Washington State Institute for Public Policy
110 Fifth Avenue SE, Suite 214 • PO Box 40999 • Olympia, WA 98501 • 360.664.9800 • www.wsipp.wa.gov

December 2023

Licensed Non-Medical Cannabis Retail Access and High School Outcomes in Washington State

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 benefit-cost evaluation will be published in 2032—the full legislative requirements for this assignment are displayed in Exhibit 1.

In the intervening years, in preparation for the final benefit-cost evaluation, we will continue to examine how facets of I-502 impact relevant outcomes. In this report, we specifically explore the relationship between non-medical cannabis (NMC) retail access, a component of I-502, and high school performance. The findings of 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 related 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.

Summary

Although Initiative 502 did not legalize cannabis consumption and purchase for those under the age of 21, evidence has suggested that exposure to licensed cannabis retail does predict higher rates of adolescent cannabis use. In this study, we build on previous research and examine the relationship between school proximity to cannabis retailers and high school outcomes including cannabis-related disciplinary incidences, attendance, and high school graduation.

Retailers are not randomly located throughout the state; therefore, in our analysis, we account for school-level sociodemographic characteristics, and we ultimately caution against a causal interpretation.

We find that school proximity to a non-medical cannabis retailer relates to both a modest increase in the average number of monthly absences, and a small decline in the average probability of four-year high school graduation. We also find that a higher number of nearby retailers predicts more unexcused absences.

Suggested citation: Rashid, A. (2023). *Licensed non-medical cannabis retail access and high school outcomes in Washington State.* (Document Number 23-12-3201). Olympia: Washington State Institute for Public Policy.

[1] Initiative Measure No. 502.

[2] RCW 69.50.550.

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

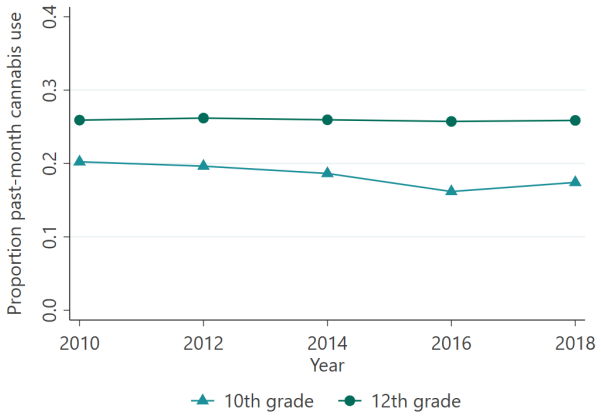
*(f) **State and local** agency administrative costs and revenues*

I. Background

In Washington State, the level of reported average adolescent cannabis use has remained relatively stable over the last decade. This pattern is observed in Exhibit 2, which depicts average rates of reported past-month cannabis use among 10th- and 12th-grade students—with about 26% of 12th-grade respondents and 17% of 10th-grade respondents reporting past-month cannabis use in 2018.

Exhibit 2

Reported Past-Month Cannabis Use



Note:
Data from the Washington State Healthy Youth Survey.

While overall trends in average adolescent cannabis use may not appear to have increased after NMC legalization in Washington, it is possible that within the state, adolescent cannabis use differentially increases with the availability of NMC retail—as was the case with legal-aged adults.[3] Although cannabis possession, consumption, and purchase are not legal for those under the age of 21, the presence of retailers and retail-related advertising may normalize cannabis use and decrease perceptions of risks associated with use.[4] In addition, increased use by adults, especially parents, could further influence youth perceptions of cannabis use.[5] Furthermore, increased availability of retail sources may ease youth access to cannabis products in the home or at social events involving older acquaintances.[6]

[3] Rashid, A. (2023). *Initiative 502 and cannabis-related public health and safety outcomes: Third required report* (Doc. No.23-09-3201). Olympia: Washington State Institute for Public Policy.

[4] Donnelly, J., Young, M., Marshall, B., Hecht, M.L., & Saldutti, E. (2022). Public health implications of cannabis legalization: an exploration of adolescent use and evidence-based interventions. *International Journal of Environmental Research and Public Health*, *19*(6), 3336 and 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.

[5] Madras, B.K., Han, B., Compton, W.M., Jones, C.M., Lopez, E. I., & McCance-Katz, E.F. (2019). Associations of parental marijuana use with offspring marijuana, tobacco, and alcohol use and opioid misuse. *JAMA Network Open*, *2*(11) and O'Loughlin, J.L., Dugas, E.N., O'Loughlin, E.K., Winickoff, J.P., Montreuil, A., Wellman, R.J., . . . Hanusaik, N. (2019). Parental cannabis use is associated with cannabis initiation and use in offspring. *The Journal of Pediatrics*, *206*, 142-147.

[6] Firth et al. (2022) and Rhew, I.C., Guttmannova, K., Kilmer, J.R., Fleming, C.B., Hultgren, B.A., Hurvitz, P.M., . . . Larimer, M.E. (2022). Associations of cannabis retail outlet availability and neighborhood disadvantage with cannabis use and related risk factors among young adults in Washington State. *Drug and Alcohol Dependence*, *232*, 109332.

Impacts of Adolescent Cannabis Use

A robust research literature suggests that sustained adolescent cannabis use is associated with several negative health outcomes, including cannabis dependence, impaired cognitive function, and increased risk of mental health disorders.[7] Potential adverse cannabis-related developmental outcomes may impact educational attainment and school outcomes. Some studies suggest that cannabis use is associated with higher absenteeism and a lower likelihood of high school and university completion.[8] Furthermore, cannabis possession and use on school property is generally a violation of rules related to substances in schools and can result in punitive disciplinary outcomes.

NMC Legalization and Adolescent Outcomes

While most studies have found that *adult* cannabis use generally increases following NMC legalization,[9] the impact of legalization on adolescent use and other cannabis-related outcomes is less clear.[10] Some studies found little change in youth outcomes immediately following legalization,[11] while others have found evidence suggesting greater rates of adolescent cannabis use and cannabis use disorder in NMC-legal states compared to states without any legal cannabis use laws.[12] One specific Washington-based study found increased use among select students in the few years post-legalization.[13] Furthermore, a study using a national survey found that NMC legalization was associated with larger increases in rates of cannabis vaping among high school and middle school students.[14]

[7] Hall, W., Leung, J., & Lynskey, M. (2020). The effects of cannabis use on the development of adolescents and young adults. *Annual Review of Developmental Psychology*, *2*, 461-483; Meier, M.H. (2021). Cannabis use and psychosocial functioning: evidence from prospective longitudinal studies. *Current Opinion in Psychology*, *38*, 19-24; and Scheier, L.M., & Griffin, K.W. (2021). Youth marijuana use: a review of causes and consequences. *Current Opinion in Psychology*, *38*, 11-18.

