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September 2025

The Impact of Cannabis Retail Availability on Cannabis and Mental Health Outcomes Among Medicaid Recipients in Washington State

Summary

In November 2012, Washington State voters passed Initiative 502 (I-502), which legalized limited possession, private use, and commercial sales of cannabis for adults. In service of WSIPP's long-term evaluation of I-502, this study explores the relationship between licensed cannabis retail availability in Washington State and healthcare outcomes related to cannabis use disorder (CUD) and mental health disorders, including depression, anxiety, bipolar, and psychotic disorders.

Using claims and encounter data on Medicaid enrollees aged 12-64, we find that residence near a cannabis retailer predicts higher rates of CUD, CUD-related hospitalization, and CUD-related inpatient SUD treatment. Furthermore, we find that retail access predicts higher rates of co-occurring CUD and mental health disorder diagnoses. Last, we find that retail access predicts an increase in the probability of having a mental health disorder diagnosis following a CUD diagnosis. Evidence suggests that impacts are generally largest in neighborhoods with multiple active retailers nearby.

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In November 2012, Washington State voters passed Initiative 502 (I-502), which legalized limited possession, private use, and commercial sales of cannabis for adults.[1] The law also directed the Washington State Institute for Public Policy (WSIPP) to conduct benefit-cost evaluations of the implementation of I-502 by examining outcomes related to public health, public safety, substance use, the criminal justice system, economic impacts, and administrative costs and revenues.[2] The final evaluation will be published in 2032—the full legislative requirements for this assignment are displayed in Exhibit 1.

We have previously published several reports covering an array of relevant topics,[3] and in the intervening years, we will continue to examine how facets of I-502 impact relevant outcomes. In this report, we explore the relationship between cannabis retail access and healthcare utilization related to cannabis use disorder (CUD) and mental health disorders. This report will ultimately contribute to the foundation needed to conduct a more comprehensive benefit-cost evaluation in the future.

In Section I, we describe relevant background information and literature. In Section II, we describe our data and methodology. In Section III, we present our results. In Section IV, we discuss our findings and the limitations of the study.

[1] Initiative Measure No. 502.
[2] RCW 69.50.550.
[3] Previous reports can be found on WSIPP's publications page.

Exhibit 1

Legislative Assignment

*(1) The Washington state institute for public policy shall conduct **cost-benefit evaluations** of the implementation of chapter 3, Laws of 2013. A preliminary report, and recommendations to appropriate committees of the legislature, shall be made by September 1, 2015, and the first final report with recommendations by September 1, 2017. Subsequent reports shall be due September 1, 2022, and September 1, 2032.*

(2) The evaluation of the implementation of chapter 3, Laws of 2013 shall include, but not necessarily be limited to, consideration of the following factors:

*(a) **Public health,** to include but not be limited to:*

(i) Health costs associated with marijuana use;

(ii) Health costs associated with criminal prohibition of marijuana, including lack of product safety or quality control regulations and the relegation of marijuana to the same illegal market as potentially more dangerous substances; and

(iii) The impact of increased investment in the research, evaluation, education, prevention and intervention programs, practices, and campaigns identified in RCW 69.50.363 on rates of marijuana-related maladaptive substance use and diagnosis of marijuana-related substance-use disorder, substance abuse, or substance dependence, as these terms are defined in the Diagnostic and Statistical Manual of Mental Disorders;

*(b) **Public safety,** to include but not be limited to:*

(i) Public safety issues relating to marijuana use; and

(ii) Public safety issues relating to criminal prohibition of marijuana;

*(c) **Youth and adult rates** of the following:*

(i) Marijuana use;

(ii) Maladaptive use of marijuana; and

(iii) Diagnosis of marijuana-related substance-use disorder, substance abuse, or substance dependence, including primary, secondary, and tertiary choices of substance;

*(d) **Economic impacts** in the private and public sectors, including but not limited to:*

(i) Jobs creation;

(ii) Workplace safety;

(iii) Revenues; and

(iv)Taxes generated for state and local budgets;

*(e) **Criminal justice impacts**, to include but not be limited to:*

(i) Use of public resources like law enforcement officers and equipment, prosecuting attorneys and public defenders, judges and court staff, the Washington state patrol crime lab and identification and criminal history section, jails and prisons, and misdemeanant and felon supervision officers to enforce state criminal laws regarding marijuana; and

(ii) Short and long-term consequences of involvement in the criminal justice system for persons accused of crimes relating to marijuana, their families, and their communities; and

*(f) **State and local** agency administrative costs and revenues*

I. Background

In the years since cannabis legalization in Washington, adult cannabis use has increased, with 30% of adults reporting recent cannabis use in 2021, up from 18% in 2011.[4] This trend is mirrored nationally, with 29% of U.S. adults reporting past-month cannabis use in 2023.[5] With increased cannabis use, there has been a rise in cannabis use disorder (CUD) and CUD-related healthcare services utilization (e.g., emergency department (ED) visits and hospitalizations).[6]

CUD is a behavioral health condition characterized by continued use of cannabis despite distress or impairment in one's life as a result of use.[7]

CUD requires clinical impairment over the past 12 months and encompasses at least two of twelve symptoms, such as social or work impairment due to continued cannabis use, inability to stop using cannabis, increased tolerance, and withdrawal symptoms when one stops using cannabis.

Furthermore, CUD is robustly tied to depression, anxiety, and other mental health disorders.[8] Additionally, elevated risk for psychosis and schizophrenia is tied to specific vulnerable predispositions.[9]

Overall, this evidence suggests that increased CUD can pose a public health problem and a burden on healthcare systems, especially because there are currently no medications approved for the treatment of CUD.

[4] Tobacco and cannabis use dashboard. Washington State Department of Health. Accessed August 20, 2025.
[5] Cannabis and hallucinogen use among adults remained at historic highs in 2023. National Institute on Drug Abuse. Accessed August 27, 2025.
[6] Fink, D.S., Samples, H., Malte, C.A., Olfson, M., Wall, M.M., Alschuler, D.M., . . . Hasin, D.S. (2025). Cannabis legalization and increasing cannabis use in the United States: Data from urine toxicology testing in emergency room patients. *International Journal of Drug Policy*, *138*, 104765 and Smart, R., & Pacula, R.L. (2019). Early evidence of the impact of cannabis legalization on cannabis use, cannabis use disorder, and the use of other substances: Findings from state policy evaluations. *The American Journal of Drug and Alcohol Abuse*, *45*(6), 644-663.
[7] Understanding your risk for cannabis use disorder. US Centers for Disease Control and Prevention. Accessed August 20, 2025.
[8] Cheng, W., Parker, N., Karadag, N., Koch, E., Hindley, G., Icick, R., . . . Andreassen, O.A. (2023). The relationship between cannabis use, schizophrenia, and bipolar disorder: a genetically informed study. *The Lancet Psychiatry*, *10*(6), 441-451; Muñoz-Galán, R., Lana-Lander, I., Coronado, M., Segura, L., & Colom, J. (2023). Association between cannabis use disorder and mental health disorders in the adolescent population: a cohort study. *European Addiction Research*, *29*(5), 344-352; and Petrilli, K., Ofori, S., Hines, L., Taylor, G., Adams, S., & Freeman, T.P. (2022). Association of cannabis potency with mental ill health and addiction: a systematic review. *The Lancet Psychiatry*, *9*(9), 736-750.
[9] Gillespie, N.A., & Kendler, K.S. (2021). Use of genetically informed methods to clarify the nature of the association between cannabis use and risk for schizophrenia. *JAMA Psychiatry*, *78*(5), 467-468. Pourebrahim, S., Ahmad, T., Rottmann, E., Schulze, J., & Scheller, B. (2025). Does cannabis use contribute to schizophrenia? A causation analysis based on epidemiological evidence. *Biomolecules*, *15*(3), 368.

Cannabis Retail

A regulated cannabis retail market is a major component of legalization. It has shaped cannabis-related outcomes—such as reported use, cannabis use disorder, cannabis poisoning, and emergency department visits[10]. A legal market has also impacted the evolution of consumable products, with products with higher concentrations of THC increasingly representing a higher share of the market.[11]

In Washington, evidence suggests that greater retail availability within the state is associated with higher rates of reported adult cannabis use and CUD.[12] Among adolescents, evidence related to retail availability and cannabis use is more mixed, with some studies suggesting that greater availability is associated with higher rates of reported past-month cannabis use and others finding no significant relationship.[13]

Mental Healthcare Utilization

A related burgeoning literature explores the relationship between retail operations and mental healthcare, with most studies focusing on psychosis-related healthcare services.[14] One study found evidence of a positive association between the number of cannabis retailers and rates of psychosis ED visits across all counties in Colorado.[15] Similarly, a study examining adolescents in Northern California found that local policies prohibiting storefront retail were associated with a lower prevalence of psychotic disorders, and greater retail availability near residences was associated with a greater prevalence of psychotic, anxiety, and depressive disorders.[16]

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[10] Walker, M., Carpino, M., Lightfoot, D., Rossi, E., Tang, M., Mann, R., . . . Cusimano, M.D. (2023). The effect of recreational cannabis legalization and commercialization on substance use, mental health, and injury: a systematic review. *Public Health, 221,* 87-96 and Myran, D.T., Roberts, R., Pugliese, M., Taljaard, M., Tanuseputro, P., & Pacula, R.L. (2022). Cantor, N., Silverman, M., Gaudreault, A., Hutton, B., Brown, C., Elton-Marshall, T., . . . Myran, D.T. (2024). The association between physical availability of cannabis retail outlets and frequent cannabis use and related health harms: a systematic review. *The Lancet Regional Health–Americas*, *32*

[11] Carlini, B.H., Garrett, S.B., Matos, P., Nims, L.N., & Kestens, Y. (2024). Identifying policy options to regulate high potency cannabis: A multiple stakeholder concept mapping study in Washington State, USA. *International Journal of Drug Policy*, *123*, 104270.

[12] Everson, E.M., Dilley, J.A., Maher, J.E., & Mack, C.E. (2019). Post-legalization opening of retail cannabis stores and adult cannabis use in Washington State, 2009–2016. *American Journal of Public Health*, *109*(9), 1294-1301.
Rashid, A., & Adams, N. (2023). *Technical report—Licensed cannabis retail access and substance use disorder* (Doc. No. 23-09-3205). Olympia: Washington State Institute for Public Policy.

