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The Impact of City Bans on Medical Marijuana Dispensaries on Marijuana Use Among High School Students in Los Angeles County, California

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Author
Branson, Catherine Moreno

Publication Date
2019

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The Impact of City Bans on Medical Marijuana Dispensaries on Marijuana Use Among High School Students in Los Angeles County, California

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Public Health

by

Catherine Moreno Branson

2019
ABSTRACT OF THE DISSERTATION

The Impact of City Bans on Medical Marijuana Dispensaries on Marijuana Use Among High School Students in Los Angeles County, California

by

Catherine Moreno Branson
University of California, Los Angeles, 2019
Professor Deborah C. Glik, Committee Chair

As marijuana policy continues to rapidly evolve in California and LA County, many regulatory approaches have been undertaken with very little evidence of their effectiveness. After storefront medical marijuana dispensaries became legal in California in 2005, some cities chose to allow them while others chose to ban them. To date, however, no empirical research has documented whether banning dispensaries or allowing and regulating them results in less harm to communities. Even less is known about which approach is more effective at achieving a policy goal that unites all sides of the debate on marijuana legalization: preventing adolescent marijuana use.

This dissertation examined the impact of city policies restricting or banning medical marijuana dispensaries on the marijuana use behaviors of public high school students in Los Angeles County, California. My first research question was whether city laws that ban or enact more restrictions on dispensaries have a preventative impact on marijuana use among high school students. My other research questions concerned what other factors might be important
determinants of whether stricter dispensary regulations or total bans on dispensaries were effective in preventing high school students’ cannabis use. I theorized that the effectiveness of dispensary bans would be at least partially dependent on effective enforcement and that MMD bans would be positively correlated with greater perceptions of the risk of marijuana use among adolescents. I therefore examined the degree to which the relationship between dispensary bans and student marijuana use was mediated by the actual number of dispensaries in the city, how dispensary bans impacted students’ perceptions of the risk of marijuana use, how close dispensaries were located to participants’ schools, and how many dispensaries were located in the close vicinity of the school.

Neither dispensary bans nor the number of dispensaries in a city (normalized by population to a rate of dispensaries per 10,000 city residents) were associated with student marijuana use in cross sectional analyses comparing the prevalence of student marijuana use across 57 cities in LA County. While lower risk perceptions were related to higher use, city dispensary bans were not directly rated to students perceptions of the risk of marijuana use and therefore did not mediate the relationship between city MMDs and adolescent marijuana use. However, a trend analysis using a difference-in-difference approach revealed a significant decline in the prevalence of lifetime marijuana use among City of Los Angeles high school students after Proposition D (a voter-approved ballot measure that outlawed over two thirds of the dispensaries in the city) was implemented in 2013. Dispensary bans were also significantly correlated with a longer distance between high schools and unlicensed dispensaries and a lower number of dispensaries located with 2,000 feet of participants’ high schools, factors which were in turn associated with less lifetime and recent marijuana use among students. Accounting for these factors strengthened the association between dispensary bans and student marijuana use but not to the point of statistical significance. The positive correlation between the number of licensed dispensaries located within 2,000 feet of high schools and a greater prevalence of lifetime marijuana use among students was statistically significant, but the positive correlation
with recent marijuana use was not and the number of dispensaries located near schools was not a significant mediator of the negative association between dispensary bans and student marijuana use.

In a cross-sectional analysis using data from 57 LA County cities during the 2015/2016 and 2016/2017 school years, dispensary bans were negatively, not but significantly correlated with lifetime or recent marijuana use among students, which negated my focal hypothesis that MMD bans would have a significant suppressing effect on adolescent marijuana use in cities where they were enacted. This study did confirm, however, that enacting more restrictive dispensary policies can have a significant preventative impact on high school students’ marijuana use over time when followed by a committed enforcement effort as was seen in the City of Los Angeles with implementation of Proposition D. This research has also identified neighborhood and enforcement factors that are significantly associated with high school students’ marijuana use, such as how far unlicensed dispensaries are located from their school and/or how many unlicensed dispensaries were located near their school. Based on these findings, the primary conclusion of this dissertation is that regardless of whether a city chooses to ban or to allow dispensaries, rigorous enforcement of restrictions on their number and location is essential to prevent adolescent marijuana use.
The dissertation of Catherine Moreno Branson is approved.

Michael C Lens
James A Macinko
Michael L Prelip
Deborah C Glik, Committee Chair

University of California, Los Angeles
2019
This dissertation is dedicated to Dr. Leo Estrada, who was one of my doctoral committee members before his death in November of 2018. I am forever grateful to have known and studied under Dr. Estrada. He was extraordinarily giving of his time and insight to me as he was to so many others and to the community at large. Rest in peace, Dr. Estrada.
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ACKNOWLEDGEMENTS

I am grateful for the support I received from my dissertation committee. Due to the guidance and critique I received from Drs. Deborah Glik, Michael Prelip, James Macinko, and Michael Lens and the late Leo Estrada, I was able to complete my dissertation and the requirements of the PhD degree. Furthermore, I credit the support of my advisor, Dr. Deborah Glik for helping me finish this dissertation and my degree with her wealth of experience and insight in conducting community-based and policy research, and especially her patience and encouragement. Most of all, I thank my husband, Steve Branson, and my children, Owen and Chloe, for their love, support, and forbearance as I completed my degree. I could not have done it without you.
EDUCATION

2019 (expected) Ph.D., Public Health, UCLA, Los Angeles, CA
   Minor: Urban Planning
2006 M.P.H., Public Health, UCLA, Los Angeles, CA
1998 B.A., International Development Studies/Anthropology, UCLA, Los Angeles, CA

SELECTED RESEARCH EXPERIENCE

2017-Present Research Analyst III
   County of Los Angeles Department of Public Health
2014 - 2016 Prevention Fellowship
   Substance Abuse and Mental Health Services Administration
2012 – 2014 Addiction Health Research Pre-Doctoral Fellow
   National Institutes of Health (NIH)/National Institute on Drug Abuse (NIDA)
2010 - 2012 Project Director, UCLA School of Nursing, Los Angeles, CA
   “HBV Prevention for Homeless at Risk for HBV/HCV/HIV” (NIH/NIDA, 5R01DA016147-04)
2007 – 2010 Project Director, UCLA Center for Community Health, Los Angeles, CA
   “Computerized vs. Interpersonal HIV Preventative Interventions for Delinquent Youth” (NIH/National Institute of Mental Health, 7R01MH074346-05)
2005 – 2007 Study Coordinator, Friends Research Institute, Inc., Los Angeles, CA
   “Reducing Meth Use and HIV Sex-risk Behaviors in Out-of-treatment MSM” (NIH/National Center for HIV, Viral Hepatitis, STDS and Tb Prevention, 7UR6PS000312-02)
2004 – 2005 Epidemiology Analyst, Tobacco Control and Prevention Program, Los Angeles County Department of Public Health, Los Angeles, CA
2001 – 2004 Program Coordinator, Multiple Morbidities Mobile Testing Program, Center for Behavioral Research and Services, Long Beach, CA
2000 - 2001 Research Assistant, California State University, Long Beach, Center for Behavioral Research and Services
GRANT AWARDS

2016  Community Partnership Grant, UCLA School of Public Health, Los Angeles
2015  Summer Research Mentorship, UCLA Graduate Division
2014  Summer Research Mentorship, UCLA Graduate Division

SELECTED PUBLICATIONS


Chapter 1. Introduction

Problem Statement

Currently, in the United States, there are more annual deaths and disabilities from substance abuse than from any other preventable health condition (Azofeifa, 2016). A robust body of literature suggests that prevention interventions that delay and minimize marijuana and other substance use during childhood and adolescence could have a considerable impact on morbidity and mortality in addition to reducing associated social and economic costs (Cartwright, 2008; Larimer ME, Malone DK, Garner MD, & et al, 2009; National Institute on Drug Abuse, 2016). Adolescent substance use is also a problem that is ideal for intervention within a public health framework, as it is both widespread and amenable to population-level approaches designed to reduce youth exposure to harmful influences. While various community-level prevention approaches have been implemented to protect underage youth from exposure to factors that encourage them to use alcohol and drugs at an age when substance use can seriously disrupt their social, physiological, and emotional development (Bentler, 1992; Clark, et al., 1998), an issue addressed in this dissertation is whether policies that restrict access to marijuana by adolescents enacted at the local level have any measurable impact. One important question is whether restrictions on marijuana have any impact on youth use in the context of high vehicle ownership, marijuana delivery services, and contrasting marijuana regulations between neighboring cities. The research literature shows that local regulations on legal substances can have a significant, if not always dramatic, effect (Hays, Hays, & Mulhall, 2003; Kuntsche, Kuendig, & Gmel, 2008; Mayberry, Espelage, & Koenig, 2009; Quinlan et al., 2015). Given the large numbers of people impacted, if city policies cause even an incremental reduction in substance use it can have a qualitatively larger impact on a community than more intensive interventions carried out with less people (Frieden, 2010).
Throughout the United States (U.S.), marijuana policy has been changing rapidly and following a consistent national trend of less restrictive state laws controlling access to marijuana (National Association of State Legislatures, 2019). In an enduring legal paradox, the marijuana plant and its products remain illegal under U.S. Federal law, but the Federal government has also allowed regulations on marijuana to be determined by each state independently (Title II of the Comprehensive Drug Abuse Prevention and Control Act, 21 U.S.C. §§ 801-971) and these laws now contrast with Federal marijuana law in the majority of U.S. states. California’s marijuana laws are among the most permissive in the U.S., allowing for home delivery of psychoactive marijuana products, storefront medical and recreational marijuana outlets, and no limits on the THC potency of products sold (CA Health and Safety Code Section 11362.775).

