differed statistically, the majority of patients in both cohorts were discharged home.

Table 4  
Complications, economic, and disposition outcomes

	CUD (n = 2,805)	Non-CUD (n = 554,250)	P-value
<b>Blood transfusion*</b>	<b>7.66%</b>	<b>7.29%</b>	<b>0.823</b>
Cardiac complications*	1.63%	2.66%	0.207
Genitourinary complications*	2.70%	4.42%	0.117
Ileus / small bowel obstruction*	4.16%	5.43%	0.282
Respiratory complications*	3.12%	4.76%	0.72
Venous thrombotic embolism (VTE)*	0.82%	0.77%	0.915
Length of stay (days)	4.6	3.5	0.001
Total charges (\$)	\$72,078	\$62,610	0.003
Discharge disposition			
Home	90.37%	90.43%	0.006
Rehab	0.53%	0.14%	
Other facility	1.60%	2.67%	
Home health	6.95%	6.50%	
AMA	0.36%	0.06%	
Deceased	0.18%	0.19%	
<i>*Represents weighted analysis</i>			

## Discussion

This study provides a large, nationally representative assessment of CUD among patients undergoing TAH in the United States. Prior research has examined cannabis use in surgical populations, particularly in major abdominal and arthroplasty procedures.<sup>3,15-18</sup> However, to our knowledge, no prior studies have specifically evaluated inpatient trends among gynecologic surgical patients with CUD.

Despite an approximately 33% decline in the overall volume of TAH during the study period, no significant association was observed between CUD prevalence and year. The decline in abdominal hysterectomy volume is consistent with national trends reflecting increased adoption of minimally invasive and robotic-assisted approaches.<sup>19-22</sup> Notably, although national surveys report increasing cannabis use in the general population and among gynecologic patients specifically<sup>23</sup>, the prevalence of CUD in this patient cohort remained stable at approximately 0.5%, comparable to rates reported in other inpatient

studies.<sup>15,16</sup> This discrepancy may reflect underrecognition or underdocumentation of cannabis use by medical providers<sup>24</sup>, highlighting the need for improved screening and documentation practices in surgical populations.

Demographic analyses demonstrated that patients with CUD were significantly younger than those without CUD, consistent with population-based data showing higher rates of cannabis use among younger adults.<sup>25-29</sup> This pattern likely reflects generational differences in social acceptance, evolving legalization policies, and shifting perceptions of risks associated with cannabis use

With respect to race and ethnicity, although White patients comprised the largest proportion of both cohorts, patients with CUD were more likely to be Black or Native American. This finding aligns with prior literature documenting racial and ethnic disparities in substance use diagnoses and documentation.<sup>29-31</sup> One study reported the highest prevalence of CUD among Black and Native American populations, attributing this to higher rates of daily cannabis use<sup>29</sup>, which may increase susceptibility to developing dependence. However, these findings should be interpreted with caution, as CUD diagnosis and reporting may be influenced by clinician implicit bias and variability in documentation practices. Such factors may contribute to the apparent overrepresentation of certain racial groups, rather than reflecting true differences in disease prevalence.

Several factors may contribute to these disparities, including socioeconomic inequities, differential access to healthcare, structural racism, and clinician bias in screening and coding practices. Prior studies suggest that substance use disorders may be more frequently documented among minority populations despite similar prevalence across racial groups, underscoring the need for equitable and standardized screening practices.<sup>24</sup> Additionally, clinician bias may influence not only the diagnosis and documentation, but also access to treatment. For example, despite higher prevalence of CUD among Black patients, this population has been shown to receive treatment less frequently and to report greater unmet treatment needs compared to White patients.<sup>32</sup>

Patients with CUD undergoing TAH were also more likely to have Medicaid coverage or be self-pay. This finding is consistent with prior studies demonstrating higher prevalence of cannabis use among lower-income populations and may partially reflect the younger age of the CUD cohort, as fewer patients qualified for Medicare coverage.<sup>25,33</sup> In addition, cannabis retailers are disproportionately concentrated in lower-income communities, where retailer density has been reported to be up to 2.5 times higher than in higher-income areas.<sup>34,35</sup> Taken together, these findings highlight the importance of targeted public health strategies aimed at improving screening, intervention, and access to treatment resources for socioeconomically disadvantaged populations.

With respect to comorbidity profile, patients with CUD demonstrated higher rates of psychiatric illness, polysubstance use, and select chronic medical conditions. The increased prevalence of anxiety and depression is consistent with extensive literature describing a bidirectional relationship between cannabis use and mental health disorders.<sup>36,37</sup> Cannabis is frequently used as a coping strategy for

psychiatric symptoms, a pattern consistently observed in epidemiologic studies of CUD populations.<sup>38,39</sup> Elevated rates of alcohol, opioid, and tobacco use disorders likely reflect shared behavioral and neurobiological risk factors<sup>37,40</sup>, including impaired inhibitory control and overlapping reward pathways, as well as broader socioeconomic vulnerabilities.