[13] Firth, C.L., Carlini, B., Dilley, J., Guttmannova, K., & Hajat, A. (2022). Retail cannabis environment and adolescent use: The role of advertising and retailers near home and school. *Health & Place, 75,* 102795; Kerr, D.C., Owen, L.D., Tiberio, S.S., & Dilley, J.A. (2023). Recreational cannabis legalization and proximity to cannabis retailers as risk factors for adolescents' cannabis use. *Prevention Science*, *24*(6), 1058-1067; and Rashid, A. (2023). *Licensed nonmedical cannabis retail access and high school outcomes in Washington State.* (Doc. No. 23-12-3201). Olympia: Washington State Institute for Public Policy.

[14] Cantor et al. (2024).

[15] Wang, G.S., Buttorff, C., Wilks, A., Schwam, D., Tung, G., & Pacula, R.L. (2022). Impact of cannabis legalization on healthcare utilization for psychosis and schizophrenia in Colorado. *International Journal of Drug Policy*, *104*, 103685.

[16] Silver, L.D., Slama, N.E., Dong, H., Padon, A.A., Pacula, R.L., Alexeeff, S.E., . . . Young-Wolff, K.C. (2025). Associations of local cannabis policy and retail availability in Northern California with adverse adolescent mental health outcomes. *Substance Use & Misuse*, *60*(10), 1571-1576.

Current Study

This study expands upon the existing literature and our previous work[17] by examining the relationship between licensed cannabis retail access and CUD and related mental health disorder diagnoses among Medicaid enrollees in Washington State. To our knowledge, this study is the first to examine how proximity to active retailers relates to CUD-related hospitalization and inpatient SUD treatment, and the co-occurrence of CUD and mental health disorders (depression, anxiety, bipolar, and psychotic disorders). We used administrative healthcare claims data for both underage and legal-aged individuals.

Specifically, we compared changes in healthcare outcomes for enrollees who reside in a census tract (i.e., neighborhood) with a retailer nearby to those without nearby access to a cannabis retailer. Our analysis examines the following outcomes: CUD diagnosis, CUD-related hospitalization, CUD-related inpatient SUD treatment, co-occurring CUD and mental health disorder diagnoses, and mental health diagnosis following CUD. In addition, we explored the significance of retail density (i.e., the number of nearby retailers) and examined how results differ across age, sex, and region of residence (rural/urban).

[17] Rashid & Adams (2023).

II. Methodology

In this section, we describe our data and analytic approach.

Data

We obtained Washington State Medicaid claims and encounter data for individuals between the ages of 12 and 64 who were enrolled over the period of January 1, 2012, through December 31, 2023.[18] Data included enrollment year, and inpatient and outpatient claims/encounter records with information about the service year and flags identifying relevant diagnostic codes (e.g., a flag that indicates a diagnostic code for "CUD" was listed on the claim).[19] Enrollee-specific records can be linked over time using a randomly generated unique patient identifier.

Our study sample includes members who are enrolled in Medicaid for at least one year and reside in Washington State.[20] We omit from our primary analysis those who became eligible only through Medicaid expansion in October 2013.[21] We link individual health care outcomes to measures of local retail access using enrollees' residential census tracts and service year.

The final analytic sample includes 853,694 enrollees aged 12-20 and 1,247,304 enrollees aged 21-64. Exhibit 2 presents characteristics of the respective study populations. White (non-Hispanic) and Hispanic are the most reported races.

Measures

Outcomes

The first outcome measure indicates whether any claim filed within the year has a flag indicating CUD (hereafter referred to as "CUD diagnoses"). Note that CUD can be either a primary or non-primary diagnosis; the data provided to us do not allow us to distinguish between the two.

In addition, we specifically identified hospitalization records with a corresponding CUD diagnosis (hereafter referred to as "CUD-related hospitalization"). Note, hospitalization could be for any health condition and may not be related to treatment for CUD. For example, hospitalization can be for an injury where CUD is listed as a secondary diagnosis. Next, we identified cannabis-related substance use disorder (SUD) inpatient/residential treatment (hereafter referred to as "CUD-related SUD inpatient treatment").[22]

[18] Washington State Medicaid claims data are provided by the Department of Social and Health Services, Research and Data Analysis Division, from its Integrated Client Databases (ICDB). ICDB contains administrative data from several state data systems, including the ProviderOne Medicaid data system and the Behavioral Health Data System (BHDS). See Mancuso & Huber (2021) for more details. Medicaid encounter data prior to data governance efforts in 2014 may be less reliable.

[19] *International Classification of Diseases, Ninth Revision* (ICD-9) or *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (ICD-10) diagnostic codes used to define binary diagnostic flags are presented in Supplemental Appendix Exhibit SA1.

[20] Our data include those who receive full and partial Medicaid benefits.

[21] Select outcomes of interest will measure the first time an enrollee receives certain diagnoses within our sample period; therefore, we omit the population that could have *only* entered the sample after Medicaid expansion in Washington State at the end of 2013. The analyses examining the overall prevalence of select outcomes (presented in Appendix Exhibits A3 and A7) are robust to the inclusion of this population. Results from these alternative analyses are presented in Appendix Exhibit SA14.

[22] Our analyses are limited to SUD treatment only indicated in the ProviderOne system after April 2016. The ProviderOne

We also examine outcomes that measure whether any claim is filed listing both a CUD diagnosis and a diagnosis of a psychotic, bipolar, anxiety, or depression disorder (hereafter referred to as "co-occurring diagnoses").[23]

Last, we measure instances where an individual, who has previously received a CUD diagnosis, receives their first mental health disorder diagnosis in our sample period (hereafter referred to as the "index diagnosis").[24]

Exhibit 2

Characteristics of WA State Medicaid Enrollees (2012-2023), by Age Group

	Aged 12-20 (N=853,694)	Aged 21-64 (N=1,247,304)
Female	0.50	0.65
Race		
Asian	0.03	0.03
Black	0.06	0.06
Hispanic	0.40	0.23
Native American	0.07	0.09
Native Hawaiian/ Pacific Islander	0.02	0.02
White	0.38	0.56
Multiple races	0.03	0.03
Age		
12-17	0.72	--
18-20	0.28	--
21-25	--	0.18
26-44	--	0.51
45-64	--	0.31
Rural residency	0.12	0.13

Note:
Racial categories are mutually exclusive. 1% of members report an unknown race.

Exhibit 3 summarizes the probability an outcome measure occurred over the sample period by age group.[25] Overall, outcomes are relatively rare, with 1.7% of the underaged population and 3.8% of the legal-aged population having received a CUD diagnosis. Most outcomes are experienced by less than 1% of the population; for example, only 0.2% of underaged enrollees and 0.7% of legal-aged enrollees experienced a CUD-related hospitalization.

Retail Access

The number of operational retailers in WA has grown over time, from fewer than 50 active retailers in 2014 to more than 450 in 2023. The Washington State Liquor and Cannabis Board provided information about the months and locations where licensed retail cannabis activity occurred. From this, we constructed two measures of retail access.

data on publicly funded SUD treatment prior to April 2016 are incomplete.

[23] This comorbidity measure only captures instances where CUD and a mental health disorder are listed on a claim together, not cases where both conditions exist but are not recorded concurrently.

[24] The index diagnosis is not necessarily the onset of the disorder, just the first time we observe it in the sample.

[25] Trends in outcomes over the study period are depicted in Appendix Exhibits A1 and A2.

Exhibit 3

Healthcare Outcomes for WA State Medicaid Enrollees (2012-2023), by Age Group

	Aged 12-20 (N=853,694)	Aged 21-64 (N=1,247,304)
CUD diagnosis	0.017	0.038
CUD-related hospitalization	0.002	0.007
CUD-related SUD inpatient treatment	0.0013	0.0028
Co-occurring CUD and		
Depression	0.006	0.013
Anxiety	0.005	0.014
Bipolar	0.001	0.006
Psychotic	0.001	0.006
CUD preceding		
Index depression	0.001	0.027
Index anxiety	0.001	0.034
Index bipolar	0.001	0.014
Index psychotic	0.001	0.003

Note:
Data on inpatient treatment covers 2016 to 2023; data on mental health disorder diagnoses cover 2013 to 2023.

Our main measure of retail access was whether an individual resided in a census tract where the average drivetime to the nearest retailer was 10 minutes or less (i.e., *nearby*).[26] Exhibit 4 maps census tracts with an average 10-minute drivetime to an operational retailer—47% of rural census tracts and 71% of urban census tracts have a nearby retailer.

Overall, 73% of enrollees resided in a census tract with an operational retailer within a 10-minute drive time. Our second measure of access focused on retail density. Specifically, we measure the *number* of active licensed retailers within a 10-minute average drive time. Census tracts were categorized based on whether there were zero (27% of tracts), one (19%), two (10%), or three or more active retailers (44%) within a 10-minute drivetime for the average local resident.

Analytic Approach

To measure the impact of retail cannabis access on healthcare outcomes, we compare changes in outcomes for Medicaid members living in areas with a cannabis retailer nearby (within a 10-minute drive) to those living in areas without a retailer, before and after the store opens (i.e., difference-in-differences model).

Our models account for individual-level characteristics, including race, sex, age, enrollment duration, and whether they are eligible for Medicaid through disability. Our model also accounts for annual census tract population and unemployment rate.[27]

[26] We explore other thresholds, including 5-minute and 20-minute drivetimes (Supplemental Appendix Exhibits SA15-SA16). Details about how we calculated drivetimes are available in the Appendix Section I.

[27] We estimate an OLS regression model including county and year fixed effects. We estimate standard errors adjusted for clustering at the census tract level.

In this study, we want to examine whether opening cannabis retail stores leads to more people using healthcare services for disordered cannabis use. However, the challenge is that stores might open in neighborhoods where cannabis use was already on the rise. If that is the case, it would be hard to know whether the increase in healthcare use was caused by retail access or was happening anyway.

To examine this, we look at patterns in healthcare use in the years **before** the stores opened, comparing neighborhoods that eventually got stores with those that did not. This approach, called an *event study model*, helps us see whether the two groups were already on different paths before retail sales began.[28]

We conduct all analyses separately for individuals aged 12-20 and those aged 21-64. In addition, we conduct subgroup analyses by sex, age group, race/ethnicity, and region.

Sensitivity Analysis

We examine the sensitivity of our results to several alternative modeling strategies. First, we estimate select results using a study period that ends in 2019, omitting information coinciding with and following the COVID-19 pandemic. Second, to ensure results are not driven by the transition from the Integrated Client Database (ICD)-9 to ICD-10 diagnostic codes, we estimate results excluding information from the period before the transition on October 1, 2015. Last, we examine the sensitivity of our results to alternative drivetime thresholds, specifically, within a 5- and a 20-minute drivetime.[29]

Exhibit 4

Census Tract with an Active Cannabis Retailer within 10-Minute Average Drivetime (2023)

Note:
Hatched lines indicate the tract is missing residential information.