An important feature of California’s state marijuana laws, however, is that they do not preempt local regulations, meaning that local jurisdictions like cities and counties have the prerogative to enact local ordinances that further restrict access to marijuana within their borders. Consequently, since medical marijuana was legalized in California in 1996 a patchwork of local legislation has developed where regulations governing marijuana differ from one local jurisdiction to the next. These local regulations include hundreds of medical marijuana dispensary bans enacted by cities in California, some of which have been in place for over a decade (League of California Cities, 2019).

The Implications of Changing Marijuana Policy and Social Norms

As one of the most commonly consumed drugs in the world (Wadsworth & Hammond, 2019), marijuana has increasingly become a target of substance abuse prevention efforts as social and political change has resulted in its increased availability and potency (Asbridge, Valleriani, Kwok, & Erickson, 2016; Friend, Pettibone, Florin, Vela, & Nargiso, 2015; Hawkins et al., 2016; Quinlan, Valenti, Barovier, Rots, & Harding, 2015). A chief concern among public health professionals and policy makers is that the increased social acceptance and
normalization of marijuana use, combined with its expansion into retail settings in states like California will improve ease of access and result in increased usage among youth (CA Blue Ribbon Commission on Marijuana Policy, 2015; LA County Dept. of Public Health, 2018). This concern has some validity on a national level, where population-based surveys of substance use among adolescents in the U.S. such as the National Survey of Drug Use and Health (NSDUH), the Youth Risk Behavior Survey System (YRBSS), and the Monitoring the Future study (MTF) have documented increases in the last several years related to lifetime and recent marijuana use in the United States among older teens (Johnston et al., 2018, SAMSA, 2018; Kann et al., 2018), even as their use of illegal drugs, cigarettes, and alcohol declined (Miech, 2017).

Other research findings suggest that the relationship between greater legal access to marijuana and changing social norms regarding adolescents’ perceptions of risk and use of marijuana may not be so straightforward (Wall et al., 2016). Adolescent cannabis use has not been found to differentially increase after states pass medical cannabis laws (Hasin et al., 2015; Wen et al., 2015) and the national-level increases in marijuana use documented among older teens have been offset by non-statistically-significant declines in marijuana use among younger teens. This has resulted in relatively stable rates in adolescents’ marijuana use overall (Rosa, 2017). Furthermore, although drastic decreases in the perceived risks related to marijuana use have been observed in the last decade among U.S. adolescents, they have not been followed by a proportional rise in marijuana use in the past decade (Sarvet et al., 2018) as they were in previous decades (Okaneku, Vearrier, McKeever, LaSala, & Greenberg, 2015). The changing relationship between adolescents’ perception of the risk of marijuana use and their patterns of use underscores the need for updated empirical research on how the increasing acceptance and accessibility of marijuana use influences adolescent marijuana use behavior in the current legal and cultural context and on a more local level.
The relationship between marijuana policy and teen marijuana use in California has been similarly dynamic and complex. California was the first state to legalize medical marijuana use in 1996. This ground-breaking policy and cultural change was associated with lower perceptions of the harm of marijuana use among adolescents and young adults (Khatapoush & Hallfors, 2004). However, statewide legalization of medical marijuana use for people over the age of 18 who had a recommendation from a licensed physician did not result in a dramatic increase in marijuana use among teens in California (SAMHSA, 1999). In November of 2003, California approved Senate Bill 420 (SB 420), which allowed medical marijuana collectives, which had formerly been defined as person-to-person networks of one marijuana supplier to a maximum of five patients, to distribute medical marijuana in a retail setting to an unlimited number of qualified patients. Qualified patients were defined as any California resident with a recommendation from a licensed physician to use marijuana to treat a health condition. SB 420 also developed a system that issued medical marijuana patients identification cards that certified them as medical marijuana patients with a valid recommendation from a physician. This allowed medical marijuana collectives that formerly existed primarily to link marijuana suppliers to customers via personal networks to evolve into brick and mortar businesses like any other. Enactment of SB 420 in January of 2004 represented the first time that marijuana could be legally be obtained from a retail establishment since it had become a legal product in 1996.

Research has shown that state marijuana laws allowing storefront sales for medical marijuana have a greater association with adult marijuana use rates than laws that permit fewer public forms of access, such as home cultivation (Pacula et al., 2015). Data from the California Healthy Kids Survey (CHKS) 2013 indicate that marijuana use rates among California high school students increased every year for eight years following 2005, the year SB 420 was enacted (Austin et al., 2016; Austin et al., 2018). Data from the National Survey of Drug Use and Health similarly demonstrated a sustained increase among adolescents aged 12-17 years old following the combined 2005-2006 survey years (Azofeifa et al., 2016). These reports do not
show a permanent increase in teen marijuana use in California after storefront medical marijuana dispensaries became a reality but their associations with increased marijuana use in the shorter term do make a persuasive case for further study of the impact retail marijuana outlets have on adolescent marijuana use.

Local contexts took on a greater meaning with the transition to a retail model for marijuana access. In response to the proliferation of medical marijuana dispensaries throughout the state, California cities began to exercise their right to “local control” and enacted ordinances to either ban dispensaries from operating within their borders or to allow them to operate under additional restrictions than were required under California law. Currently over 65% of the cities in California have dispensary bans in place (League of California Cities, 2019), as do 75 out of the 88 cities in LA County (Ostrowitz, Dahlin, Hart, & Sheji, 2019; CannaRegs.com). State-level studies and reports do not capture these local variations in access to marijuana outlets, making it difficult to determine how these controls influence local variations in adolescent marijuana use. For example, the impacts of dispensary operations within neighborhoods have been studied for associations with crime (Freisthler, Ponicki, Gaidus, & Gruenewald, 2016; Contreras, 2017) and adult marijuana use (Mair, Freisthler, Ponicki, & Gaidus, 2015), but the localized impact of these outlets on the likelihood of a young person using marijuana is unknown.

Setting

Several factors make Los Angeles County an ideal location to study the effect of dispensaries on adolescent marijuana use. The County of Los Angeles was home to over 10 million people in 2018 (10.19 million) (LA County Internal Services Department, 2019), a population that is larger than 42 U.S. states. It is also large and diverse in area, covering 4,084 square miles that span highly concentrated urban areas as well as suburban and rural zones. One of the oldest medical marijuana dispensaries in California, the Los Angeles Cannabis Resource Center, was founded here in 1996 (Romero, 2013), the same year that medical
marijuana use was legalized. Among the 88 incorporated cities in LA County, ten now allow medical marijuana dispensaries (LA County of Department Health, 2019). In the Fall of 2016, when the data for this study were collected, there were only six cities in Los Angeles that allowed marijuana dispensaries. However, since one of those cities was the City of Los Angeles, with a population of approximately 4 million people (American Community Survey, 2018) 43% of LA County residents already lived in a city that allowed storefront dispensaries.

Motivation

My experience as a resident of the City of Los Angeles for most of the study period provided the original motivation for this study. Between 2009 and 2015, I saw dispensaries open and close in my Northeast Los Angeles neighborhood with bewildering frequency, including one located directly across the street from an elementary school. Between 2014 and 2016, I was also completing a two-year Prevention Fellowship with the Substance Abuse and Mental Health Services Administration where I tracked developments in marijuana policy, developed literature reviews for the LA County Department of Public Health Substance Abuse Prevention and Control Program (SAPC), and provided research support to a coalition of SAPC prevention providers and community members dedicated to preventing marijuana use among children and adolescents.