Higher rates of chronic obstructive pulmonary disease and hepatitis among CUD patients may reflect increased inhalational and substance-related exposures<sup>41</sup>, whereas lower prevalence of atrial fibrillation, diabetes, and endometrial hyperplasia likely reflects the younger age of the CUD cohort. These comorbidities are clinically relevant in the perioperative setting, as psychiatric illness, substance use, and physiologic stress have each been associated with impaired postoperative recovery, increased pain, and delayed wound healing.<sup>42-46</sup> This is particularly relevant for patients undergoing hysterectomy, a procedure that can be accompanied by heightened psychological stress, hormonal changes, and shifts in reproductive or gender identity, potentially amplifying vulnerability in patients with preexisting CUD and psychiatric comorbidity.

Although unadjusted analyses demonstrated higher rates of blood transfusion and respiratory complications among patients with CUD, these associations were not sustained after propensity score matching, suggesting that baseline demographic and comorbidity differences accounted for the observed findings. These findings are consistent with prior studies in abdominal surgery populations showing that cannabis use is not independently associated with increased postoperative complication rates.<sup>18,46-48</sup> However, prior work has suggested that while complication incidence may be similar, complication severity may be greater among cannabis users<sup>46</sup>, highlighting an important distinction that warrants further investigation. Future studies should explore how cannabis dosage, chronicity, and patterns of use influence postoperative outcomes across surgical populations.

Despite similar postoperative complication rates, patients with CUD experienced significantly longer hospital stays and higher total hospital charges. While existing literature on length of stay remains mixed, there is consistent evidence linking CUD to increased healthcare utilization and hospital costs.<sup>15,16,49</sup> These differences may reflect higher perioperative resource use, particularly related to pain management, as patients with CUD have been shown to report higher postoperative pain scores<sup>8,50,51</sup> and require greater opioid doses.<sup>6,52</sup> However, one must also recognize hospital charges may not accurately reflect true healthcare costs or reimbursements, as they are influenced by institutional billing practices, regional variation, negotiated payer rates, and accounting practices, rather than actuarial resources utilized during hospitalization. Clinically, these findings highlight the importance of recognizing CUD as a factor influencing perioperative resource needs, individualized pain management strategies, and discharge planning. Although a statistically significant difference in discharge disposition was observed, it is unlikely to be clinically meaningful, as the majority of patients in both cohorts were discharged home.

This study has limitations inherent to large registry-based analyses. The NIS relies on administrative coding, which is subject to misclassification, underreporting, and inconsistent documentation.<sup>53,54</sup> The database also lacks granular clinical details, including cannabis use patterns, laboratory data, and post-discharge outcomes, limiting assessment to immediate inpatient events. As such, this precludes the assessment of post-discharge complications, readmissions, or long-term recovery. Additionally, the analysis was restricted to patients undergoing TAH for benign indications, excluding minimally invasive approaches and malignancy-related procedures, which may limit generalizability to contemporary hysterectomy populations and outpatient surgical settings.

Despite these limitations, this study has notable strengths in both design and scope. To the authors' knowledge, it represents the largest national analysis examining demographic and epidemiologic characteristics of patients with CUD undergoing TAH. The large sample size, extended study period, procedure-specific focus, and use of survey-weighted analyses and propensity score matching strengthen the validity of the findings. Moreover, the use of survey-weighted analyses and propensity score matching allowed for adjustment across a broad range of demographic factors and medical comorbidities, improving the accuracy of postoperative complication comparisons and reducing confounding.<sup>12,14</sup> Collectively, these results may help gynecologists, perioperative teams, and public health professionals better understand the implications of CUD in gynecologic surgery and inform risk stratification, resource allocation, and perioperative care planning.

## Abbreviations

CUD  
cannabis use and dependence  
TAH  
total abdominal hysterectomy  
NIS  
National Inpatient Sample

## Declarations

Ethics approval and consent to participate: Not applicable. IRB review was not required under 45 CFR 46.104(d)(4).

Consent for publication: Not applicable

Availability of data and materials: The datasets generated and analyzed during the current study are available through the National Inpatient Sample (NIS), which is a publicly available inpatient database in the United States. The database can be obtained through the following website: <https://hcup-us.ahrq.gov/db/nation/nis/nisdbdocumentation.jsp>.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: DR conceived the study, developed and executed the study design, and drafted the manuscript. DM managed the data and contributed to manuscript writing and revisions. MG and ERE contributed to writing the manuscript. LC provided substantial edits and critical revisions to the manuscript. IHH served as the principal investigator, oversaw the study design, and provided manuscript revisions. All authors reviewed the manuscript.

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