[28] More details about these models are provided in Appendix Section II.

[29] As an additional sensitivity check, we implement an alternative estimator proposed by Callaway and Sant'Anna (2021) that relaxes the typical assumption of panel fixed effects estimates that policy effects are constant over time and do not depend on the timing of retail openings. Callaway, B., & Sant'Anna, P.H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, *225*(2), 200-230.

III. Results

In this section, we describe our results. First, we present results for measures of CUD-related healthcare service utilization. Second, we present results related to mental health disorder diagnoses. Importantly, these findings are specific to the Medicaid insured population and cannot be generalized to draw conclusions for the overall population.

Cannabis Use Disorder

CUD Diagnosis

Exhibit 5 depicts the average probability of receiving a CUD diagnosis for enrollees who reside within a 10-minute average drivetime from a retailer and those who do not, as predicted by our model. Among enrollees aged 12-20, living near a retailer statistically significantly predicts a 13% higher likelihood of receiving a CUD diagnosis relative to those who do not (i.e., a predicted probability of 1.8% versus 1.6%).[30] This translates to roughly 2,900 more cases annually. Among enrollees aged 21-64, residing near a retailer statistically significantly predicts a 7% higher likelihood of receiving a CUD diagnosis—about 12,500 more cases annually.

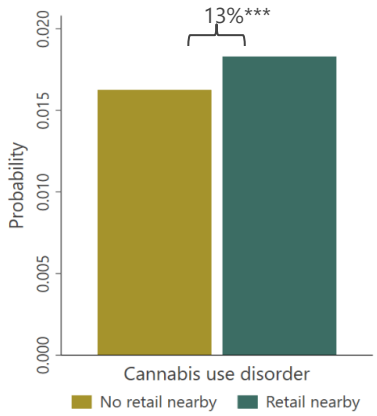
Exhibit 6 shows the results from our event study model. Each dot marks the average difference in the likelihood of having a CUD diagnosis between people living near a retailer and those who do not. The corresponding vertical lines show the range of uncertainty around each estimate. If a line crosses zero, it means the difference is not statistically significant.

The horizontal axis shows the years before and after the first retailer opened in a census tract—for example, "-1" is the year before a store opened, and "0" is the year it opened.

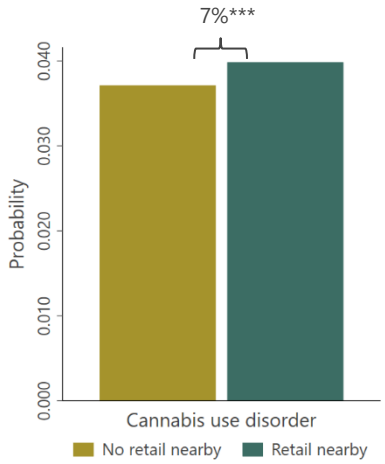
Exhibit 5

Predicted Probability of CUD Diagnosis, by Retail Access and Age Group

a) Aged 12-20



b) Aged 21-64



Notes:
***Significant at the 0.001-level.
The study period covers January 2012 to December 2023.
Full results from these analyses are summarized in Appendix Exhibit A3.

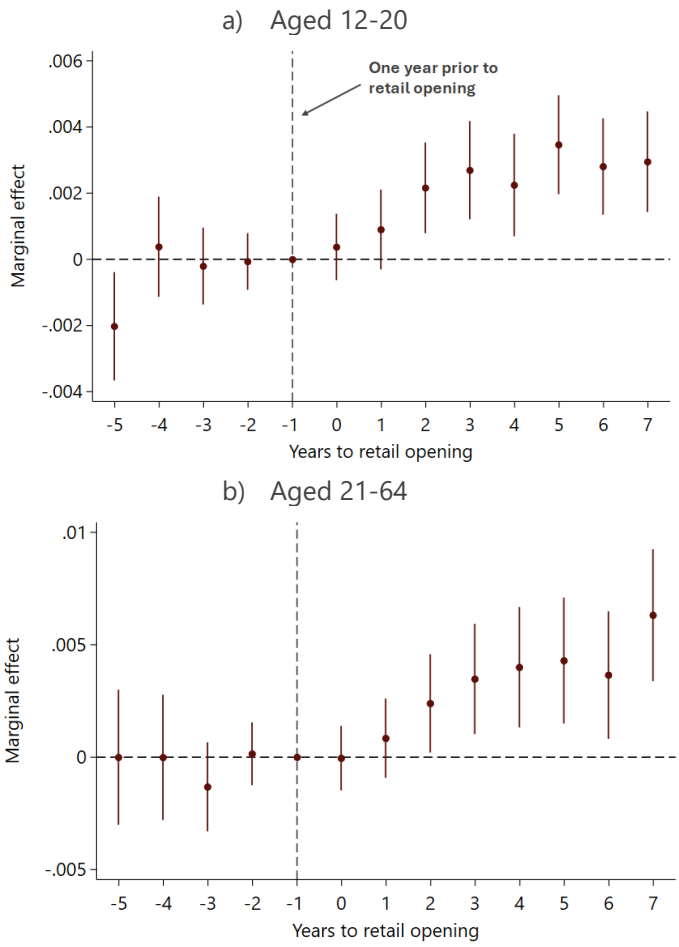
[30] Full results from these analyses are found in Appendix Exhibit A3.

The results in Exhibit 6 show that in the years before retail operations commenced, Medicaid enrollees who eventually lived near a retailer and those who never lived near one had very similar rates of CUD. However, after a retailer opened, the two groups started to look different, with the likelihood of having a CUD diagnosis increasing for people living near a retailer. These patterns suggest that differential increases in the probability of CUD diagnosis are likely observed only *after* retail operations commenced.

Retail Density. Next, we evaluate the relationship between retail density and CUD diagnosis. Specifically, we examine the impact of operating one, two, or three or more retailers near a neighborhood relative to zero retailers. The results from these analyses are summarized in Exhibit 7. Our findings indicate that the impact of retail access on CUD diagnoses is largest among those living near three or more retailers.

Exhibit 6

Cannabis Retail Openings and CUD, by Age Group

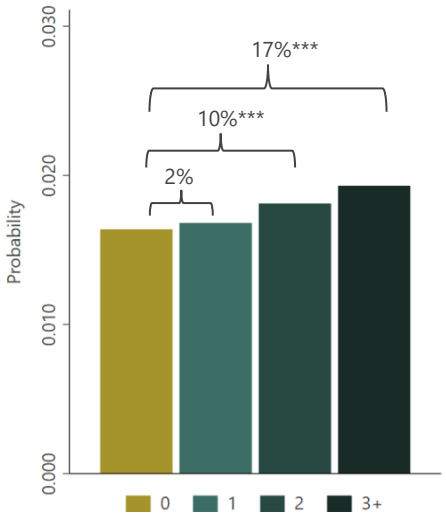


Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

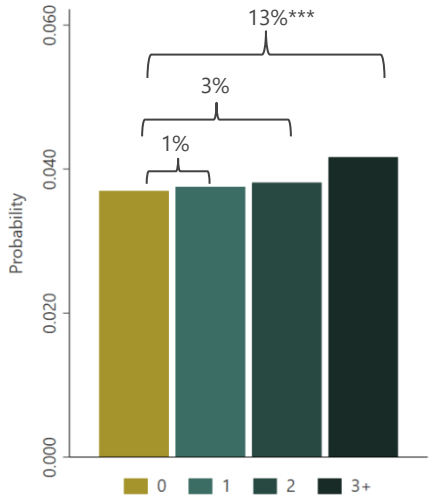
Exhibit 7

Predicted Probability of CUD Diagnosis, by Number of Active Nearby Retailers and Age Group

a) Aged 12-20



b) Aged 21-64



Notes:
***Significant at the 0.001-level.
The study period covers January 2012 to December 2023.
Full results from these analyses are summarized in Appendix Exhibit A4.

In our sample, almost half of enrollees reside in a census tract with three or more retailers in operation within a 10-minute drive time.

CUD-Related Hospitalization

Exhibit 8 depicts the average probability of a CUD-related hospitalization for enrollees who reside within a 10-minute average drivetime from a retailer and those who do not, as predicted by our model. In census tracts with a nearby retailer, legal-aged members were 7% more likely to experience CUD-related hospitalization compared to those without local retail access nearby. We do not find a statistically significant relationship between retail access and CUD-related hospitalization among those aged 12-20.

CUD-Related Inpatient SUD Treatment

Exhibit 9 depicts the average probability of CUD-related inpatient SUD treatment for enrollees who reside within a 10-minute average drivetime from a retailer and those who do not, as predicted by our model. Those aged 21-64 who reside in a neighborhood near a retailer after the retailer opens are 24% more likely to experience CUD-related inpatient SUD treatment compared to those who do not live near an active retailer—this translates to roughly 1,500 more cases per year. We do not find a statistically significant relationship between retail access and CUD-related inpatient treatment among those aged 12-20.[31]

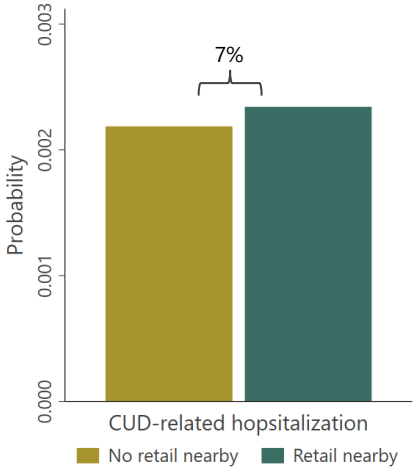
[31] Results from our event study analyses for CUD-related healthcare outcomes are depicted in Appendix Exhibits A5-A6.

Retail Density. We also examine the relationship between retail density and both CUD-related hospitalization and inpatient SUD treatment. The results of these analyses are presented in Appendix Exhibit A4. Like before, results indicate that the relationship between retail access and CUD-related healthcare service utilization is largest among those living near three or more retailers.