It was an interesting time to work in marijuana policy, as Colorado had recently become the first US state to legalize “recreational” (non-medical) marijuana use for adults in 2014. Several ballot measures to do the same in California were already in development and State and local officials acknowledged the need to act quickly in preparation for the possibility that one would be approved by voters in next election. The one unifying concern among prevention advocates, California legislators, and even the lobbying group developing the ballot measure that later became the Adult Use Marijuana Act was to limit the impacts of policies increasing access for adults on youth populations. As this was an issue that was important to me as well, I
proposed tracking changes in city ordinances regulating marijuana use in 2014 as a project for my SAMHSA Prevention Fellowship and continued updating the policy database quarterly through the end of 2016. Upon locating a data source with a large enough sample size to compare student behavior at a city level, that policy tracking document (Appendix A: Medical Marijuana Dispensary Ordinances in LA County) became the basis for this dissertation research. It provided the link between city policies and student marijuana use that could be used to test whether dispensary bans have a dampening effect on adolescent marijuana use. I also believed it was important to include the number of storefront dispensaries in each city in LA County in my analysis. I therefore proposed collecting data on the number and location of the medical marijuana dispensaries in LA County as a research project near the end of my fellowship in September 2016.

Research Questions

The basic question motivating this research is whether city regulations banning or restricting storefront dispensaries are effective in reducing youth marijuana use (Research Question 1) and whether their effects are dependent on any other factors (Research Questions 2-5). One hypothesis for why dispensary bans might be effective is that even though they are not always effective in preventing dispensaries from locating in a city, they are likely to result in a lower number of total outlets, which would make access to marijuana less convenient in that city. Alternatively, bans on marijuana storefronts could have a dampening effect on youth marijuana use by signaling that marijuana use is not considered safe or socially acceptable in their community. I also wondered if dispensary bans could prevent marijuana use among high school students by being more effective at reducing the presence of storefront dispensaries near high schools than a city policy that allows dispensaries. This dissertation will test each of these theories.
Research Approach

I investigated whether city ordinances restricting dispensaries have a cross-sectional and long-term impact on youth marijuana use. I also explored the mechanisms through which this effect may operate, i.e., whether an impact of dispensary bans on student marijuana is mediated by factors like the number of dispensaries actively operating in a city, students’ perceptions of the risk of marijuana use, or the proximity of dispensaries near their school. To do this I used four linked data sets. One is a database categorizing and compiling the texts of every ordinance that was enacted to regulate marijuana in Los Angeles County municipalities between 2014 and 2016. The database contains the full text of each city ordinance regulating dispensaries, including detailed notes about when they were enacted and amended. Regulations were categorized by whether cities banned or allowed dispensaries, which was the independent variable for all of the analyses presented here.

The second data source is a school-based behavioral survey, the California Healthy Kids Survey (CHKS). The CHKS survey was used for the measures of lifetime and recent marijuana that were the dependent variables for all of these analyses. The CHKS survey has included standardized questions on marijuana use and the perceived risk of marijuana use since it began to be administered statewide in the late 1990’s and is the only survey of adolescent behavior that is conducted on large enough scale to allow for reliable measurement of marijuana use among high school students in LA County at the city level. I used CHKS survey data from the 2005/2006 school year through the 2016/2017 school year for this dissertation.

Students’ behavioral data was linked to location using the third dataset, the California Schools Directory. The California Schools Directory is a listing of school addresses that is maintained by the California Department of Education. The LA County public schools that participated in the CHKS survey were linked to their location in cities by the California
Department of Education identification code, a unique code for each school that is common to both the CHKS survey and California Schools Directory.

The fourth dataset is a collection of the addresses of dispensaries that were active in LA County in September of 2016, which I obtained from online searches of dispensary listing websites like Weedmaps. Each business included in the analyses was verified as being in active operation via phone calls, checking WeedMaps message boards for current ratings and comments, and by whether a dispensary was photographed at that location using Google Street View. Once verified as being active, the address of each storefront was geocoded using geographic information systems (GIS) software to pinpoint their location within city boundaries and determine their location relative to LA County public high schools.

**Practical and Theoretical Relevance of the Research**

The primary practical use of this research is to establish whether dispensary bans are effective on a city level, or if spillover effects and the many other ways young people can access marijuana render them symbolic. The theoretical relevance is gained by establishing why city dispensary ordinances may or may not be effective. The results of this dissertation will determine whether dispensary bans work by making access less convenient at a city level, by changing teens’ perceptions of risk, or by limiting the number of outlets near areas young people frequent. Research on city dispensary policies and the local impacts of dispensaries on youth use is so scarce that it is unknown if all of these mechanisms apply…or none of them.
Chapter 2. Empirical Literature Review

In this review of the literature I will first assess the physiological, psychological, developmental and social consequences of marijuana use among adolescents. I will then review the current prevalence of marijuana use as well as trends in attitudes and norms toward marijuana use in California over the past two decades following the legalization of medical marijuana use in 1996. I will then cover current state and local policy approaches to regulating marijuana use and conclude by reviewing gaps in the literature. Given that the goal of this research is to assess the role of city dispensary policies in limiting exposure to marijuana among adolescents, community and societal-level approaches to marijuana use prevention are the focus of this literature review, rather than family and peer influences.

The Mental and Physical Health Effects of Marijuana Products

Marijuana is comprised of the dried flowers and leaves of the Cannabis Sativa plant. Marijuana and cannabis are used as general terms to refer to the many extracts and preparations that can be made from this plant. Marijuana products vary in effects and potency by genetic strain, cultivation technique, and by how it is processed (Sevigny, Pacula, & Heaton, 2014). Traditionally used by smoking the dried flowers, marijuana can also be used by heating flowers, oils, or other concentrated forms in electronic vaporizing devices, by baking extracted oils into foods, and in pills, tinctures, sprays, creams, ointments, eye drops, and suppositories (Association of Public Health Laboratories, 2016; NIDA, 2017).

The chemical contents of marijuana include over 100 cannabinoids; chemical compounds with physiological and/or psychoactive effects. The distinct effects of most cannabinoids have yet to be studied in laboratory settings and are poorly understood (Atkinson & Abbott, 2018; Cohen & Weinstein, 2018). The two best-known cannabinoids are delta-9
tetrahydrocannabinol (THC) and cannabidiol (CBD). THC is the primary psychoactive ingredient in marijuana that causes intoxication and euphoria. CBD is thought to be responsible for the anti-convulsive and pain-relieving properties of marijuana but is not intoxicating. Recent research on therapeutic uses of cannabinoids has shown that they have considerable promise to treat appetite loss, nausea, chronic pain, insomnia, inflammation, and glaucoma (Bergamaschi et al., 2011; NIDA, 2017; Hill, 2015; Volkow et al., 2014), but marijuana products containing THC also produce potent psychoactive side effects. Favorable psychoactive effects from THC include calming, relaxing, stimulating, or uplifting feelings, but unpleasant effects like anxiety, panic attacks, and paranoia can also occur (Brangham, 2014).

THC products act on the central and peripheral nervous systems by binding to receptors for endogenous cannabinoids called “endocannabinoids”. Endocannabinoids are neurotransmitters naturally produced in the human brain that bind to and activate cannabinoid receptors found in the prefrontal cortex, hippocampus, basal ganglia, thalamus, hypothalamus, and cerebellum (Gaoni & Mechoulam, 1971). The psychoactive effects of marijuana are produced by displacing endocannabinoids with exogenous cannabinoids such as THC, thus altering cognitive function. Documented effects of marijuana use on cognitive function include chronic short-term memory problems, loss of balance and coordination, difficulty concentrating, changes in sensory perceptions, impaired ability to perform complex tasks, decreased alertness, and decreased reaction time (Borgelt et al., 2013; Bolla et al., 2002; Croft et al., 2001; Lyons et al., 2004; Pope et al., 1997; Solowij & Grenyer, 2002; Varma et al, 1988). Long-term cognitive effects from marijuana use are mild compared to those described above but can last for weeks after acute effects wear off (Tapert, Schweinsburg, & Brown, 2008). The most enduring cognitive effects are seen in decision-making, concept formation, and planning (Lisdahl & Price, 2012). Cognitive effects also differ in severity depending on the quantity of regular use, how recently a person used, how old they were when they started using marijuana, and how long they have been using it (Crean, Crane, & Mason, 2011).
The Significance of Adolescent Marijuana Use

Marijuana use that occurs during adolescence has been associated with use of other drugs (including heroin and cocaine), poor school performance, and a higher likelihood of substance abuse or dependence in adulthood (Brook, Lee, Brown, & Finch, 2012; D’Amico, Ellickson, Collins, Martino, & Klein, 2005; Juon, Fothergill, Green, Doherty, & Ensminger, 2011). Adolescents are more vulnerable to harmful effects from marijuana use because of the active processes of brain development that occur during this stage (D’Amico et al., 2015; Volkow et al., 2014). For example, developing dependence on marijuana is more likely among adolescents than among adults and the effects of frequent use at this age appear to be much longer lasting.

The overall likelihood of developing dependency among people who use marijuana is estimated to be 9% (Hall & Degenhardt, 2009), but among people who begin using marijuana before age 18, the likelihood to develop dependence is almost doubled (17%) and developing symptoms of problem use is estimated to be 4 to 7 times more likely (Winters & Lee, 2008).