[8] Duckworth, J.C., Graupensperger, S., Schultz, N.R., Gilson, M. S., Fairlie, A.M., Patrick, M.E., & Lee, C.M. (2023). Alcohol and marijuana use predicting next-day absenteeism and engagement at school and work: A daily study of young adults. *Addictive Behaviors*, *142*, 107670.

[9] Chiu, V., Leung, J., Hall, W., Stjepanović, D., & Degenhardt, L. (2021). Public health impacts to date of the legalization of medical and recreational cannabis use in the USA. *Neuropharmacology*, *193*, 108610.

[10] Ingraham, B., & Rashid, A. (2023). *Technical report—The relationship between Initiative 502 and reported substance use* (Doc. No. 23-09-3204). Olympia: Washington State Institute for Public Policy.

[11] Dilley, J.A., Richardson, S.M., Kilmer, B., Pacula, R.L., Segawa, M.B., & Cerdá, M. (2019). Prevalence of cannabis use in youths after legalization in Washington state. *JAMA Pediatrics*, *173*(2), 192-193 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.

[12] Gunadi, C., Zhu, B., & Shi, Y. (2022). Recreational cannabis legalization and transitions in cannabis use: findings from a nationally representative longitudinal cohort in the United States. *Addiction*, *117*(10), 2651-265 and Mennis, J., McKeon, T.P., & Stahler, G.J. (2023). Recreational cannabis legalization alters associations among cannabis use, perception of risk, and cannabis use disorder treatment for adolescents and young adults. *Addictive Behaviors*, *138*, 107552.

[13] Cerdá, M., Wall, M., Feng, T., Keyes, K.M., Sarvet, A., Schulenberg, J., . . . Hasin, D.S. (2017). Association of state recreational marijuana laws with adolescent marijuana use. *JAMA Pediatrics*, *171*(2), 142-149.

[14] Nicksic, N.E., Do, E.K., & Barnes, A.J. (2020). Cannabis legalization, tobacco prevention policies, and Cannabis use in E-cigarettes among youth. *Drug and Alcohol Dependence*, *206*, 107730.

The Impact of NMC Retail Access

Some studies have also suggested that the proximity of schools and homes to retailers relates to higher rates of youth use, lower age of onset cannabis use, and higher rates of cannabis use disorder diagnoses.[15] Washington-based studies found that both retail proximity and exposure to advertising near the school and home relate to higher rates of reported cannabis use.[16]

Another recent study found that after NMC legalization in Oregon, middle schools located within one mile of an NMC retailer experienced increases in the rates of discipline referrals for substance use in middle schools located within one mile of a retailer, relative to referral rates in schools not located near a retailer.[17]

Current Study

In this study, we expand upon the existing literature by examining if school proximity impacts relevant high school-related outcomes.

As previously mentioned, recent studies have found suggestive evidence that NMC retail predicts higher rates of adolescent cannabis use. Using data from the 2016 and 2018 Washington State Healthy Youth Survey (HYS),[18] one study found that retail exposure is significantly associated with higher rates of reported current and frequent cannabis use among high school students.[19] Using the same HYS data and similar methodology, in analyses presented in Appendix I, we also find evidence to suggest that school proximity to an NMC retailer is related to higher reported cannabis use among high school students. Most notably, we estimate that *attending a school located within a five-minute drive time of at least one NMC retailer predicts a 7.7% higher likelihood of reporting at least 10 out of 30 days of cannabis use among 10th-grade students*.

Given this suggestive evidence that school proximity to an NMC retailer predicts greater adolescent cannabis use, this study uses administrative school records data to examine further the relationship between retail access and relevant school outcomes.

[15] Firth et al. (2022); Palali, A., & van Ours, J.C. (2015). Distance to cannabis shops and age of onset of cannabis use. *Health Economics*, *24*(11), 1483-1501; and Rashid, A. (2023).

[16] Dilley, J.A., Guttmannova, K., Richardson, S.M., Firth, C.L., Hong, G., & Maher, J.E. (2023). Cannabis use and risk factors among adolescents in the pacific northwest: Associations with local cannabis retail exposure during early market expansion after adult-use legalization. (*Under Review*) and Firth et al. (2022).

[17] Cil, G., Winters, K.C., Austin, S.C., Kittelman, A., Smolkowski, K., Westling, E., & Seeley, J.R. (2023). Legalization and retail availability of recreational marijuana and adolescent use in schools. *Health Economics*.

[18] The HYS is a school-based survey administered to a sample of Washington State students in grades 6-12. For more information about the HYS see Appendix I.

[19] Dilley et al. (2023).

The use of administrative Washington State data provides several advantages. First, it allows us to examine an array of different cannabis-related school outcomes, including cannabis-related disciplinary incidents, attendance, and on-time high school completion. Furthermore, unlike the HYS, which includes only a voluntary sample of students from select grades in select years, administrative records data allow us to examine annual outcomes across the entire population of enrolled high school students.

Given the potential health and long-term developmental impacts of adolescent cannabis use, it is important to understand the full scope of the relationship between NMC legalization and adolescent outcomes. Little is known about the impact of retail availability and school-based outcomes, and this study aims to fill some of this gap. Understanding high school performance is vital because it can contribute to an adolescent's current well-being as well as future social and economic outcomes.

II. Data & Methods

Data

School Records

For this study, we obtained high school student-level administrative records from the 2010-11 through 2018-19 academic years (AY).[20] These data provide information related to student demographic characteristics, school program participation, attendance, disciplinary actions, and academic outcomes.[21]

Outcomes. For all students, we consider the following outcomes: 1) an indicator for whether a cannabis-related disciplinary incident (e.g., cannabis purchase or use) occurred during school or school-related activities each year,[22] and 2) the average number of monthly unexcused absences. We additionally construct an indicator for whether a student graduates high school in four years (i.e., on-time graduation).[23]

Disciplinary records are observed starting in the 2013-14 AY; attendance records are observed starting in the 2012-13 AY; and records regarding high school completion are available starting in the 2010-11 AY. We use information from the years before and after NMC retail operations started in July 2014. Including data from the years before the advent of retail allows us to observe if student outcomes change systematically as local retail expands over time.