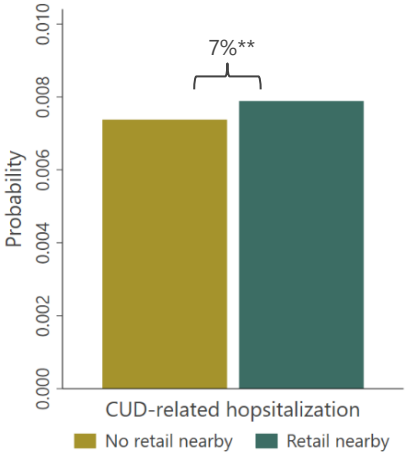
Exhibit 8

Predicted Probability of CUD-Related Hospitalization, by Retail Access and Age Group

a) Aged 12-20



b) Aged 21-64



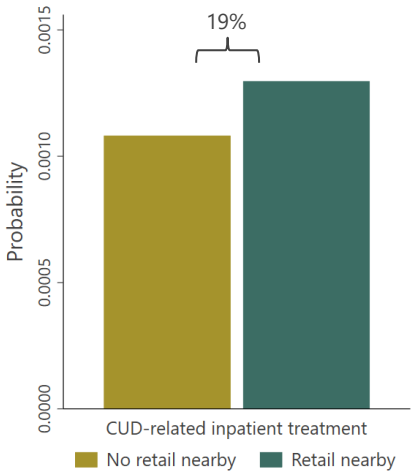
Notes:
**Significant at the 0.005-level.
The study period covers January 2012 to December 2023.

Full results from these analyses are summarized in Appendix Exhibit A3.

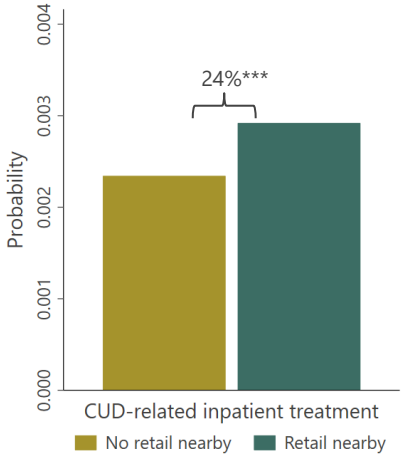
Exhibit 9

Predicted Probability of CUD-Related Inpatient SUD Treatment, by Retail Access Age Group

a) Aged 12-20



b) Aged 21-64



Notes:
***Significant at the 0.001-level.
The study period covers January 2016 to December 2023.
Full results from these analyses are summarized in Appendix Exhibit A3.

Mental Health Conditions

In this section, we examine the relationship between retail access and patterns of co-occurring or sequential CUD and mental health disorders.

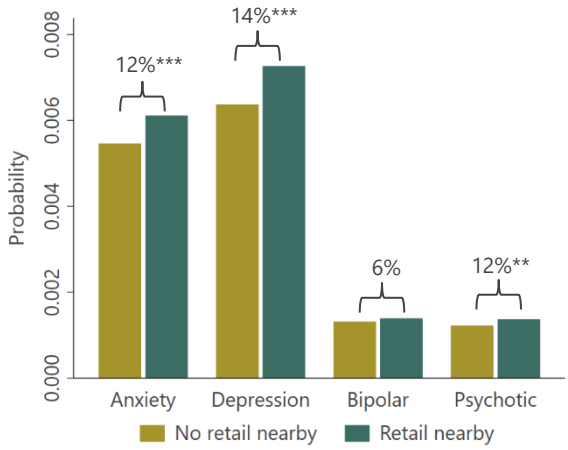
Co-Occurring CUD and Mental Health Disorder Diagnoses

Exhibit 10 depicts the predicted likelihood of receiving a concurrent CUD and a mental health disorder diagnosis. Among enrollees aged 12-20, those who live near an active retailer have a 12%-14% higher likelihood of CUD co-occurring with depression, anxiety, and psychotic disorders relative to enrollees who do not live near an active retailer. Among enrollees aged 21-64, those who live near an active retailer have a roughly 10-20% higher likelihood of CUD co-occurring with depression, anxiety, bipolar, and psychotic disorders relative to enrollees who do not live near an active retailer. [32]

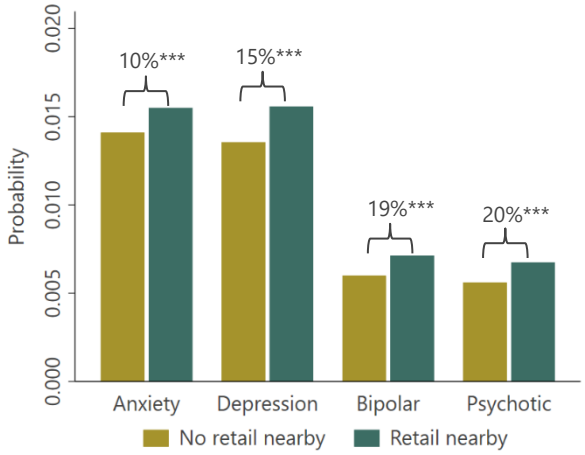
Exhibit 10

Co-Occurring CUD and Mental Health Disorder Diagnoses, by Retail Access and Age Group

c) Aged 12-20



d) Aged 21-64



Notes:
Significant at the ***0.001-level and the **0.05-level.
The study period covers January 2013 to December 2023.
Full results from these analyses are summarized in Appendix Exhibit A7.

[32] Results from our event study analyses for CUD-related healthcare outcomes are depicted in Appendix Exhibits A9-A10.

Index Mental Health Disorder Diagnosis Following CUD

Exhibit 11 shows the predicted likelihood of being diagnosed with a mental health disorder for the first time during our sample period, among people who had already been diagnosed with CUD (i.e., index diagnosis). Among enrollees aged 12-20, retail access relates to a roughly 10-23% higher likelihood of an index diagnosis for depression, anxiety, bipolar, or psychotic disorders following CUD. Findings are similar among legal-aged adults.

For adults of legal age, event study analyses (Appendix Exhibits A11 and A12) support that index mental health disorder diagnoses likely increased in neighborhoods only after retail stores opened nearby, compared to areas without retailers. For underage populations, the evidence is less clear.

While we do see a significant link between retail access and mental health outcomes among youth and young adults, it is possible that these outcomes were already on the rise in those neighborhoods before retailers opened.

Retail Density. Last, we examine the relationship between retail density and mental health outcomes (Appendix Exhibits A13 and A14). Results indicate that the largest impacts are experienced in neighborhoods within proximity to more than one active retailer.

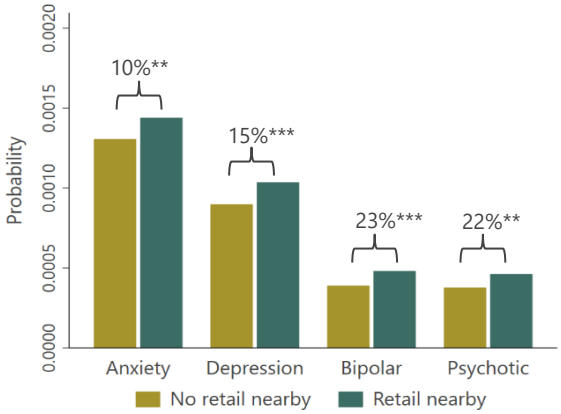
Subgroup Analyses

In analyses not presented here, we examine whether the relationship between cannabis retail access and healthcare outcomes differs across individual demographic characteristics. The full results can be found in Supplemental Appendix Exhibits SA2 and SA13. In this section, we summarize key takeaways.

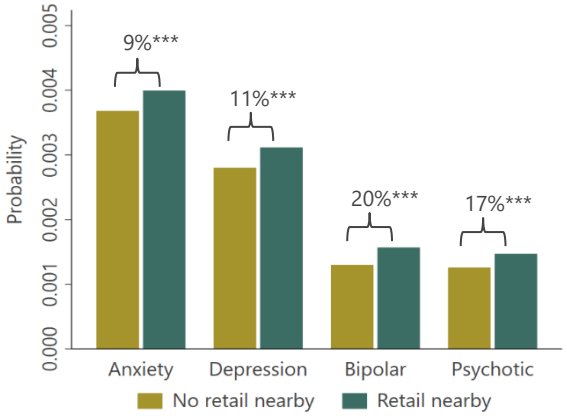
Exhibit 11

Index Mental Health Disorder Diagnosis Following CUD, by Retail Access and Age Group

a) Aged 12-20



b) Aged 21-64



Notes:
***Significant at the 0.001-level and **significant at the 0.05-level.
The study period covers January 2013 to December 2023.
Full results from these analyses are summarized in Appendix Exhibit A8.

The relationship between retail access and healthcare outcome measures is largely driven by residence in urban neighborhoods. Note, only about 4% of residents in rural neighborhoods live within a 10-minute drivetime of *more than one* active retailer as opposed to 58% of those residing in an urban neighborhood.

By race, statistically significant associations between retail access and healthcare outcomes are concentrated among Hispanic and White enrollees, with the largest impacts typically experienced among Hispanic enrollees. Retail access is significantly associated with higher rates of CUD and mental healthcare outcomes for both sexes, though impacts are generally larger among female enrollees.

Sensitivity Analyses

The full results of our sensitivity analyses can be found in Supplemental Appendix Exhibits SA15 and SA20. In this section, we summarize key takeaways.

Our results remain consistent if we leave out the years affected by the COVID-19 pandemic. They are also consistent if we exclude years during which the ICD-9 diagnostic codes were in use.

The impact of retail access is generally larger when defined as a 5-minute average drivetime to the nearest retailer (as opposed to 10 minutes). Residence within a 20-minute drivetime to the nearest retailer generally does not have a significant relationship with our healthcare measures. About 55% of enrollees reside within a 5-minute drivetime to an operational retailer, and 83% reside within a 20-minute drivetime to an operational retailer.

VI. Discussion

Our analyses indicate that, on average, residence near an active cannabis retailer predicts higher prevalence of the following healthcare outcomes: CUD diagnoses, CUD-related hospitalization, CUD-related inpatient SUD treatment, co-occurring CUD and mental health disorder, and mental health disorder diagnoses following CUD. The literature would support that these increases, at least in part, result from increases in frequent cannabis use.

Enrollees of legal age who reside near a retailer are 7% more likely to receive a CUD diagnosis and 24% more likely to receive CUD-related inpatient/residential SUD treatment, compared to those who do not. Underaged enrollees residing near a retailer are 13% more likely to receive a CUD diagnosis, compared to those who do not. Furthermore, across both age groups, retail access generally relates to a roughly 10%-20% higher likelihood of CUD co-occurring with or preceding select mental health disorder diagnoses.