Among adults the cognitive effects of marijuana use generally disappear within a month, when the last traces of the fat-soluble THC molecule dissipate (Mizrahi, Watts, & Tseng, 2017; Schweinsburg, Brown, & Tapert, 2008; Scott et al., 2018, 2017; Yanes et al., 2018). In contrast, neuroimaging studies have shown that regular marijuana use in adolescence is associated with changes to areas of the brain involved in executive functions like memory, attention, learning, retention, and impulse control (Filbey et al., 2014; Schreiner & Dunn, 2012). Advances in brain imaging technology have made it possible to directly observe the impact of substance use on the brain (Bava et al., 2009; Bisogno, 2008; Chambers, Taylor, & Potenza, 2014; Giedd, 2008; Koob & Volkow, 2009; Volkow et al., 2009), which has resulted in a greater understanding of the mechanisms by which marijuana use interferes with normal brain development.

Studies using prospective case-control and other longitudinal designs have found that cognitive effects from repeated marijuana use during adolescence persist into adulthood (Crean
et al., 2011, Meier et al., 2012; Wagner and Anthony, 2002; Windle et al., 2019). Windle and colleagues (2019) recently reported results from a prospective study that followed U.S. children into adulthood where they found that substance use (alcohol, marijuana, and tobacco use) between the ages of 13 and 15 years old was associated with a smaller amygdala, a brain region that develops earlier in adolescence and is crucial to emotional regulation. The authors also found that substance use between the ages of 16 and 18 years old was associated with a lower volume of gray matter (brain tissue) in the pars opercularis, a region of the brain that develops later in adolescence and is responsible for cognitive control. These very recent research findings suggest that not only does substance use during adolescence result in changes to the brain that persist into adulthood, but that initiating regular use at different times may affect different regions of the brain according to which regions are in active development at the age when the substance use is occurring.

The Endocannabinoid System and Neurological Development During Adolescence

Recent research has documented that endocannabinoids are instrumental to the final processes of brain development that occur during adolescence (Becker, Collins, & Luciana, 2014; Chambers, Taylor, & Potenza, 2014). Receptors for endocannabinoids begin to increase in the subcortical and frontal cortical regions of the brain during childhood (Ellgren et al., 2008; Rodriguez de Fonseca, Ramos, Bonnin, & Fernandez-Ruiz, 1993) and peak in adulthood, which has led scientists to conclude that the endocannabinoid system is a mechanism through which greater degrees of cognitive control are achieved between childhood and adulthood (Becker, Collins, & Luciana, 2014; Gogtay & Thompson, 2010; Long et al., 2012). During normal neural development endocannabinoid receptors are pruned as part of the consolidation of neuronal pathways that increases efficiency in signals to and from the prefrontal cortex, which in turn increases the capacities for cognitive control and self-directed behavior (Gogtay & Thompson, 2010). If THC molecules replace the endocannabinoids that drive these processes, it alters the
way the brain consolidates neuronal pathways throughout adolescence, which may in turn result in less capacity for cognitive control and self-directed behavior in adulthood (Volkow et al., 2014).

The Dunedin Longitudinal Study, a prospective cohort study conducted in Dunedin, New Zealand, has provided the best evidence of the long-term effects of marijuana use on intelligence and life prospects. In this study, 1,037 people were followed from birth into adulthood. Their intelligence was assessed at the ages of 7, 9, 11, and 13 years of age (theoretically before the onset of marijuana use) using the Intelligence Quotient (IQ) test (Stern, 1914). The Dunedin Longitudinal Study investigators found that repeated marijuana use before the age of 15 years old was associated with declines across multiple domains of cognitive functioning, even after controlling for years of education (Meier et al., 2012). Their research was the first to document a decline in cognitive functioning from adolescence to adulthood among adolescent-onset marijuana users compared to non-users and that cessation of marijuana use after adolescence did not fully restore neuropsychological functioning in adulthood. More recently, Cerda and colleagues (2016) used the Dunedin Longitudinal Study data to demonstrate that chronic marijuana use during adolescence and adulthood was associated with downward socioeconomic mobility and more financial difficulties, and workplace problems in early midlife, even when controlling for socioeconomic adversity, childhood psychopathology, achievement orientation, family structure, marijuana-related criminal convictions, early onset of marijuana dependence, and comorbid substance dependence.

The threshold of adolescent marijuana use where loss of cognitive potential occurs or where dependence becomes a risk is unknown and likely differs by individual. Nevertheless, it is clear from the literature that earlier and more frequent marijuana use during childhood and adolescence is associated with a greater potential to disrupt normal brain development and to develop problem substance use (Crean, Crane, & Mason, 2011; Meier et al., 2012; Volkow et al., 2014). More randomized controlled trials and prospective cohort studies are needed to
definitively characterize the impacts of marijuana use on adolescent brain development, but the current body of literature persuasively documents the importance of minimizing exposure to THC during adolescence (Ammerman, Ryan, and Adelman, 2017).

**Current Prevalence of Marijuana Use in the United States, California, and LA County**

The 2017 National Survey on Drug Use and Health (NSDUH) Annual Report indicates that 25% of 9th graders and 37% of 11th graders in the U.S. report lifetime marijuana use, while 13% of 9th graders and 18% of 11th graders in the U.S. report having used within the past 30 days (“2017 NSDUH Annual National Report | CBHSQ, 2018). The Monitoring the Future study found that as of 2017, 6% of 12th graders in the U.S. report daily use of marijuana, which corresponds to about one in 16 high school seniors (Miech et al., 2018). Rates of recent marijuana use among adolescents in California are over three times higher than the national average; 22% of California adolescents aged 12-17 reported using marijuana in the past 30 days in 2017 (YRBSS online query system), compared to 6.5% nationally (Center for Behavioral Health Statistics and Quality. (2018). NSDUH trend data for California between 2002 and 2014 indicates that among youth aged 12-17 there has been an overall increase of 16%, but also that there was not a consistent trend of increase. Instead, marijuana decreased from the 2002-2003 study years through the 2005-2006 study years and held relatively steady before increasing again during the 2010-2011 study years (Azofeifa et al., 2016).

A Community Needs Assessment conducted by the LA County Department of Public Health in 2017 (LA County Department of Public Heath, 2018) indicates that nearly half (48%) of LA County residents aged 12 or older have used marijuana at least once in their lifetime and that 14% had used marijuana in the past 30 days. It also found that residents were an average age of 17 years old when they first used marijuana, with a majority (61%) using marijuana for the first time before age 18. Similar to national (Johnson, O’Malley, Miech, Bachman, & Schulenberg, 2015) and state (YRBS, 2019) reports of the perceived accessibility of marijuana,
the LA County assessment found that most (62%) County residents over the age of 12 perceived it easy to access marijuana in their neighborhood. The marijuana users in the study most commonly obtained their marijuana from a friend (58%), followed by a dispensary (21%), family/relative (11%), or the illicit market (6%).

More specific data is available from the YRBSS survey for the Los Angeles Unified School District (LAUSD) and indicates a local pattern different from what has been observed at a state level (Figure 2.1).


Between 1997 and 2017 lifetime marijuana use among high school students in the LA Unified School District has declined overall by 21%. Past 30 days use declined even further, by 25% overall (Figure 2.2).
The difference noted here between national, state, and local trends of marijuana use underscores the importance of assessing youth perceptions and behaviors on a local level. Teen substance use behaviors are more likely to be more constrained by their local geography than adults (Paschall et al., 2012; Pedersen & Bakken, 2016) and local contexts have been found to be associated with variations in perceptions of the safety of marijuana use, in perceived peer approval of marijuana use, and in the age of onset for marijuana use, all factors which are in turn correlated with rates of marijuana use among adolescents (Chaney & Rojas-Guyler, 2015).

Social Context: The Increased Normalization of Marijuana Use in the United States

Attitudes toward drugs and alcohol are known to be powerful predictors of adolescent substance use. A 2016 study by Schmidt and colleagues concluded that attitudes and beliefs about addictive substances forged during late adolescence and young adulthood were more influential than the combined
effects of all other lifestyle determinants (Schmidt et al., 2016). Opinion research indicates that social acceptance of marijuana has increased substantially among adults (The National Center on Addiction and Substance Abuse, 2011), while qualitative research with at-risk youth has found that 90% perceive marijuana use as “normal” (Sanders, 2012) and as having fewer negative consequences than alcohol use (D'Amico, et al., 2015).

In LA County, half of the residents that participated in a Community Assessment survey (LA County Department of Public Health, 2018) perceived that there was a great risk of harm for youth to use marijuana regularly (defined as 1-2 times per week), while over a third (33%) perceived it a great risk for adults to use marijuana regularly. When differentiating between marijuana users and non-users, however, it was evident that perceptions of the risks of marijuana use were much lower among marijuana users than among non-users, indicating a strong association between people’s perceptions of the risk of marijuana use and their willingness to partake in marijuana use. For example, less than half of the community assessment respondents who were marijuana users perceived regular marijuana use to be a great risk for youth compared to over two-thirds among non-users (34% vs. 65%). The disparity in perceptions of risk between marijuana users and non-users was even greater when asking about the perceived risk of regular marijuana use for adults (15% vs. 49%).