Outcomes are summarized by grade in Exhibit 3. Cannabis-related disciplinary incidents are relatively rare, with an occurrence rate of only about 1% annually. For perspective, on average, about 9% of high school students experience any disciplinary incident annually. The average number of monthly unexcused absences is lowest among 9th-grade students (1.5 days) and highest among 12th-grade students (2.5 days). The 4-year graduation rate is about 82%.

[20] High school student-level enrollment and outcomes data are provided by the Office of Superintendent of Public Instruction (OSPI).

[21] Characteristics and program participation of high school students are summarized in Appendix Exhibit A2.

[22] We do not separately examine disciplinary interventions, such as expulsion or suspension, for several reasons. Primarily, policies around disciplinary actions are largely at the discretion of the school district and may change systematically with legalization or cannabis-related prevention efforts. Furthermore, how disciplinary interventions are recorded in the data change in meaningful ways over our analysis period.

[23] A student is flagged as "graduated" if their reason for withdrawal from school in grade 12 includes: graduated with a regular high school diploma (HSD), an associate degree AA), both an HSD and AA, an International Baccalaureate high school degree, or a confirmed completion of Individualized Education Program. A 4-year cohort graduation rate is defined in this report: OSPI (2019).

Exhibit 3

High School Student Outcomes, by Grade

	9th grade	10th grade	11th grade	12th grade
Cannabis-related behavioral incidents	0.01 (0.11)	0.01 (0.11)	0.01 (0.09)	0.01 (0.08)
Average monthly unexcused absences	1.45 (2.57)	1.78 (2.89)	2.11 (3.25)	2.53 (3.77)
Four-year high school graduation	-	-	-	0.82 (0.39)
Observations	815,205	824,904	840,774	895,836

Notes:
Data come from OSPI student records.
Disciplinary data span the 2011-2019 academic years (AYs), attendance data span the 2013-2019 AYs, and high school graduation data span the 2011-2019 AYs.
The number of observations reported in the table reflect the number of student-records between the 2010-11 AY and 2018-19 AY.

Non-Medical Cannabis Retail Access

We measure access to NMC retailers using administrative data, which includes information about the active dates and locations of all licensed retailers in WA. The first cannabis sales from a licensed retailer in Washington State occurred in July 2014. By the end of our sample period in 2019, there were 463 operational licensed cannabis retailers in the state.

Our primary measure of access indicates whether a school has at least one active NMC retailer within a five-minute drive time. We chose a five-minute cutoff to capture plausibly walkable distances. Over our sample period, roughly 40% of schools (1,431 high schools) had an NMC retailer in operation within five minutes.[24] Note that regulations prohibit a retail cannabis business from opening within 1,000 feet of a school (0.2 miles).[25]

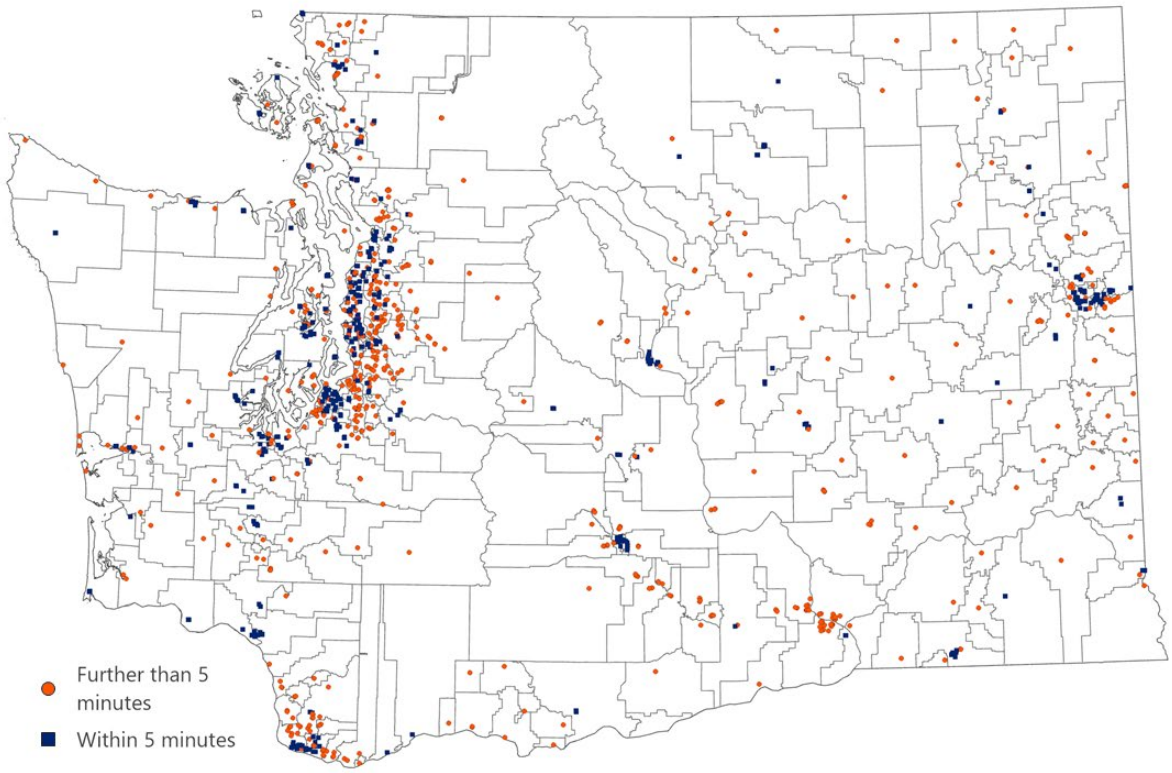
Exhibit 4 is a map of school districts in Washington in the 2018-19 AY, our last year of analysis. Each point on the map represents a high school in operation in this academic year. The blue squares represent schools with an operational NMC retailer located within a five-minute drive time and orange circles represent schools with no retailer within a five-minute proximity.