Our findings indicate that impacts are largest for enrollees residing near multiple active retailers. In addition, evidence suggests that impacts are concentrated among urban residents and White and Hispanic populations.

Our analyses indicate a potential causal relationship between retail access and health care outcomes among legal-aged adults, but evidence is less clear for enrollees aged 12–20.

Limitations

This study has several clear limitations. First, we have limited information about both the patients' health care history and the healthcare claim (e.g., other corresponding diagnoses or treatment setting), especially for individuals dually enrolled in Medicaid and Medicare, or with third-party insurance.

Second, this study used claims data, which may underdiagnose outcomes. For example, providers may omit diagnoses that are not relevant to the specific reimbursement claim. Furthermore, these results are not representative of individuals who are not covered by Medicaid and do not interact with the healthcare system. The uninsured and those without access to healthcare constitute a vulnerable and understudied population.

Third, we cannot describe the forms of cannabis use that preceded healthcare encounters: we do not observe the type of product consumed (e.g., edibles, flower, or concentrates), the THC concentration of the product, or the frequency of consumption. This information would allow us to better understand what consumption patterns are at highest risk of CUD-related healthcare services and co-occurring/subsequent mental health disorders.

Fourth, we cannot explore the mechanism by which greater density relates to larger effects. This could be due to market competition inducing lower prices, greater advertising, and/or products with higher THC concentration; however, we do not have information about prices or inventory.

Last, unmeasured factors—like shifts in healthcare access, diagnostic practices, or other policies—could affect our results. However, for this limitation to affect our conclusions, these factors need to change systematically as neighborhoods experience increases in retail access.

Notwithstanding these limitations, this study has several strengths. Primarily, it is the first to evaluate how retail access relates to CUD-related hospitalization/inpatient SUD treatment, and CUD preceding or co-occurring with mental health disorder diagnoses for both legal-aged and underaged populations in Washington. Furthermore, our primary findings are robust to several sensitivity measures.

Conclusion

Ultimately, we find evidence that increasing retail access predicts a moderate increase in the prevalence of CUD and related mental health disorder diagnoses. This study contributes to a broader literature that examines the role cannabis retail access plays in shaping public health outcomes.

Regarding WSIPP's legislatively mandated benefit-cost evaluation of I-502, the analyses presented in this report represent an intermediate step. In service of supporting a comprehensive evaluation of I-502, to be completed in 2032, we will continue to examine how components of I-502 relate to relevant outcomes in the intervening years. This will include more analysis of substance use and healthcare outcomes, in addition to analysis of public safety, criminal justice outcomes, and economic impacts.

Acknowledgments

The authors would like to thank staff at Washington State Health Care Authority and DSHS RDA for their support in obtaining and understanding the administrative data required to facilitate this work. In particular, we thank Dr. Grace Hong and Dr. Barbara Lucenko at RDA.

I would also like to thank Dr. Sarah Okey (LCB), Dr. Rahi Abouk (William Paterson University), Micah McFeely (WSIPP), and Morgan Spangler (WSIPP) for providing feedback on earlier drafts of the report. I thank Dr. Julia Dilley for her continued support of WSIPP's I-502 evaluation work.

Appendices

The Impact of Cannabis Retail Availability on Cannabis and Mental Health Outcomes Among Medicaid Recipients in Washington State

Appendices

I. Retail Proximity Measure

Although we do not have information on the address of the Medicaid enrollees in our data, we use 2019 census block-group data to approximate household locations throughout the state. For computational feasibility, we produce a 1% population sample of synthetic households to approximate the spatial distribution of household residential locations. The exact location assigned to any synthetic household within a block-group is random, assuming a uniform distribution of families within the livable areas of census block-group boundaries—we include census block-group boundaries that are on a tax parcel with a building on it or a military base. The travel time between each household and each operational licensed retailer (within 120 minutes) is then estimated. The synthetic household sample and drive times were generated using ArcGIS Pro and OpenStreetMap. We aggregate household-level proximity measures up to the census tract level, resulting in the average drive time to the nearest retailer for residents in each census tract. These measures are then linked to the residential census tract recorded for Medicaid enrollees in the study sample.

II. Event Study Model

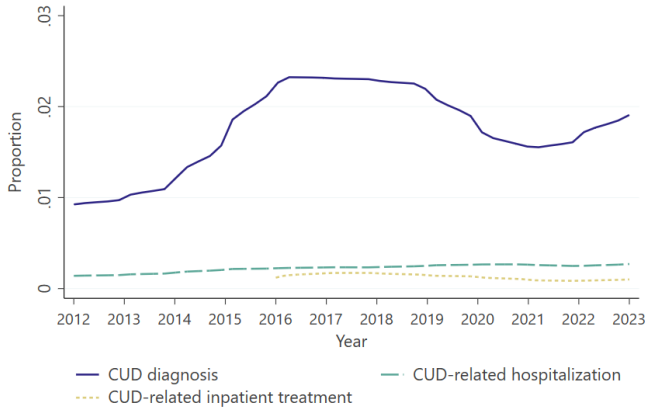
Our primary estimation strategy is a difference-in-differences analysis. This is a statistical method used to estimate the impact of treatment or intervention. This model critically assumes that in the absence of treatment, outcomes for the treatment and control group would have evolved similarly over time (i.e., the parallel trends assumption). While the parallel trends assumption cannot be explicitly tested, to assess how the outcomes of interest changed before and after a cannabis retailer opens nearby, we estimate event study models. In these models, the binary difference-in-differences estimator (which is equal to zero in the periods before retail access and one in the periods after) is replaced with dummy variables indicating the number of years before or following the year a retailer opens nearby. Our dummy variables include the following leading indicators: 5 or more years, 4 years, 3 years, 2 years, and 1 year (the reference category) prior; and the following lagging indicators: 1 year, 2 years, 3 years, 4 years, 5 years, 6 years, and 7 or more years after. Unlike the single-coefficient two-way fixed effects model, in this model, the coefficient estimates for the leading indicators allow us to examine whether there are significant differences in outcomes between those who live in a neighborhood near a retailer and those who do not in the pre-treatment period. Significant differences in the periods leading to treatment would suggest a violation of the parallel trends assumption. Furthermore, the coefficient estimates for the lagging indicators allow us to assess whether the treatment effects persist, grow, or shrink in the years after retail access. All event study models follow the same specifications as the single coefficient two-way fixed effects model described in Section II.

III. Figures and Tables

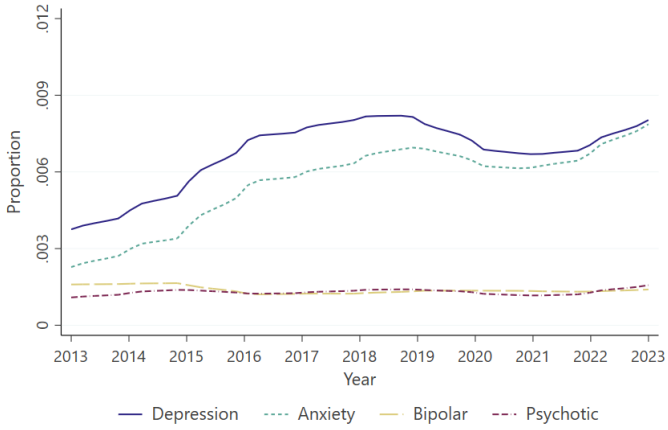
Exhibit A1

Measures of CUD and Mental Healthcare, Medicaid Enrollees Aged 12-20

a) CUD-Related Healthcare Services



b) Co-Occurring CUD and Mental Health Disorder Diagnoses



c) Index Mental Health Disorder Diagnosis Following CUD Diagnosis

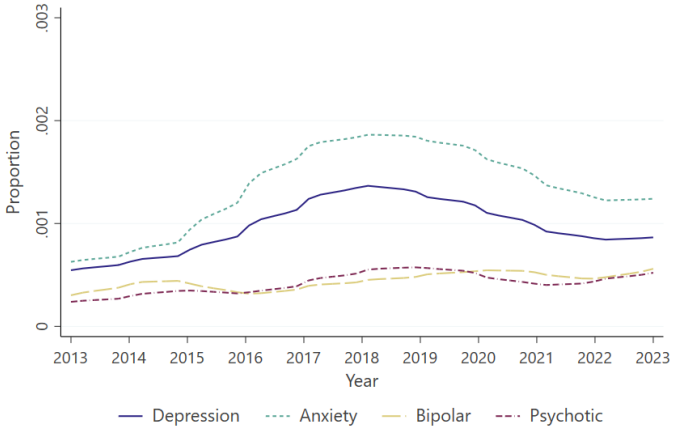
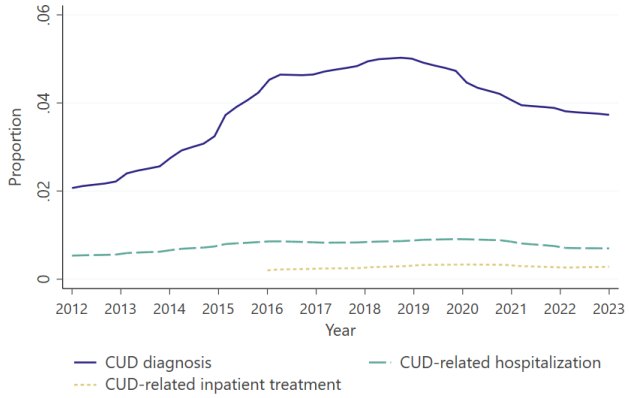