The Role of Policy in the Normalization of Marijuana Use

Changing attitudes to perceive marijuana use as more socially acceptable and less of a health risk have been noted among youth populations, but whether changes in these attitudes are the result of policy changes or of a general secular change in attitudes toward marijuana is often difficult to determine. Some research supports the idea that the increasingly liberal state laws governing marijuana in the U.S. stem from more positive adult attitudes toward marijuana rather than the reverse. For example, rates of marijuana use among adults is higher in states that have approved medical and recreational marijuana laws, but the higher rates of marijuana
use in these states preceded enactment of the laws, suggesting that the more liberal attitudes toward marijuana use were a motivation for liberalizing marijuana laws (Harper, Strumpf, & Kaufman, 2012; Pacula, Powell, Heaton, & Sevigny, 2013).

Teasing out the impact of adult attitudes on adolescent marijuana use is difficult in the context of rapidly changing marijuana policy and is further complicated by the fact that there is seldom data available to account for whether a law that granted easier access to marijuana for adults increased the supply of marijuana available to adolescents. Marijuana laws may also have an influence on youth attitudes toward marijuana and marijuana use behavior that is independent of any increase in availability. For example, Miech and colleagues (2015) found that passage of a 2010 California law decriminalizing possession of personal use quantities of marijuana for adults was followed by a 25% increase in 12th graders’ likelihood of using marijuana, a 20% decrease in their likelihood to perceive regular marijuana use as dangerous, and a 20% decrease in the likelihood of strong disapproval of marijuana use (Miech et al., 2015). That these trends were in evidence when the law had been approved but not yet enacted suggests that the policy change may have enhanced impressions among adolescents that marijuana use is socially acceptable and/or decreased perceptions of harm without having made any change in the accessibility of marijuana use (Miech et al., 2015).

The Current Policy Environment

*The Compassionate Use Act*

When California voters approved the Compassionate Use Act of 1996, California became the first state to decriminalize possession of small quantities of marijuana for medical use. Under the Compassionate Use Act medical marijuana patients and their primary caregivers were permitted to possess and cultivate marijuana for personal use with a recommendation from a licensed physician. The purpose of the Compassionate Use Act was to ensure that seriously ill Californians could use marijuana to treat serious medical conditions such as cancer,
AIDS, and seizure disorders (CA Health and Safety Code 11362.775) without being vulnerable to criminal prosecution. The text of the Compassionate Use Act specifies these aims as follows:

To ensure that seriously ill Californians have the right to obtain and use marijuana for medical purposes where that medical use is deemed appropriate and has been recommended by a physician who has determined that the person’s health would benefit from the use of marijuana in the treatment of cancer, anorexia, AIDS, chronic pain, spasticity, glaucoma, arthritis, migraine, or any other illness for which marijuana provides relief.

The phrase “any other illness for which marijuana provides relief” is a broad definition of illness and symptoms compared to the medical marijuana laws that have followed in other states, and in practice it allows physicians in California to recommend marijuana for any condition they think it might help with.

The language of the Compassionate Use Act directly addressed the rights of the marijuana patient and their primary caregiver but did not provide guidelines for how a person could obtain medical marijuana without growing it themselves or buying it on the illicit market. Nor did it address details of enforcement such as how law enforcement officers could distinguish qualified patients from recreational users. A regulatory structure was intended to be decided with subsequent legislation and the Act explicitly encouraged the State government to implement “a plan for the safe and affordable distribution of marijuana to all patients in medical need of marijuana”. Unfortunately, although multiple state and assembly bills were proposed over the years following the enactment of the Companionate Use Act in 1996, legislation to develop a truly comprehensive regulatory structure for medical marijuana in California was not successfully passed until twenty years later, with the Medical Marijuana Regulation and Safety Act of 2016.
State-level estimates for marijuana use in California are not reliably available prior to 2002, but in response to the passage of the Compassionate Care Act in 1996, the National Household Survey of Drug Abuse (NHSDA), the precursor to the NSDUH, supplemented the survey sample in California during the 1997 and 1998 survey years to measure the impact of legalizing medical marijuana. In addition, the NHSDA sample in California was large enough in 1995 and 1996 to allow examination of longer-term trends. A 1999 supplemental report issued by the Substance Abuse and Mental Health Services Administration (SAMHSA) indicates that there was no significant change in marijuana use between 1997 and 1998 in California among adults or among adolescents between 12-17 years old. Instead, the NHSDA survey results indicated that rates of both adolescent and adult marijuana use had been stable since 1995 and that perceptions of the health risk associated with using marijuana also remained fairly constant (SAMHSA, 1999).

California State Senate Bill 420 (SB 420): The Medical Marijuana Protection Act

The Medical Marijuana Protection Act became effective on January 1, 2004. It created a voluntary identification card system for purchasing medical marijuana, the California Department of Public Health Medical Marijuana Program (MMP), that was administered by county health departments. The MMP created a state-licensed medical marijuana identification card program and a registry database for verification of qualified patients and their primary caregivers (California Department of Public Health, 2016). The identification cards were issued to people with physician recommendations to use marijuana to treat medical conditions, as well as to their designated primary caregiver. The action of the law that was most relevant to this dissertation, however, was that SB 420 allowed for the establishment of storefront dispensaries. Whereas previously caregivers could only supply medical marijuana privately to 5 patients, with the enactment of SB 420 a collective of caregivers could provide for hundreds of patients and sell marijuana at retail storefronts as long as they operated as a non-profit business (CA Health and
Safety code section 11362.775). State-level estimates of NSDUH data for California show a small and gradual increase in rates of current use among adolescents aged 12-17 not long after SB 420 was enacted in 2004 and storefront medical marijuana dispensaries became a reality (Azofeifa, Mattson, & Lyerla, 2016). The trend was minimal, however, until there an expansion in the medical marijuana industry after 2009 that is explained in further detail in the next section.

**Federal Laws and Department of Justice Memoranda 2009 - 2013**

The Federal policy environment may likewise be an important influence on marijuana use behaviors and perceptions of risk among LA County youth. Changes in state laws may have played an influential role in the rapid changes in teenagers’ attitudes toward marijuana that have been noted at a national level. Following California’s precedent of legalizing medical marijuana use in 1996, an increasing number of U.S. states have enacted policies legalizing some degree of access to marijuana. By 2009, over half of the population of the United States lived in a state sanctioning some level of marijuana use (Titus, 2009), although marijuana remains an illegal substance under Federal law today. A total of 34 states, the District of Columbia, Guam, Puerto Rico and the US Virgin Islands have now approved comprehensive, publicly available medical marijuana programs and an additional 12 states allow use of "low THC, high cannabidiol (CBD)" products for medical reasons in limited situations or as a legal defense (National Conference of State Legislatures, February 2019). The increasingly liberal state marijuana laws being passed in the U.S. have coincided with declining perceptions of the risk of marijuana among American teenagers, but not with increased use (Cerda et al., 2017; Sarvet et al., 2018). Thus, it seems that to date the primary impact of state medical marijuana laws has been increasingly liberal social norms and attitudes toward marijuana use rather than a change in marijuana use behaviors. Alternatively, the increasingly liberal state laws governing marijuana may instead reflect a secular change in social norms and attitudes toward marijuana that precedes the
passage of laws allowing greater access to marijuana. Indeed, both processes may occur simultaneously in a self-reinforcing cycle of increasingly liberal marijuana laws and attitudes.

In contrast with the change in secular attitudes toward marijuana use that has been noted on a national level, there are several Federal policies and enforcement efforts that have had a direct effect on the availability of marijuana in LA County. Marijuana is regulated under the Controlled Substances Act (“CSA”) of 1970 and with the exception of two FDA-approved medications derived from cannabinoids that are available by prescription it remains classified as a Schedule I drug. Schedule I drugs are defined as having a high potential for abuse, as having no currently accepted medical use for treatment in the U.S., and as unsafe for use without medical supervision (Title 21 in United States Code Section 812). Possession and sale of Schedule 1 drugs are subject to severe criminal penalties, which has important implications for law enforcement.

The inconsistency between Federal and state laws governing marijuana raises legal questions that are in active debate by the nation’s highest courts. In the meantime, the Department of Justice has been obliged to issue a series of memoranda defining the Federal position on medical marijuana and the extent of their judicial and law enforcement authority. These memoranda, while directed to state legislatures and law enforcement agencies, also had a significant impact on the medical marijuana market in California and by extension the availability and visibility of marijuana outlets in LA County. The first, the “Ogden Memorandum” of 2009, stated that Federal resources should not be directed toward prosecuting “individuals whose actions are in clear and unambiguous compliance with existing state laws providing for the medicinal use of marijuana” (October 19, 2009: David Ogden, Deputy Attorney General, United States Department of Justice). The development of a commercial marijuana industry in California occurred largely after this memo signaled that the Federal government would not prosecute dispensaries that were operating in compliance with state laws. Increases in the number of dispensaries were noted throughout the state (ONDCP, 2016), but the exact number
of dispensaries that were established soon after the Ogden Memo was released is unknown (ONDCP, 2016). Data from the City of Los Angeles, however, documents that in 2007 the City reported 186 dispensaries, whereas by 2010 they reported 545, an increase of nearly 200% (Freisthler et al., 2014).