[24] In analyses not presented here, we examine the sensitivity of our findings to alternative cutoffs and measures of access: 1) a retailer within a 10-minute drive time, and 2) a continuous measure of drivetime to the nearest retailer. The association between access and student outcomes is strongest when access is measured with a five-minute drive time cutoff.

[25] For reference, a five-minute drive time in our data corresponds to roughly 3-5 miles.

Exhibit 4

High Schools in Washington, by NMC retail proximity status—2019



Research Design

Our models estimate how student outcomes change after a retailer opens nearby relative to outcomes at schools with no retailer nearby.

Since retailers are not located randomly, our models account for relevant school-level characteristics such as demography, school type, percent poverty, and regionality.[26] We also account for student-level characteristics such as race/ethnicity and sex.[27]

Despite accounting for relevant school-level demographic and economic characteristics, there may be other factors we do not control for that predict both retail location and outcomes. Therefore, we caution against a causal interpretation of our results.

We examine all outcomes separately for each grade. In addition, we explore differences in outcomes across relevant subgroups such as sex and regionality. In alternative analyses, we also explore the impact of the *number* of retailers operational within five miles.

[26] We estimate an OLS model that accounts for student-level characteristics, time-varying school-level characteristics, school fixed effects, and school-year fixed effects. Standard errors are estimated to allow for clustering at the school-level.

[27] Student-level controls include race/ethnicity, sex, free and reduced-price meal eligibility, and both Special Education, and Limited English Proficiency program participation.

III. Results

Main Results

Attendance

First, we examine the relationship between retail proximity to the school and the average number of monthly absences—we separately examine unexcused and excused absences. Exhibit 5 depicts the average monthly absences for students attending schools near a retailer and those who do not, as predicted by our model.

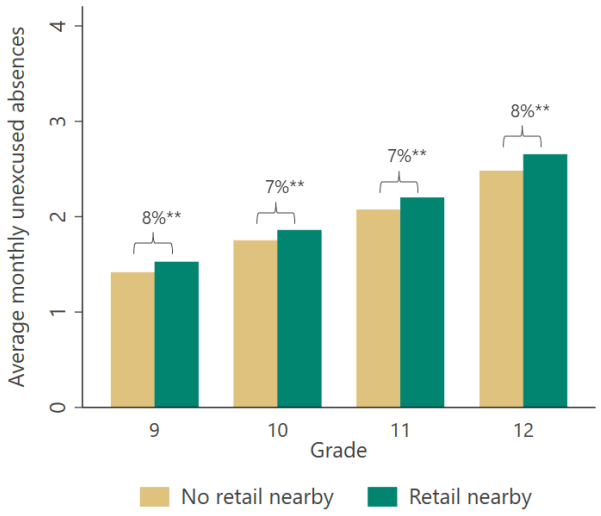
Across all grades, attending a school within a five-minute drive time of at least one NMC retailer predicts a 7-8% higher number of average monthly unexcused absences relative to students in schools further away from an operational retailer. For example, 12th-graders attending a school near a retailer have about 2.7 unexcused absences monthly, on average, and those attending a school with no nearby retailer have an average of about 2.5 unexcused absences—this translates to an 8% higher number of average monthly unexcused absences (about two more absent days per year).

Notably, attending a school near an NMC retailer does not predict a higher number of monthly *excused* absences. An absence is excused for reasons such as family emergencies and verified illness or health conditions. Therefore, our findings indicate that retail availability most likely predicts increases in absences resulting from truant behavior.

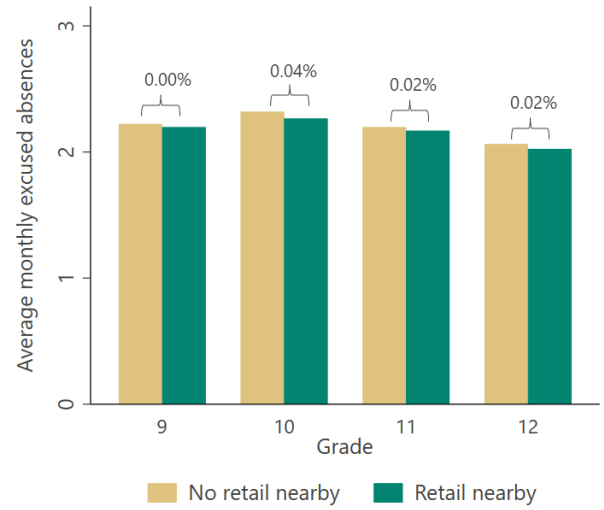
Exhibit 5

NMC Retail Availability and Predicted Monthly Absences, by Grade

a) Unexcused Absences



b) Excused Absences



Notes:
**Significant at the 0.05-level.
Attendance data span the 2012-13 AY through 2018-19 AY.
Full results from these analyses are summarized in Appendix Exhibit A3.

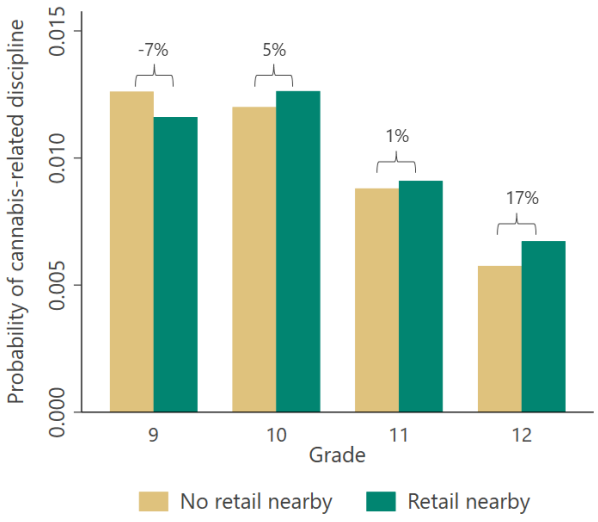
Discipline

We next examine the relationship between school proximity to a retailer and cannabis-related disciplinary incidents. Exhibit 6 summarizes the estimated predicted probabilities from these analyses by grade.

Among 12th graders, attending a school near a retailer predicts roughly a 17% higher likelihood of a cannabis-related behavioral incident occurring than attending a school with no nearby retail (i.e., a predicted probability of 0.007 versus 0.006).[28] However, given the rarity of the outcome, our estimates are imprecise, making it challenging to detect statistical significance.