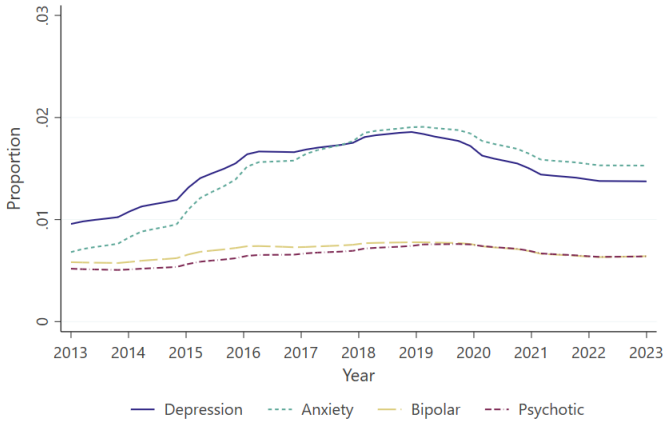
Exhibit A2

Measures of CUD and Mental Healthcare, Medicaid Enrollees Aged 21-64

a) CUD-Related Healthcare Services



b) Co-Occurring CUD and Mental Health Disorder Diagnoses



c) Index Mental Health Disorder Diagnosis Preceded by CUD

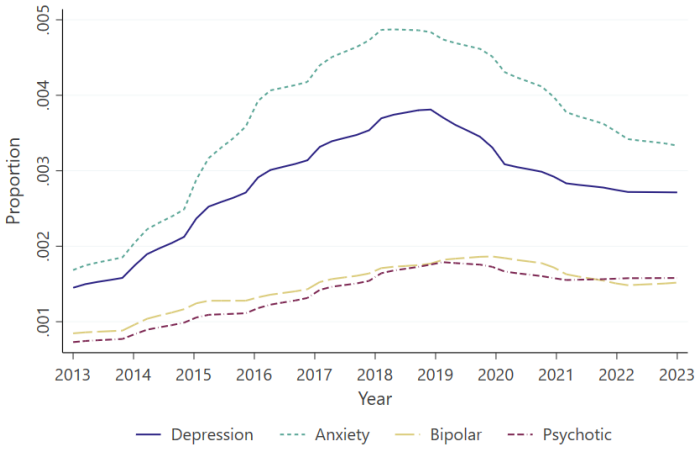


Exhibit A3

Cannabis Retail Within 10-Minute Average Drivetime and Cannabis Use Disorder (CUD)-Related Healthcare Utilization Among Medicaid Enrollees, by Age Group

	CUD diagnosis	CUD-related hospitalization	CUD-related inpatient SUD treatment
Panel a. Aged 12-20			
Any retail within 10 minutes	0.0021***	0.0002	0.0002
	(0.0005)	(0.0001)	(0.0001)
Observations	4,234,908	4,234,908	2,722,470
Mean	0.0177	0.0023	0.0013
Panel b. Aged 21-64			
Any retail within 10 minutes	0.0027***	0.0005**	0.0006***
	(0.0009)	(0.0002)	(0.0002)
Observations	7,629,741	7,629,741	4,860,740
Mean	0.0391	0.0078	0.0029

Note:
***Significant at the 0.001-level and **significant at the 0.05-level.

Exhibit A4

Number of Cannabis Retailers Within 10-Minute Average Drivetime and CUD-Related Healthcare Services Utilization, by Age Group

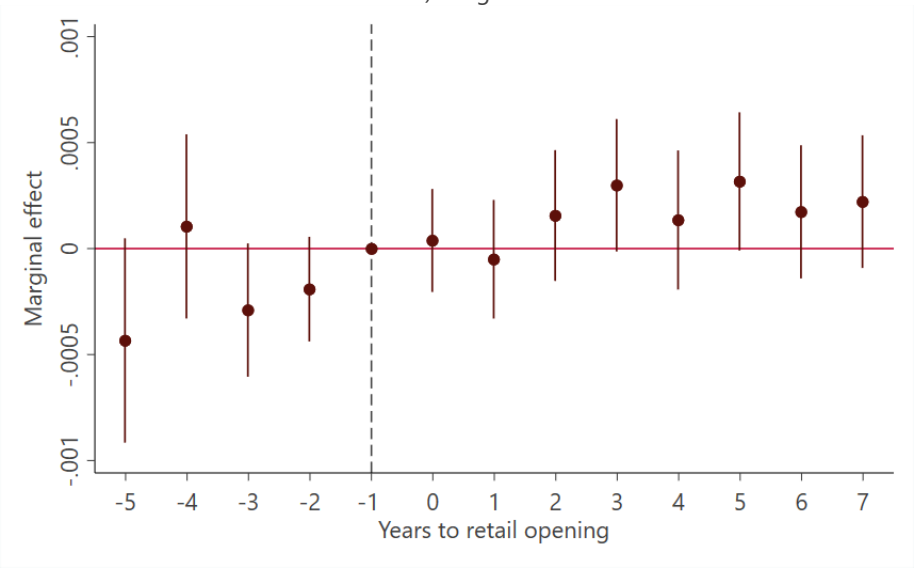
	Aged 12-20			Aged 21-64		
	CUD diagnosis	CUD-related hospitalization	CUD-related inpatient SUD treatment	CUD diagnosis	CUD-related hospitalization	CUD-related inpatient SUD treatment
Number of retailers within 10 minutes						
1	0.0004	0.0001	0.0001	0.0006	-0.0001	0.0002
	(0.0005)	(0.0001)	(0.0001)	(0.0008)	(0.0002)	(0.0001)
2	0.0017***	0.0001	0.0002	0.0011	-0.0000	0.0003
	(0.0006)	(0.0001)	(0.0001)	(0.0009)	(0.0002)	(0.0002)
3+	0.0029***	0.0003***	0.0002**	0.0047***	0.0010***	0.0007***
	(0.0006)	(0.0001)	(0.0001)	(0.0009)	(0.0002)	(0.0002)
Observations	4,234,908	4,234,908	2,666,312	7,629,741	7,629,741	4,860,740
Mean	0.0177	0.0023	0.0013	0.0391	0.0078	0.0029

Note:
***Significant at the 0.001-level and **significant at the 0.05-level.

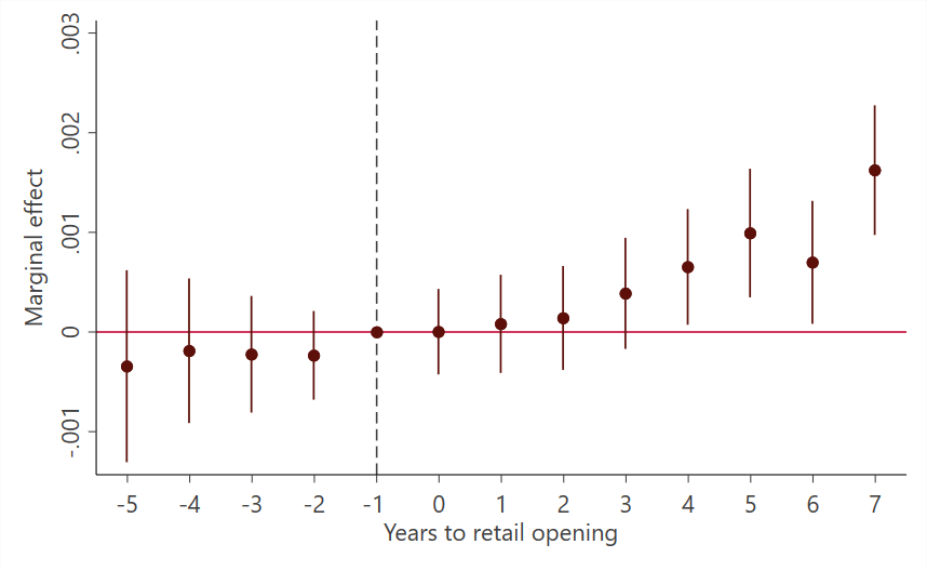
Exhibit A5

Event Study Estimates for the Relationship Between a Cannabis Retailer Opening Within a 10-Minute Average Drivetime and CUD-Related Hospitalization

a) Aged 12-20



b) Aged 21-64

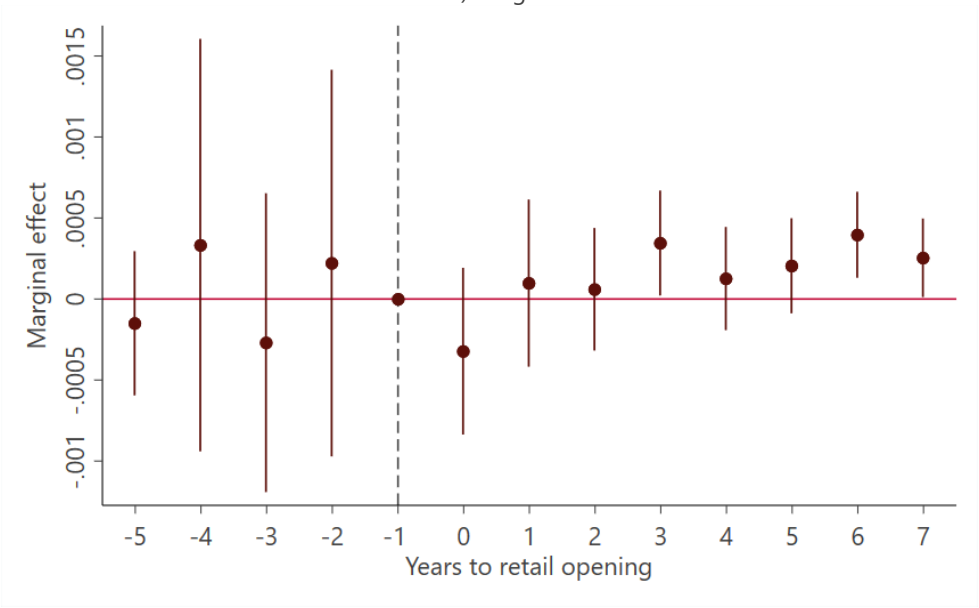


Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

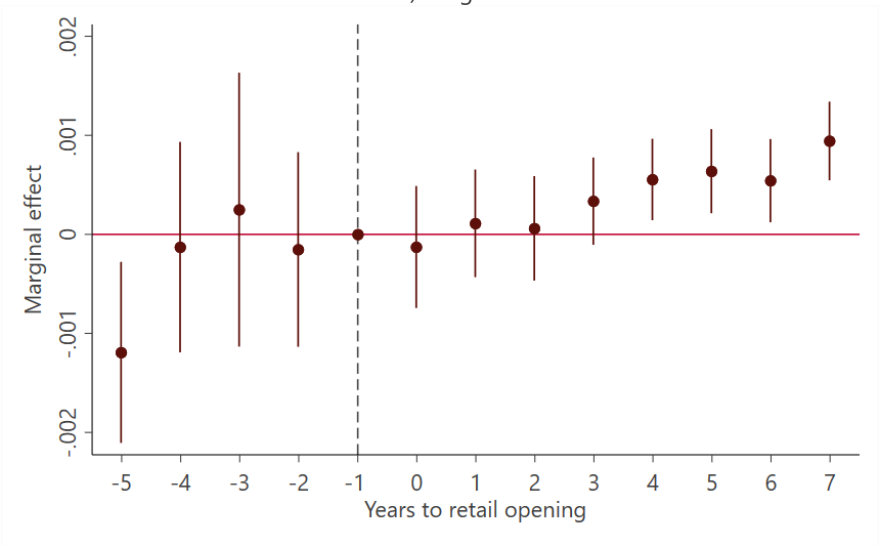
Exhibit A6

Event Study Estimates for the Relationship Between a Cannabis Retailer Opening Within a 10-Minute Average Drivetime and CUD-Related Inpatient SUD Treatment

a) Aged 12-20



b) Aged 21-64



Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

Exhibit A7

Cannabis Retail Within 10-Minute Average Drivetime and Co-Occurrence of CUD and Mental Health Disorder Diagnoses, by Age Group

	Depression	Anxiety	Bipolar	Psychotic
Panel a. Ages 12-20				
Any retail within 10 minutes	0.0010***	0.0008***	0.0001	0.0002**
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Observations	3,686,436	3,686,436	3,686,436	3,686,436
Mean	0.007	0.006	0.001	0.001
Panel b. Ages 21-64				
Any retail within 10 minutes	0.0022***	0.0016***	0.0012***	0.0012***
	(0.0003)	(0.0004)	(0.0002)	(0.0002)
Observations	6,733,967	6,733,967	6,733,967	6,733,967
Mean	0.015	0.015	0.007	0.007

Note:
***Significant at the 0.001-level and **significant at the 0.05-level.