In 2011, a new Department of Justice memorandum had an opposite, dampening effect on the marijuana marketplace. The “Cole Memorandum” narrowed the policies set forth in Ogden and drew a clear distinction between individual patients and commercial dispensaries, extending protection from Federal prosecution to registered patients but not to dispensaries (June 29, 2011, James Cole, Deputy Attorney General, United States Department of Justice). This memorandum was followed by a series raids by Federal prosecutors conducted throughout California in October of 2011. Hundreds of dispensaries across the state had their inventory confiscated and more than 200 dispensaries were shut down in Los Angeles County and surrounding counties (Onishi, 2012). Although the Cole Memorandum and the subsequent raids targeted businesses and were not widely publicized, they had a significant impact on the number of dispensaries operating in LA County that reduced the accessibility of marijuana for adults and is likely to have resulted in reduced exposure to marijuana outlets among youth. According to Drug Use Social Norm theory, this reduced exposure to active dispensaries would be expected to result in LA County adolescents having less favorable perceptions of the acceptability of marijuana use. To date, however, this effect has not been investigated.

The growth of the number of dispensaries in communities throughout California after the Ogden Memo of 2009 was correlated with a temporary increase in youth and adult use that reversed after the Cole Memo signaled a stricter federal stance toward marijuana businesses in 2011. Although the changes in youth use were not drastic any point over these years, the degree to which they correspond with these policy decisions is striking. That an increase in youth use was not noted following enactment of the Compassionate Use Act and there was a minimal trend of increase after SB 420 was enacted is important. It suggests that the impact of
making marijuana available as a legal product (the CUA) and in retail settings (SB 420) has much to do with the number of marijuana outlets in our communities and how tightly they are regulated (Figure 2.3).

Figure 2.3. Trends in past 30 days marijuana use in California among youth aged 12-17 years 2002 - 2014, NSDUH. Adapted from Azofeifa, Mattson, & Lyerla, 2016.

The Medical Cannabis Regulation and Safety Act (MCRSA)

In 2015, the California Legislature passed the Medical Cannabis Regulation and Safety Act (MCRSA). The MCRSA is divided into three parts: AB 266 (Bonta), AB 243 (Wood), and SB 643 (McGuire). Each bill pertains to a different aspect of medical marijuana regulation and monitoring. AB 266 established a new Bureau of Medical Marijuana regulation, which is responsible for establishing a comprehensive internet database for keeping track of licensees. The bill also required the adoption of a system to report and monitor the movement of commercial marijuana and marijuana products. SB 643 & AB 243 gives responsibility to different
departments to regulate cultivation, develop standards for manufacturing, testing, and production and labeling of edibles, develop pesticide standards, and to protect water quality. SB 643 also mandated the development of standards and accountability for physicians prescribing medical marijuana (California Health and Safety Code Section 11362.785). The MCRSA went into effect January 1, 2016 but the state deadline to establish the necessary agencies, information systems, and regulations was January 1, 2018 (California Health and Safety Code Section 11362.785). Some have surmised that the prospect of a marijuana legalization measure on the 2016 ballot is what motivated California legislators to finally establish a comprehensive regulatory structure in 2015. Indeed, a marijuana legalization ballot measure passed the following year, in 2016.

*The Adult Use Marijuana Act of 2016*

The Adult Use Marijuana Act (AUMA) legalized marijuana possession, cultivation and use for adults over the age of 21 without requiring a recommendation from a California-licensed physician. As stated in the ballot measure text, the purpose of the AUMA is to “establish a comprehensive system to legalize, control and regulate the cultivation, processing, manufacture, distribution, testing, and sale of nonmedical marijuana, including marijuana products, for use by adults 21 years and older, and to tax the commercial growth and retail sale of marijuana.” The act employed a dual license structure similar to the MCRSA that allows local jurisdictions to define polices that are more restrictive than state law. A notable exception to the dual license law is that cities and counties cannot ban personal use cultivation of less than 6 plants if cultivated indoors.

The AUMA created a comprehensive regulatory structure in which every marijuana business is overseen by a specialized agency. The Bureau of Marijuana Control, housed in the Department of Consumer Affairs, oversees the marijuana legal market, and began issuing licenses to marijuana retailers and distributors in January of 2018. The Department of Food and
Agriculture licenses and oversees marijuana cultivation and enforces environmental regulations on cultivation and food safety regulations on edibles. The Department of Public Health licenses and oversees manufacturing and testing or marijuana products, and the State Board of Equalization collects taxes from marijuana businesses. Staffing and development in the state agencies that will carry out these aims is incomplete and ongoing to date.

**Changing Prevention Approaches as Marijuana is Legalized**

Approaches to limiting youth exposure to marijuana products have changed dramatically as marijuana has become a legal product offered in retail settings. With the expansion of medical marijuana into the retail domain, preventing youth access to marijuana took on a new dimension, where in addition to preventing access to marijuana through illicit markets and social networks it became necessary to prevent youth from accessing it from storefronts located in communities. Bringing marijuana into a regulated market has some advantage from a prevention standpoint. Explicit regulations on business practices can be applied to legal retail environments while law enforcement agencies are often the only agencies with the authority to deal with illicit markets. Within legal markets, however, prevention advocates face new and different challenges and that may require different approaches.

Policy-based prevention approaches have proven to be effective at reducing adolescent substance use, despite targeting the general population (Martineau, 2013; Nelson, 2013) and have been particularly useful to address legal substances available in retail settings (Chaloupka et al., 2012; Grube, 1997; Kenkel and Manning, 1996; Stockwell and Gruenewald, 2001; Wagenaar, 1993). With the movement of marijuana into the legal market, regulatory controls on business practices have become necessary tools for prevention of adolescent marijuana use. Practices currently required by California law to restrict youth access include requiring employee assistance to handle products, keeping all products in their original child-resistant packaging, checking ID electronically or manually, and prohibiting products designed to be attractive to
youth (CA Bureau of Marijuana Control, 2018). Other recommended approaches to prevent youth marijuana use include requiring increased retailer liability and enacting stiff penalties for providing marijuana to youth (CA Blue Ribbon Commission on Marijuana Policy, 2015).

City Ordinances Regulating Dispensaries

City policies intended to prevent underage marijuana use include limiting the density of marijuana outlets in a community, preventing them from being located near sensitive areas such as schools and parks, limiting billboard advertising, and limiting the extent of exterior signage on dispensaries. Key informant interviews with LA County residents recently conducted by the LA County Dept. of Public Health (2019) indicate that keeping dispensaries a safe distance from schools and residential areas and limiting the density of outlets in the city were the top concerns stated by residents, followed by concerns about the effects of allowing dispensaries on social acceptability, particularly among youth (LA County Dept. of Public Health, 2019). Perhaps intimidated by the challenge of regulating dispensaries, 75 of the 88 cities in LA County have passed local ordinances prohibiting dispensaries from locating within city limits (League of California Cities, 2019).

In Los Angeles County, the ten cities that have passed ordinances that allow and regulate dispensaries have set forth detailed rules for how dispensaries can operate. Conditions that these cities have specified to minimize the impact of dispensaries on public health include requiring them to be located a minimum distance from schools, parks, libraries and other places frequented by youth, limiting the hours of operation, and controlling their density and location (League of California Cities, 2016). However, research indicates that preventing unlicensed dispensaries and restricting them from sensitive areas has been a problem in cities that allow dispensaries as well as in cities that ban them (Los Angeles County Marijuana Dispensary Premise Survey, 2018/2019).
Enforcement

Enforcement of city regulations intended to prevent adolescent substance use is an important determinant of their effectiveness in preventing substance use behaviors (Paschall et al., 2012). A key concern for this study is the degree to which adolescents are exposed to dispensaries in the city where they attend school and likely live. Exposure to dispensaries is therefore a factor that depends not only on the city ordinances regulating dispensaries but on how effectively those ordinances are enforced. It not yet known whether banning outlets altogether or allowing and regulating them is more effective at keeping outlets a safe distance from schools and other sensitive areas, as unlicensed dispensaries have been found in sensitive areas in cities that ban dispensaries as well as in cities that allow them. Cities that allow dispensaries are faced with enforcing limits on density and keeping outlets a defined distance away from sensitive areas such as parks and schools and some cities are more successful than others in accomplishing this. For example, unlicensed marijuana outlets were found to greatly outnumber licensed outlets within the City of Los Angeles (Thomas & Freisthler, 2016). Among cities that have banned dispensaries the enforcement challenge has been to shut down unlicensed outlets and prevent new ones from opening in a different area of the city. This has been a problem in the unincorporated areas of LA County as well. For example, the LA County Office of Marijuana Management recently reported that it had identified 75 unlicensed outlets operating in the unincorporated areas of LA County in 2017. Seven months later, 29 of those shops had been shut down, but 31 new ones had opened in their place (Marcellino, 2018).