Exhibit 6

NMC Retail Availability and Predicted Probability of Cannabis-Related Disciplinary Incidents, by Grade



Notes:
Disciplinary records data span the 2013-14 AY through the 2018-19 AY.
Full results from these analyses are summarized in Appendix Exhibit A3.

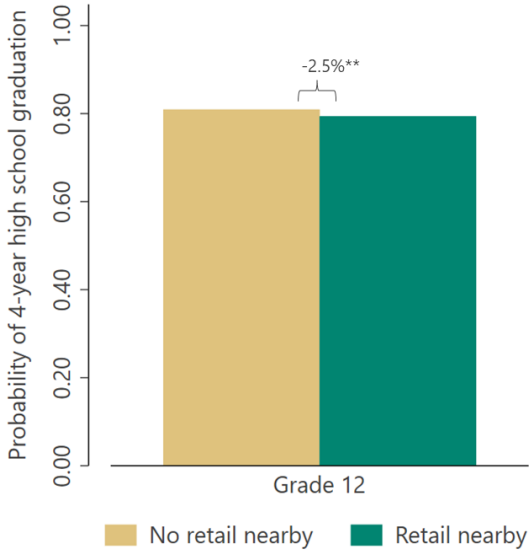
For students in other grades, the relationship between retail proximity and cannabis-related disciplinary incidence is generally practically small and not statistically significant.[29]

4-Year High School Graduation

We also examine how school proximity to an NMC retailer predicts the probability of 4-year high school graduation. Exhibit 7 summarizes the estimated predicted probabilities from these analyses.

Exhibit 7

NMC Retail Availability and Predicted Probability of 4-Year High School Graduation



Notes:
**Significant at the 0.05-level.
High school graduation data span the 2010-11 AY through 2018-19 AY
Full results from these analyses are summarized in Appendix Exhibit A3.

[28] The difference in the rate of at least one cannabis-related disciplinary incident between the two groups is 0.7%-0.6% = 0.1 percentage points. Therefore, the percent difference is 17% = (0.7%-0.6%)/0.6.

[29] In alternative analyses not presented here, we similarly find no significant relationship between NMC retail proximity and the likelihood of *any* disciplinary incident. Note, in the years after our sample ends (2019), substantial changes to disciplinary policies and data collection occurred.

On average, students who attend a high school near an NMC retailer are 2.5% less likely to graduate high school in four years than those who attend a school with no retailer nearby (i.e., 79% versus 81%).

In alternative analyses presented in Appendix Exhibit A3, we find no relationship between school proximity to an NMC retailer and the probability of *ever* completing high school.

Subgroup Analyses

This section explores differences in all outcomes—unexcused absences, cannabis-related disciplinary incidents, and high school graduation—across relevant subgroups. For these analyses, we focus on the population of 12th-grade students. Students in the 12th grade have the highest reported rates of cannabis use. Furthermore, we generally find that the results of these analyses are both largely driven by and most robust for this population.[30] We estimate results across urban/rural regionality, sex, and free and reduced-price meal (FRPM) eligibility.

Region

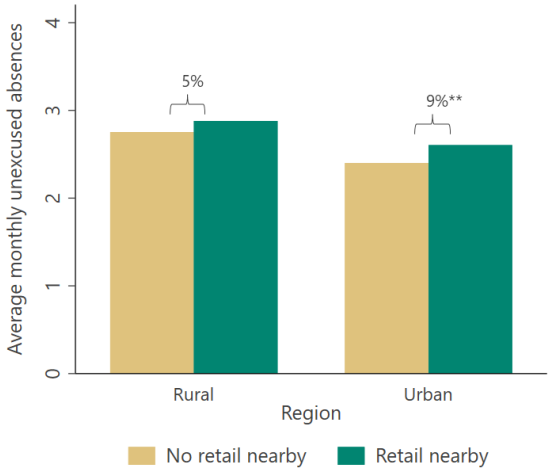
In Exhibit 8, we summarize results separately for schools in rural and urban regions. Results suggest that retail availability predicts a smaller increase in the number of monthly unexcused absences for students attending a school in a rural versus urban region (5% versus 9%). However, for 12th-graders in rural regions, retail availability significantly predicts a 48% higher probability of a cannabis-related disciplinary incident and a 4% lower probability of on-time high school graduation. Similar relationships are not observed for students in urban regions.

[30] Results from the subgroup analyses across all grades are presented in Appendix Exhibits A4-A5.

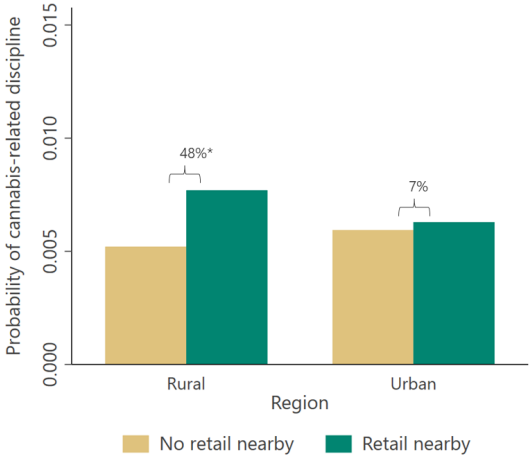
Exhibit 8

NMC Retail Availability and Predicted Probability of 12th-Grade Outcomes, by Region

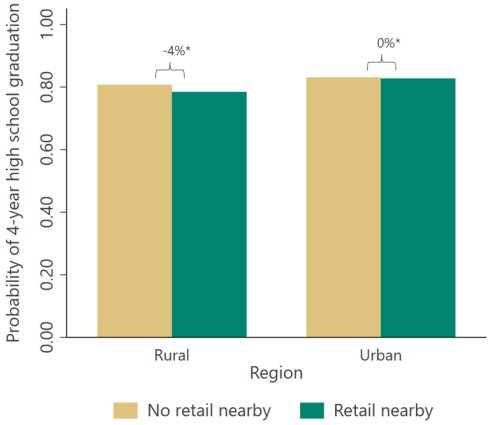
a) Monthly Unexcused Absences



b) Cannabis-related Disciplinary Incidents



c) High School Graduation



Note:
**Significant at the 0.05-level and *significant at the 0.10-level.