Exhibit A8

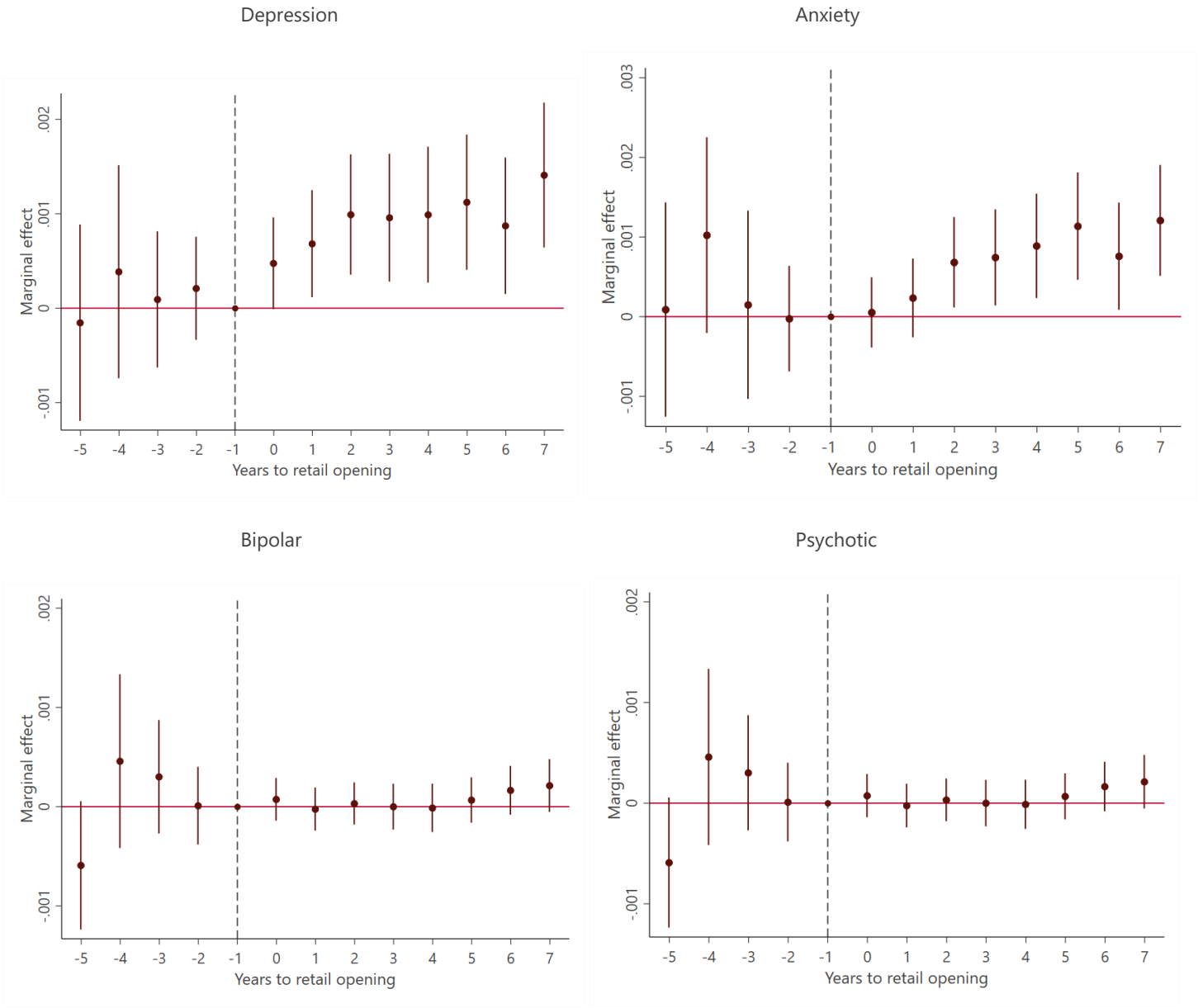
Cannabis Retail Within 10-Minute Average Drivetime and Index Mental Health Disorder Diagnosis Following CUD Diagnosis by Age Group

	Depression	Anxiety	Bipolar	Psychotic
Panel a. Ages 12-20				
Any retail within 10 minutes	0.0001***	0.0001**	0.0001***	0.0001**
	(0.0000)	(0.0001)	(0.0000)	(0.0000)
Observations	3,686,436	3,686,436	3,686,436	3,686,436
Mean	0.001	0.001	0.000	0.000
Panel b. Ages 21-64				
Any retail within 10 minutes	0.0003***	0.0003***	0.0003***	0.0002***
	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Observations	6,167,195	6,167,195	6,167,195	6,167,195
Mean	0.003	0.004	0.002	0.001

Note:
***Significant at the 0.001-level and **significant at the 0.05-level.

Exhibit A9

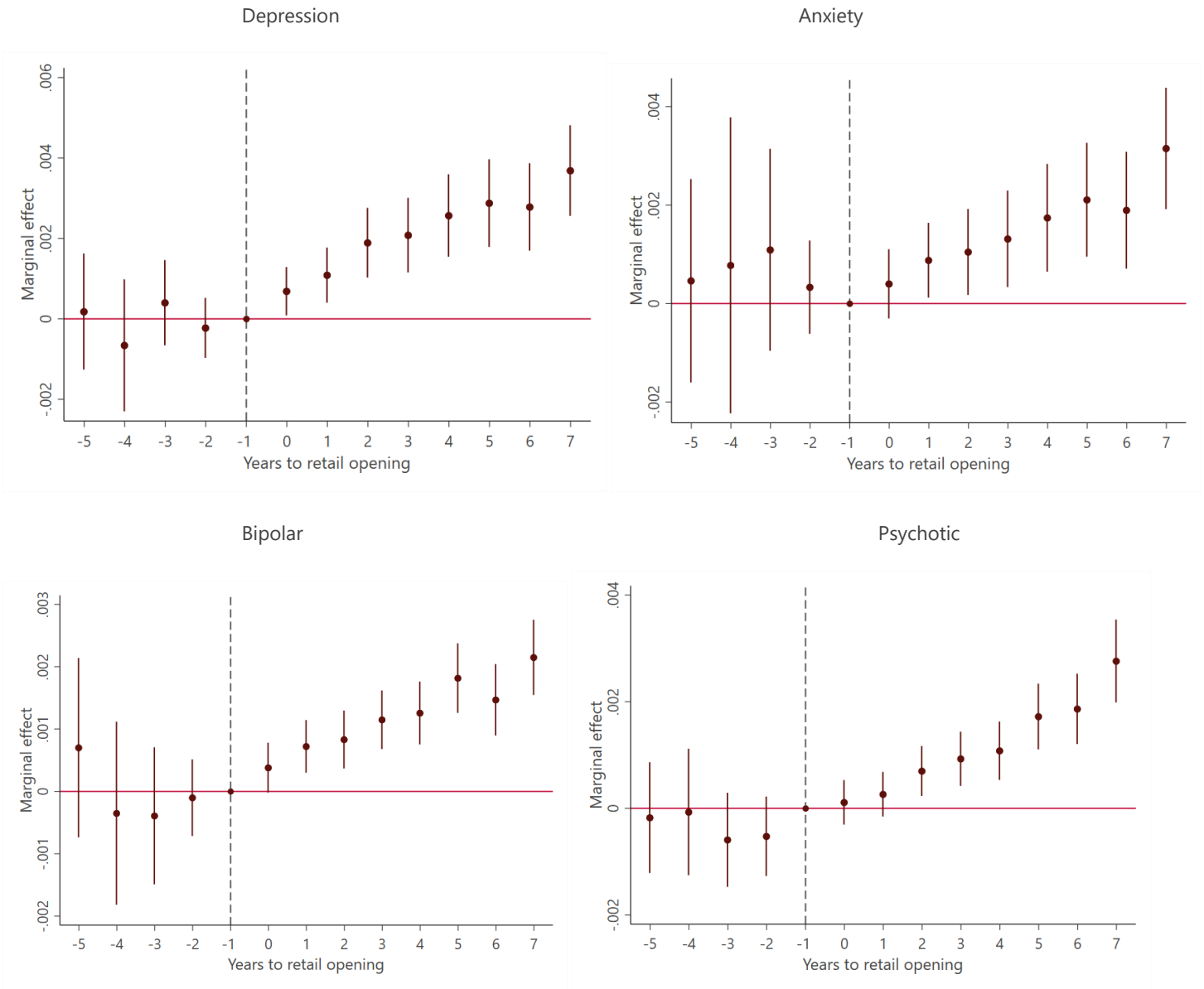
Event Study Estimates for the Relationship Between a Cannabis Retailer Opening Within a 10-Minute Average Drivetime and the Co-Occurrence of CUD and Mental Health Disorder Diagnoses, Aged 12-20



Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

Exhibit A10

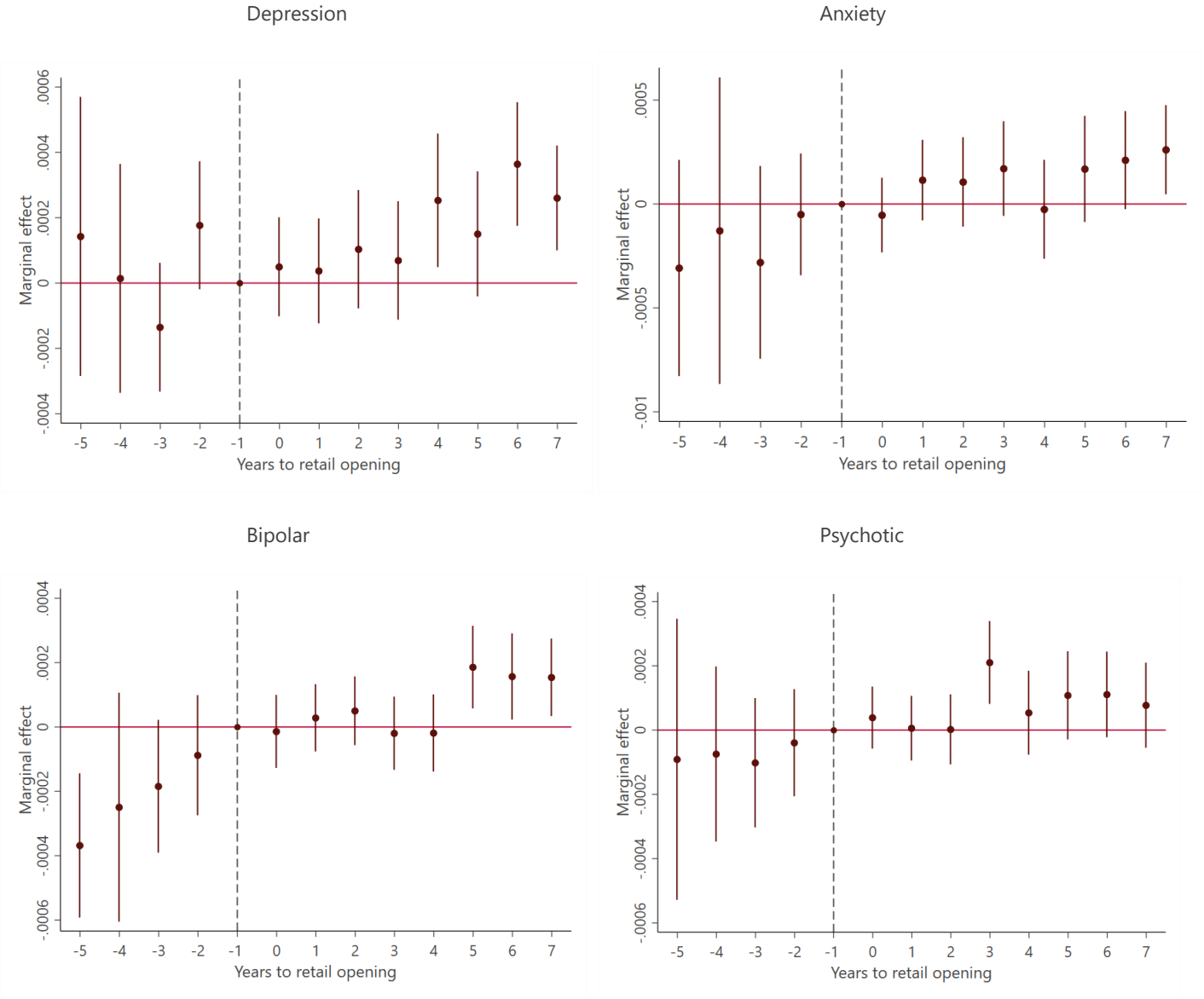
Event Study Estimates for the Relationship Between a Cannabis Retailer Opening Within a 10-Minute Average Drivetime and the Co-Occurrence of CUD and Mental Health Disorder Diagnoses, Aged 21-64



Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

Exhibit A11

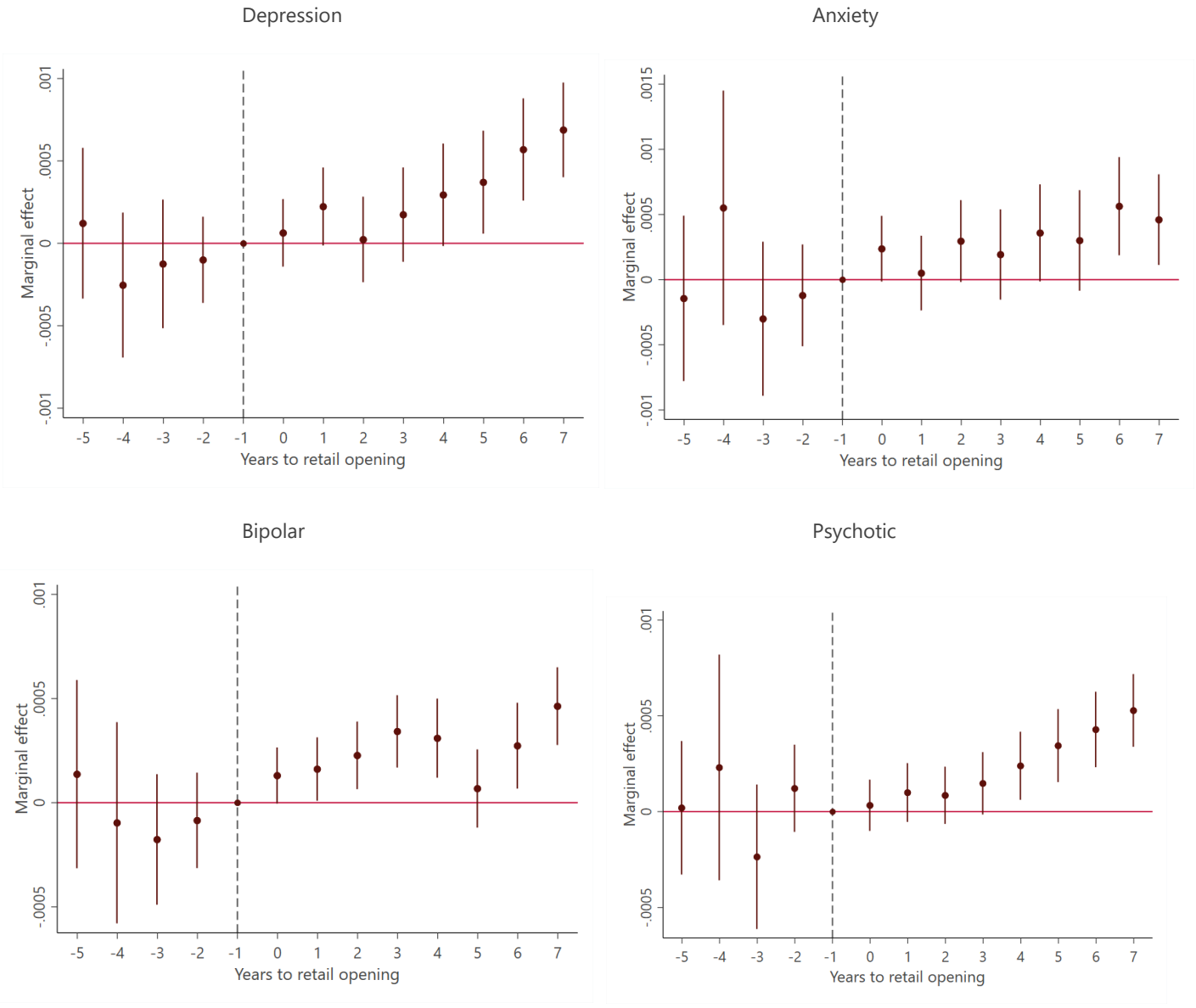
Event Study Estimates for the Relationship Between a Cannabis Retailer Opening Within a 10-Minute Average Drivetime and Index Mental Health Disorder Diagnosis Following CUD Diagnosis, Aged 12-20



Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

Exhibit A12

Event Study Estimates for the Relationship Between a Cannabis Retailer Opening Within a 10-Minute Average Drivetime and Index Mental Health Disorder Diagnosis Following CUD Diagnosis, Aged 21-64



Notes:
The circle markers indicate estimated marginal effects from the event study model.
Vertical lines represent the 95% confidence intervals.

Exhibit A13

Number of Cannabis Retailers Within 10-Minute Average Drivetime and Co-Occurring CUD and Mental Health Disorder Diagnoses, by Age Group

	Depression	Anxiety	Bipolar	Psychosis
Panel a. Ages 12-20				
Number of retailers within 10 minutes				
1	0.0003	0.0002	0.0000	0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
2	0.0011***	0.0008***	0.0002*	0.0001
	(0.0003)	(0.0002)	(0.0001)	(0.0001)
3+	0.0017***	0.0013***	0.0002***	0.0003***
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Observations	3,686,436	3,686,436	3,686,436	3,686,436
Mean	0.007	0.006	0.001	0.001
Panel b. Aged 21-64				
Number of retailers within 10 minutes				
1	0.0011***	0.0008**	0.0005***	0.0001
	(0.0003)	(0.0003)	(0.0002)	(0.0002)
2	0.0019***	0.0013***	0.0009***	0.0005**
	(0.0003)	(0.0004)	(0.0002)	(0.0002)
3+	0.0037***	0.0028***	0.0022***	0.0025***
	(0.0004)	(0.0003)	(0.0002)	(0.0003)
Observations	6,733,967	6,733,967	6,733,967	6,733,967
Mean	0.015	0.015	0.007	0.007

Note:
***Significant at the 0.001-level and **significant at the 0.05-level.

Exhibit A14

Number of Cannabis Retailers Within 10-Minute Average Drivetime and Index Mental Health Disorder Diagnosis Following CUD Diagnosis, by Age Group

	Depression	Anxiety	Bipolar	Psychosis
Panel a. Ages 12-20				
Number of retailers within 10 minutes				
1	0.0003	0.0002	0.0000	0.0001
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
2	0.0011***	0.0008***	0.0002*	0.0001
	(0.0003)	(0.0002)	(0.0001)	(0.0001)
3+	0.0017***	0.0013***	0.0002***	0.0003***
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Observations	3,686,436	3,686,436	3,686,436	3,686,436
Mean	0.007	0.006	0.001	0.001
Panel b. Aged 21-64				
Number of retailers within 10 minutes				
1	0.0011***	0.0008**	0.0005***	0.0001
	(0.0003)	(0.0003)	(0.0002)	(0.0002)
2	0.0019***	0.0013***	0.0009***	0.0005**
	(0.0003)	(0.0004)	(0.0002)	(0.0002)
3+	0.0037***	0.0028***	0.0022***	0.0025***
	(0.0004)	(0.0003)	(0.0002)	(0.0003)
Observations	6,733,967	6,733,967	6,733,967	6,733,967
Mean	0.015	0.015	0.007	0.007

Note:
***Significant at the 0.001-level and **significant at the 0.05-level.

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