Differentiating between licensed and unlicensed medical marijuana dispensaries is important because each type of dispensary may comply with regulations intended to prevent marijuana related harm and youth use to different degrees. By already existing in defiance of local law by operating in a location where they are not permitted, unlicensed dispensaries may have little incentive to comply with medical marijuana regulations. Recent observational
research on compliance with regulations among dispensaries in LA County indicates that unlicensed outlets were more likely to have violated several practices designed to restrict youth access, such as displaying products designed to be attractive to youth, displaying products outside of their original child resistant packaging, or allowing onsite consumption (Los Angeles County Marijuana Dispensary Premise Survey, 2018/2019). The same premise survey also found that unlicensed dispensaries are more likely to be found located near sensitive areas where dispensary regulations prohibit them than licensed dispensaries (Los Angeles County Marijuana Dispensary Premise Survey, 2018/2019).

**Gaps in the Literature**

Although a robust body of literature supports the efficacy of city ordinances in preventing alcohol (Thomas, Paschall, Grube, Cannon, & Treffers, 2012) and tobacco use among adolescents (Ahmad & Billimek, 2007; Asbridge et al., 2016; Francis, Abramsohn, & Park, 2010; Weber et al., 2012), there exists a gap in empirical literature evaluating the effectiveness of these approaches in preventing marijuana use among adolescents (Rogeberg et al., 2018). While a handful of studies have examined the impacts of the local marijuana policy environment on adult marijuana use (Mair, Freisthler, Ponicki, & Gaidus, 2015; Freisthler & Gruenewald, 2014; Freisthler, Ponicki, Gaidus, & Gruenewald, 2016; Thomas & Freisthler, 2015) the ability to quantify the impacts of city dispensary policies on youth marijuana use and outcomes has thus far been severely hampered by a lack of available data on youth marijuana use at the local level. Population-based national surveys like the Youth Risk Behavior Survey, the National Survey on Drug Use and Health, and state-level surveys like the California Health Interview Survey do not sample with enough density to allow for comparison of teen marijuana use between the cities within Los Angeles County (“2017 NSDUH Annual National Report | CBHSQ,” n.d.; “Results | YRBSS | Data | Adolescent and School Health | CDC,” 2018). Even the Los Angeles County Health Survey, a population-based survey of health behaviors among
adults and children in LA County, does not sample enough youth under 18 to provide estimates of adolescent marijuana use for geographic units smaller than the County’s health districts, most of which span several cities (LA County Department of Public Health, 2016).

It is important to know whether the hundreds of ordinances that have been enacted to ban dispensaries in local jurisdictions across California have any impact on young people or whether the many other ways people can obtain marijuana render them primarily symbolic. Even if city ordinances do not influence the supply of marijuana available to youth or ultimately impact their marijuana use behaviors, what effect do they have on their perceptions of risk and on youth social norms surrounding marijuana use? The primary aims of this dissertation will be to answer these research questions, i.e., to learn whether local policies governing dispensaries are linked to rates of use as well as risk perceptions among Los Angeles County adolescents.

Summary

This chapter is a review of the literature that assesses the consequences of marijuana use among adolescents, which presents a persuasive evidence that early and regular marijuana use can have lasting negative consequences for this population. The current literature on national trends in adolescent youth perceptions and behaviors was reviewed, as well as trends for California and Los Angeles County, where this study takes place. I summarized recent changes in laws governing marijuana in California and Los Angeles County, what is known about local policies regulating marijuana outlets and highlighted the lack of studies assessing the influence of these laws and ordinances on use among local youth populations.

Given that this research is mainly about the influence of distal policy and community factors on rates of marijuana use among adolescents living and/or attending school in the communities of Los Angeles County, the literature on more proximal influences such as the influence of social networks, exposure to preventive interventions, school policies, and personal characteristics was not reviewed in any depth here. These factors, while important, are not the
focus of this research study, so they were used as control variables in the analysis wherever possible to help isolate the effect of the focal community-level variable; whether a city allowed storefront dispensaries.
Chapter 3. Theoretical and Conceptual Frameworks:

Effective prevention of adolescent substance use requires an understanding of the complex etiology behind this very common behavior. Explanatory theories of adolescent substance use must elucidate relationships within the wide variety of factors that have been shown to influence substance use behavior while accounting for the unique context of adolescence. Consequently, comprehensive theoretical models that incorporate factors from multiple domains of influence have gained prominence as the field of substance abuse prevention has developed (CSAP, 2004; Golden & Earp, 2012). Key themes in the etiology of adolescent substance use are that there are both distal and proximal influences at work (Zucker, Heitzeg, & Nigg, 2011) and that a young person’s developmental stage interacts with almost every other influence (Chassin, Sher, Hussong, & Curran, 2013). This chapter will give more emphasis to theories that apply to community and societal-level domains of influence on adolescent substance use behaviors. These theories directly address important constructs for this study, such as how and why young people’s substance use attitudes and behaviors are responsive to community contexts.

Developmental theories encompassing a wide range of biological, psychological, and experiential factors are prominent among individual-level theories and provide an explanatory framework for the most proximal influences on adolescent substance use behavior (Trucco, 2014). However, even developmental theorists are increasingly looking to community contexts to explain inconsistencies and conditional relationships that have been identified in individual and relationship influences, such as the ways neighborhood effects mediate peer and family relationships (Nebbitt, Lombe, Yu, Vaughn, & Stokes, 2012; Reitz-Krueger, Nagel, Guarnera, & Reppucci, 2015; Trucco, Colder, Wieczorek, Lengua, & Hawk Jr, 2014). Simultaneously, an increased interest in the social determinants of health has led to more examination of how cultural and economic community characteristics and local policy may act on adolescent

The Social Ecological Model

The convergence of developmental and environmental perspectives within the Social Ecological Model makes it a particularly useful epistemological tool to understand the motivations that drive adolescent substance use and the contexts in which this behavior occurs. By linking the processes of youth development to community and societal-level factors, the Social Ecological Model is a conceptual framework allows for examination of the interactions with environment that shape adolescent substance abuse behaviors (Browning, Soller, & Jackson, 2015; Gruenewald, Remer, & LaScala, 2014; Gorman, 2003). The Social Ecological Model is conceptualized as levels of systems that influence human behavior to varying degrees, beginning with the individual as the most proximal influence and expanding to the level of the society as the most distal (Bronfenbrenner, 1986). The four levels of the Social Ecological Model include:

1. Individual Level: Factors specific to a person, such as age, education, income, health, and psychosocial characteristics.
2. Relationship Level: A person’s closest social circle—family members, peers, teachers, and other close relationships.
3. Community Level: The settings in which social relationships occur, such as schools, workplaces, and neighborhoods.
4. Societal Level: Broad societal factors, such as social and cultural norms and the health, economic, educational, and social policies that shape attitudes and behaviors.
A core principle of the Social Ecological Model is that there exist reciprocal relationships among diverse personal and environmental factors contributing to health and illness (Bronfenbrenner, 1999; Golden & Earp, 2012; Stokols, 1996). Influences from any domain can encourage or discourage substance use, or there could be conflicting influences from within the same domain. While the model emphasizes social and environmental influences, it also accounts for the role of personal attributes such as genetic heritage, psychological dispositions, and behavior patterns. For example, similar environmental conditions may affect people’s health in different ways depending on each person’s individual-level characteristics (Bronfenbrenner, 1999). Social Ecological theorists thus acknowledge the reciprocal relationships between people and their environments and value the compatibility between people and their surroundings as an important predictor of well-being (Browning, Soller, & Jackson, 2015; Golden & Earp, 2012).

The Individual Domain

Individual-level factors represent the most proximal motivations for substance use and therefore tend to be important predictors of substance use behaviors. Generally, life experiences and psychological factors that present challenges to mental and emotional health also present risk factors for substance use and SUD (Chassin et al., 1996; Grant et al., 2006; Mitchell, Ybarra, & Finkelhor, 2007; Unger & Chen, 1999). Decades of research have found that sub-groups of adolescents who experience social isolation, abuse, trauma, and mood disorders are at very high risk for SUDs and resulting health harms (Adams et al., 2013; Clark, Lesnick, & Hegedus, 1997; Cohen, Mannarino, Zhitova, & Capone, 2003; Ford, Elhai, Connor, & Frueh, 2010; The National Center on Addiction and Substance Abuse, 2011). The most vulnerable adolescent populations include youth who are in the child welfare system (Guibord, Bell, Romano, & Rouillard, 2011; Singh, Thornton, & Tonmyr, 2011), drop out of high school (Aloise-Young, Cruickshank, & Chavez, 2002), are involved with the criminal justice system (CASA, 2011).
Peer-reviewed empirical research of the influence of parental marijuana use on individual-level risk factors for adolescent substance use is still relatively sparse to date. Freisthler and colleagues (2015) found that parents who reported that they were current marijuana users were more likely to be physically abusive and used corporal punishment more frequently, but current marijuana use was associated with neither supervisory neglect or physical neglect. This led the authors to theorize that marijuana might be used by highly impulsive and agitated parents to relax but that their marijuana use did not appear to impair parents’ ability to care for their children’s basic needs.