Exhibit 9 summarizes the estimated relationship between retail proximity and outcomes by sex and FRPM-eligibility.

Sex

Our findings indicate that the relationship between retail and school outcomes is generally comparable across female and male students.

FRPM-Eligibility

Next, we examine how retail proximity impacts outcomes differently across FRPM eligibility status. Eligibility for FRPM is commonly used as a proxy for low-income status. The magnitude of the relationship between retail proximity and outcomes is generally larger for FRPM-eligible students. However, estimated impacts corresponding to cannabis-related disciplinary incidents are not statistically significant for either group.

Exhibit 9

NMC Retail Availability and Student Outcomes, 12th Grade Students

	Female	Male	FRPM	No FRPM
Monthly absences				
Any NMC retailer within 5-minute drive time	0.1677** (0.0782)	0.1854** (0.0883)	0.2368** (0.1038)	0.1171* (0.0698)
Outcome mean	2.322	2.740	3.617	1.797
Observations	316,295	341,864	268,234	389,925
Cannabis-related discipline				
Any NMC retailer within 5-minute drive time	0.0004 (0.0005)	0.0015 (0.0012)	0.0015 (0.0013)	0.0007 (0.0007)
Outcome mean	0.003	0.009	0.009	0.004
Observations	272,232	294,557	231,622	335,167
4-year high school graduation				
Any NMC retailer within 5-minute drive time	-0.0128* (0.0072)	-0.0175** (0.0082)	-0.0197** (0.0098)	-0.0111 (0.0070)
Outcome mean	0.849	0.798	0.771	0.849
Observations	361,498	378,542	310,699	503,071

Notes:
Each column summarizes estimates from separate regressions.
**Significant at the 0.05-level and *significant at the 0.10-level.
FRPM = Free and reduced-price meals.

Race/Ethnicity

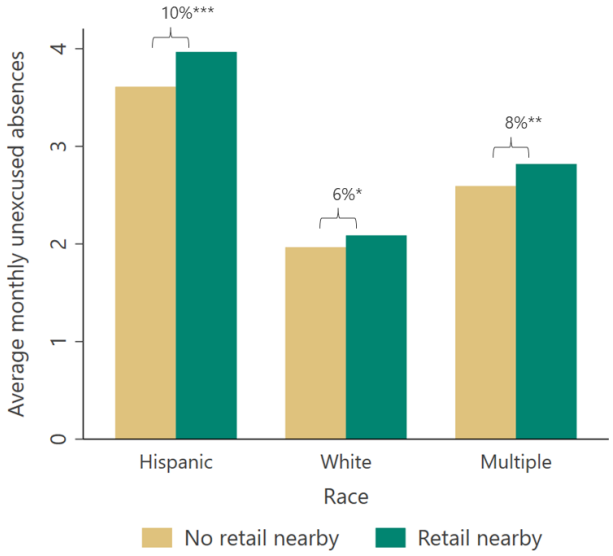
We also examine outcomes across race and ethnicity. The data define seven mutually exclusive race and ethnic categories: American Indian/Alaska Native (AIAN), Asian, Black, Hispanic, Native Hawaiian/other Pacific Islander (NHPI), White, and multiple races. Here, we discuss key findings from these analyses; the full results are summarized in Appendix Exhibit A6.

Notably, we find the largest relationships between retail proximity and a higher number of unexcused absences among Hispanic students, White students, and students with multiple race/ethnic backgrounds. These three categories also comprise the largest student populations. The estimated relationship is largest among Hispanic students, who also experience the highest average number of monthly unexcused absences (3.73). On average, Hispanic students in the 12th grade attending a school within a five-minute drive time of a retailer have 10% more monthly unexcused absences than students attending a school with no retail nearby.

For disciplinary and graduation outcomes, findings are comparable and not significantly different across racial categories.

Exhibit 10

NMC Retail Availability and Predicted 12th Grade Monthly Unexcused Absences, by Race and Ethnicity



Notes:
***Significant at the 0.001-level, **significant at the 0.05-level, and *significant at the 0.10-level.
Attendance data span the 2012-13 AY through 2018-19 AY.

Retail Density

Last, we examine how retail density relates to outcomes. Previously, we examined the impact of any retailer availability near a school. Here, we explore if the *number of retailers* located within five minutes of a school (i.e., density) further predicts differences in student outcomes. Density is important because a greater concentration of local retailers can result in greater advertising, different products offered, and lower prices.

We conduct these analyses across all grades. Our results—presented in Exhibit 11—focus on the relationship between density and monthly unexcused absences.

Across all grades, adding one more operational NMC retailer within a five-minute drive time to the school predicts a roughly 3% increase in monthly unexcused absences. Importantly, only 8% of students attend a school near more than one operational retailer. Further examination of the characteristics of these unique school neighborhoods is required to understand better the relationship between retail density and school outcomes.

We do not find evidence to suggest that retail density significantly relates to disciplinary or high school completion outcomes.

Exhibit 11

NMC Retail Density and Averagely Monthly Unexcused Absences

	Average monthly unexcused absences
9th grade	
Number of NMC retailers within a 5-minute drive time	0.0373** (0.0180)
Outcome mean	1.448
Observations	605,673
10th grade	
NMC retailer within a 5-minute drive time	0.0476** (0.0185)
Outcome mean	1.782
Observations	601,578
11th grade	
NMC retailer within a 5-minute drive time	0.0568*** (0.0211)
Outcome mean	2.111
Observations	616,812
12th grade	
NMC retailer within a 5-minute drive time	0.0621** (0.0248)
Outcome mean	2.533
Observations	660,539

Notes:
***Significant at the 0.001-level and **significant at the 0.05-level.
Attendance data span the 2012-13 AY through 2018-19 AY.

VI. Findings & Limitations

In this study, we examine how high school student outcomes change after NMC retailers start to operate near a school relative to comparison schools with no operational retailer nearby. We find that after the advent of NMC retail operations within a five-minute drive time of a school, the average number of monthly unexcused absences increased by about 7% for all high school students. Results suggest this relationship is largest for Hispanic, White, and multi-racial students. We also find that school proximity to a retailer predicts a 2.5% decrease in the probability of 4-year high school graduation. Results suggest this relationship is largest for students in rural regions and FRPM-eligible students.

Overall, the relationship between retail proximity and cannabis-related disciplinary incidents is practically small and not significant. However, among 12th-grade students in rural areas, retail proximity predicts a 48% increase in the likelihood of a cannabis-related disciplinary incident.

There are several limitations to this study. Notably, retailers are not randomly located throughout the state. Retailers consider factors such as rental prices and anticipated demand when choosing where to locate. Furthermore, we cannot account for the fact that some locales banned retail sales altogether. While our models account for several relevant school-level sociodemographic characteristics, there may be factors that predict retail location and outcomes that we do not control for.

Furthermore, we require more information to better understand the underlying mechanisms for some results. For example, we find that the number of nearby retailers relates to student attendance. However, it is unclear if this is driven by more advertising, lower prices, more product selection, or other market consequences. Further information about retail markets and the products sold is required to explain these results further.

Our study focuses on retail access near schools, but it is plausible that retail access from home also relates to adolescent cannabis use, perceived risk, and subsequent outcomes. Unfortunately, little is known about the impact of home exposure to retail, in large part due to limited residential information for students and adolescents.

Last, I-502 mandated funding for school-level cannabis prevention programming and education. Prevention strategies have the potential to mitigate adverse student-level impacts of legalization and greater access to cannabis products. More data and future research are required to understand better if prevention strategies play a moderating role.

Despite these limitations, our study presents robust findings that provide evidence to suggest a modest adverse relationship between legalized NMC retail and select high school outcomes.

Acknowledgments

The author would like to thank the staff at OSPI for helping us obtain the data we needed to conduct this evaluation. We are particularly grateful to Darby Kaikkonen, Leilani Tyler, and Keleen Crawford.

I would also like to thank Julia Cramer (WSIPP) and Danielle Fumia (ERDC) for providing feedback on earlier drafts of the report. I thank Julia Dilley for her continued support of WSIPP's I-502 evaluation work.

Appendices

Licensed Non-Medical Cannabis Retail Access and High School Outcomes in Washington State

Appendices

I. Healthy Youth Survey

The Healthy Youth Survey (HYS) is a school-based biennial survey administered to 6th-12th grade students statewide.[31] The HYS collects information related to youth health behaviors and risk factors, including attitudes toward and use of cannabis. Participation in the HYS is voluntary, and 12th-graders have a relatively lower participation rate.

Here, we examine the association between attending a school with at least one operational non-medical cannabis (NMC) retailer located within a five-minute drive time of the campus and reported cannabis use.[32] Our measures of cannabis use include an indicator for any reported cannabis use in the past 30 days ("past-month use") and an indicator for reporting at least ten days of cannabis use in the past month ("frequent past-month use"). We estimate this relationship for a sample of 10th- and 12th-grade participants. Middle school respondents report much lower rates of cannabis use. For example, on average, 7% of 8th-grade respondents report past-month cannabis use versus 18% of 10th graders and 26% of 12th graders.

The results of this analysis are summarized in Exhibit A1. We also summarize results for the sample of female students separate from male students.

[31] The Healthy Youth Survey (HYS) is a collaborative effort of the Health Care Authority—Division of Behavioral Health and Recovery (DBHR), the Department of Health (DOH), the Office of Superintendent of Public Instruction (OSPI), the Liquor and Cannabis Board (LCB), and the contractor, Looking Glass Analytics. Student participation is anonymous and voluntary.

[32] For our analysis we use data from the survey years 2012, 2014, 2016, and 2018.

Exhibit A1

NMC Retail Availability and Reported Cannabis Use, Healthy Youth Survey

	Total		Female		Male	
	Past-month cannabis use	Frequent past-month cannabis use	Past-month cannabis use	Frequent past-month cannabis use	Past-month cannabis use	Frequent past-month cannabis use
10th grade						
Any NMC retailer within a 5-minute drive time	0.0035	0.0045*	0.0050	0.0088***	0.0014	-0.0003
	(0.0044)	(0.0027)	(0.0053)	(0.0031)	(0.0060)	(0.0039)
Outcome mean	0.179	0.058	0.177	0.049	0.181	0.067
Standard deviation	0.383	0.233	0.381	0.217	0.385	0.249
Observations	192,196	192,196	99,867	99,867	92,329	92,329
12th grade						
Any NMC retailer within a 5-minute drive time	0.0059	0.0034	0.0146**	0.0070	-0.0040	-0.0008
	(0.0057)	(0.0038)	(0.0072)	(0.0044)	(0.0083)	(0.0058)
Outcome mean	0.260	0.098	0.245	0.077	0.275	0.119
Standard deviation	0.439	0.297	0.430	0.266	0.447	0.324
Observations	139,770	139,770	70,120	70,120	69,650	69,650

Notes:

***Significant at the 0.001-level, **significant at the 0.05-level, and *significant at the 0.10-level.
Sample includes data from the 2011-12, 2013-14, 2015-16, and 2017-18 academic years.

II. Full Results

Exhibit A2

Student Characteristics Grades 9-12

Characteristics	Mean (SD)
Female	0.48 (0.50)
Race	
American Indian or Alaska Native	0.02 (0.13)
Asian	0.07 (0.26)
Black	0.05 (0.22)
Hispanic	0.20 (0.40)
Native Hawaiian or Pacific Islander	0.01 (0.10)
White	0.59 (0.49)
Multiple races	0.06 (0.24)
Language	
English	0.81 (0.39)
Spanish	0.11 (0.31)
Other	0.08 (0.27)
Free and reduced-price meals (FRPM)	0.43 (0.49)
Special education (SPED)	0.12 (0.32)
Limited English Proficiency (LEP)	0.05 (0.22)
Observations	3,545,770

Note:
Data come from OSPI student records (2010-11 AY through 2018-19 AY).

Exhibit A3

NMC Retail Availability and High School Outcomes

	Average monthly unexcused absences	Average monthly excused absences	Cannabis-related disciplinary referral	4-year high school graduation	Ever graduated high school
9th grade					
NMC retailer within 5-minute drive time	0.1094**	-0.0252	-0.0010		
	(0.0478)	(0.0377)	(0.0014)	-	-
Outcome mean	1.448	2.215	0.012		
Observations	605,673	605,673	518,455		
10th Grade					
NMC retailer within 5-minute drive time	0.1081**	-0.0541	0.0006		
	(0.0530)	(0.0452)	(0.0012)	-	-
Outcome mean	1.782	2.304	0.012		
Observations	601,578	601,578	516,437		
11th Grade					
NMC retailer within 5-minute drive time	0.1264**	-0.0284	0.0003		
	(0.0637)	(0.0459)	(0.0010)	-	-
Outcome mean	2.111	2.189	0.009		
Observations	616,812	616,812	531,936		
12th Grade					
NMC retailer within 5-minute drive time	0.1731**	-0.0375	0.0010	-0.0155**	-0.004
	(0.0808)	(0.0532)	(0.0007)	(0.0074)	0.007
Outcome mean	2.533	2.051	0.006	0.820	0.871
Observations	660,539	660,539	568,850	505,466	742,982

Note:

**Significant at the 0.05-level.

Exhibit A4

NMC Retail Availability and Monthly Unexcused Absences

	Female	Male	Rural	Urban	FRPM	No FRPM
9th grade						
Any NMC retailer within a 5-minute drive time	0.1539*** (0.0486)	0.0713 (0.0556)	0.1241 (0.0882)	0.1094* (0.0564)	0.0766** (0.0320)	0.1488** (0.0717)
Outcome mean	1.394	1.506	1.526	1.429	0.795	2.223
Observations	292,195	310,920	142,562	460,553	325,873	277,242
10th grade						
Any NMC retailer within a 5-minute drive time	0.1247** (0.0528)	0.0956* (0.0575)	0.1079 (0.0860)	0.1083 (0.0657)	0.0843** (0.0429)	0.1185 (0.0731)
Outcome mean	1.687	1.881	1.846	1.769	1.099	2.658
Observations	290,190	308,862	142,792	456,260	334,465	264,587
11th grade						
Any NMC retailer within a 5-minute drive time	0.1319** (0.0619)	0.1256* (0.0697)	0.1743 (0.1160)	0.1125 (0.0740)	0.0775 (0.0544)	0.1786** (0.0845)
Outcome mean	1.951	2.272	2.230	2.081	1.436	3.058
Observations	296,964	317,307	147,433	466,838	356,400	257,871
12th grade						
Any NMC retailer within a 5-minute drive time	0.1677** (0.0782)	0.1854** (0.0883)	0.1266 (0.1375)	0.2040** (0.0991)	0.1171* (0.0698)	0.2368** (0.1038)
Outcome mean	2.322	2.740	2.797	2.458	1.797	3.617
Observations	316,295	341,864	157,442	500,717	389,925	268,234

Notes:
FRPM =Free and reduced-price meals.
***Significant at the 0.001-level, **significant at the 0.05-level, and *significant at the 0.10-level.

Exhibit A5

NMC Retail Availability and Cannabis-Related Disciplinary Incidents

	Female	Male	Rural	Urban	FRPM	No FRPM
9th grade						
Any NMC retailer within a 5-minute drive time	0.0003 (0.0012)	-0.0021 (0.0020)	-0.0010 (0.0030)	-0.0008 (0.0017)	0.0012 (0.0023)	-0.0008 (0.0011)
Outcome mean	0.009	0.016	0.014	0.012	0.019	0.006
Observations	250,366	265,876	122,031	394,207	237,261	278,977
10th grade						
Any NMC retailer within a 5-minute drive time	0.0008 (0.0012)	0.0003 (0.0017)	0.0005 (0.0025)	0.0006 (0.0015)	0.0012 (0.0021)	0.0001 (0.0009)
Outcome mean	0.008	0.016	0.012	0.012	0.018	0.007
Observations	249,097	265,175	122,566	391,705	227,490	286,781
11th grade						
Any NMC retailer within a 5-minute drive time	0.0009 (0.0007)	0.0004 (0.0016)	0.0018 (0.0021)	-0.0006 (0.0011)	0.0004 (0.0017)	0.0001 (0.0009)
Outcome mean	0.005	0.013	0.009	0.009	0.013	0.006
Observations	256,066	273,676	127,210	402,535	223,238	306,507
12th grade						
Any NMC retailer within a 5-minute drive time	0.0004 (0.0005)	0.0015 (0.0012)	0.0025* (0.0015)	0.0003 (0.0009)	0.0015 (0.0013)	0.0007 (0.0007)
Outcome mean	0.003	0.009	0.006	0.006	0.009	0.004
Observations	272,232	294,557	135,166	431,623	231,622	335,167

Notes:
FRPM =Free and reduced-price meals.
*Significant at the 0.10-level.

Exhibit A6

NMC Retail Availability and School Outcomes—12th Grade, by Race/Ethnicity

	AIAN	Asian	Black	Hispanic	NHPI	White	Multiple
Monthly absences							
Any NMC retailer within a 5-minute drive time	-0.3828 (0.3126)	0.1377 (0.1171)	0.0902 (0.1809)	0.3580*** (0.1336)	0.0084 (0.2456)	0.1277* (0.0749)	0.2355** (0.1114)
Outcome mean	3.672	2.144	3.879	3.725	4.334	2.007	2.674
Observations	10,796	48,365	33,741	128,767	6,405	390,449	39,631
Cannabis-related discipline							
Any NMC retailer within a 5-minute drive time	0.0003 (0.0042)	0.0004 (0.0012)	0.0019 (0.0035)	0.0022 (0.0016)	-0.0007 (0.0058)	0.0006 (0.0007)	0.0013 (0.0021)
Outcome mean	0.009	0.003	0.012	0.008	0.008	0.005	0.008
Observations	9,259	41,713	29,173	112,988	5,672	332,955	35,026
High school graduation							
Any NMC retailer within a 5-minute drive time	-0.0416 (0.0283)	-0.0082 (0.0118)	-0.0161 (0.0185)	-0.0158 (0.0147)	0.0760*** (0.0247)	-0.0071 (0.0083)	0.0051 (0.0112)
Outcome mean	0.670	0.884	0.753	0.770	0.752	0.834	0.829
Observations	13,084	63,044	39,324	141,931	7,030	506,565	42,792

Notes:
AIAN = American Indian/Alaska Native.
NHPI = Native Hawaiian/other Pacific Islander.
***Significant at the 0.001-level, **significant at the 0.05-level, and *significant at the 0.10-level.

For further information, contact:
Amani Rashi at 360.664.9804, amani.rashid@wsipp.wa.gov

Document No. 23-12-3201