The Intra-Personal Domain

Intra-personal correlates of adolescent marijuana use include social and friend networks, the quality of family interactions, and the influence of school peers (CASA, 2011). Social networks are important influences on adolescents’ behavior (Dishion & Kavanagh, 2000) and often mediate more distal influences like community and societal-level factors (Bahr, Hoffmann, & Yang, 2005). Peer and family values, attitudes, and beliefs about substance use help shape adolescents’ values, attitudes, and beliefs about acceptable levels substance use (Bahr, Hoffmann, & Yang, 2005; Barnes, Reifman, Farrell, & Dintcheff, 2004; DiClemente et al., 2001; Griffin, Botvin, Scheier, Diaz, & Miller, 2000; Padilla, Crisp, & Rew, 2010; Trucco, Colder, Wieczorek, Lengua, & Hawk, 2014). More accepting attitudes toward substance use among adults are correlated with a greater likelihood of substance use among adolescents (Scalco, Trucco, Coffman, & Colder, 2015) and several studies have replicated these findings for marijuana use specifically (Asbridge, Valleriani, Kwok, & Erickson, 2016; Friese and Grube, 2013; Pilgrim et al., 2006; Trucco, et al., 2014). For example, in the state of Montana, Friese and Grube (2013) found that adolescents who lived in counties with a higher percentage of adult
voters reporting approval for legalization of medical cannabis were more likely to have used
cannabis with the last 30 days, whereas the number of medical cannabis cards that had been
issued by county was not associated with higher rates of recent or lifetime cannabis use among
the adolescent residents. This finding suggests that adults' favorable attitudes toward cannabis
drove the association between state policy and adolescent marijuana use rather than an
increase in the availability of cannabis in the community. A marijuana-using parent could
present a predisposing factor for an adolescent to use marijuana from the standpoint that they
are communicating social norms accepting of marijuana use and may possibly contribute to
adolescents’ perceptions that marijuana use represents little risk for health harms. To date, very
little research has been dedicated to examining the relationship of parental marijuana use with
adolescent marijuana use. However, a national survey of young adults ages 18 to 25 found that
children of parents who smoke marijuana were more than three times more likely to use it
themselves. Among young adults whose parents had used marijuana, 72% had used it, while
only 20% of those whose parents had never used marijuana reported having used it themselves

The Community Domain

Adolescence is a time when community context becomes an increasingly important
devvelopmental influence (Reitz-Krueger, Nagel, Guarnera, & Reppucci, 2015). The communities
where young people live shape their substance use perceptions and behaviors by how the
environment encourages or prevents substance use, e.g., via the attitudes of their parents and
peers or the availability of drugs and alcohol in their neighborhood. The Community Domain is
the primary domain of influence for this study of city policy impacts and community-level
influences on adolescent marijuana use and thus is reviewed in greater detail below.

Availability
Geographic variables such alcohol and marijuana outlet density in neighborhoods have been found to be correlated with greater localized use of these products (Freisthler & Gruenewald, 2014; Gruenewald, 2007; Scribner et al., 2010). The availability of alcohol and tobacco within cities and neighborhoods contributes to adolescents’ perceptions of the normalcy and social acceptability of substance use (Bryden, Roberts, McKee, & Petticrew, 2012; Chen, Grube, & Gruenewald, 2010; Paschall, Grube, Thomas, Cannon, & Treffers, 2012), which is, in turn, related to an increased propensity to use these substances (Bray et al., 2000; Trucco et al., 2014). Kuntsche and colleagues (2008) concluded that adolescents who have more opportunities to obtain alcohol develop the impression that underage drinking is “common and socially endorsed” in their community. Thus, marijuana outlet density in a city could be expected to contribute to social norms encouraging marijuana use, even if it does not create easier access.

City Policy

Regardless of the fact that cannabis use remains illegal for minors throughout the U.S., state and city marijuana laws that increase access for adults do present important implications for youth access to marijuana and social norm change. Although studies have examined the effect of city-level alcohol and tobacco policies on alcohol and tobacco use and perceptions of risk among adolescents (Bryden, Roberts, McKee, & Petticrew, 2012; Paschall, Grube, Thomas, Cannon, & Treffers, 2012; Paschall, Lipperman-Kreda, & Grube, 2014; Thomas, Paschall, Grube, Cannon, & Treffers, 2012; Wagenaar, Tobler, & Komro, 2010), these studies have not been replicated to study the impact of city ordinances regulating marijuana.

Cannabis dispensed to adults has been shown to eventually get into the hands of adolescents. For example, a 2012 study of adolescents in drug treatment in Colorado found that 75% had used someone else’s medical cannabis within the previous year (Salomonsen-Sautel, 2012). However, it is not known if city policies that allow for more convenient adult access to
cannabis in a community will necessarily be associated with greater use among adolescents. For example, while cannabis legalization advocates have theorized that legitimizing the market for cannabis products by allowing dispensaries in a community will result in the eventual collapse of the illicit market (Drug Policy Alliance, 2018), the continued presence of a robust illicit market for marijuana in California (Reed et al., 2019) may compete with city policy as a determinant of the availability of marijuana in a community. Alternatively, changes in attitudes and social norms toward cannabis related to city policy or external social influences may have a more important influence on the likelihood of young people experimenting with adolescent cannabis use than their access on a local level. This dissertation will test both theories.

The Societal Domain

American culture drives teen substance use via social norms communicated by neighborhood access and availability, social relationships, advertising, and media (Yanovitzky & Stryker, 2001). Norms are basic orientations concerning the acceptability of specific behaviors for a specific group of individuals. These cultural and environmental cues influence teen’s perceptions of the risk and benefits, and socially acceptable substance use is (Scull, Kupersmidt, & Erausquin, 2014). The Societal Domain will be discussed in greater detail below in the context of the Drug Normalization Framework.

Limitations of Comprehensive and Integrated Theoretical Approaches

Comprehensive theoretical models of adolescent substance use such as the Social Ecological Model highlight the importance of interrelated risk and protective factors (e.g., Chuang et al., 2005; Reitz, et al., 2006) operating on multiple levels of influence. Yet, conceptual models integrating sociocultural risk and protective factors across contexts are so complex as to be nearly impossible to test. It is methodologically impossible to measure and analyze all of the factors that could influence adolescent substance use at once. As a
consequence, comprehensive theoretical models like the Social Ecological Model are rarely tested in their entirety (Schulenberg, Patrick, Maslowsky, & Maggs, 2014; Trucco et al., 2014). Given the breadth and complexity of the Social Ecological Model, more specific methodological frameworks have been developed to operationalize and implement theoretical constructs that specifically influence adolescent substance use.

The Drug Normalization Framework

The rapid liberalization of attitudes toward marijuana is an important backdrop to this research and calls for a theoretical framework that accounts for the influence of social norm change. Normalization is the idea that behavior once considered deviant by mainstream society can gradually become accepted as “normal”. The Drug Normalization Framework (Parker, Aldridge, and Measham, 1998) was developed to explain the increasing presence of drug use in mainstream culture and has been used to guide empirical research on the social integration of illicit drug use over the last 20 years (Eisenberg et al., 2014; Sandberg et al., 2012; Sznitsman et al., 2015; Wambeam et al., 2014).

Based on Parker and colleagues (2005) studies of drug normalization in the United Kingdom, the Drug Normalization Framework has since been expanded (Aldridge et al., 2011; Duff et al., 2012; Hathaway, Comeau, & Erickson, 2011; Hathaway et al., 2016; Kolar et al., 2018; Sznitman & Taubman, 2016) to include the following seven components: 1. Drug trying, 2. Availability/Accessibility; 3. Recent and regular drug use; 4. Being “drugwise”; 5. Social accommodation; 6. Cultural accommodation; 7. Drug policy and global processes. Drug trying refers to lifetime drug use prevalence and experimentation. Drug availability and accessibility refers to the likelihood of being offered drugs or situations where one might access drugs. Recent and regular use refer to rates of use beyond lifetime prevalence. Being “drugwise” refers to knowledge of drug-related experiences among both users and non-users. Social accommodation refers to the idea of recreational drug use as an integrated or tolerated part of
mainstream social life among users and nonusers (Parker, 2005, p. 207). Cultural accommodation refers to the way drugs and drug use attitudes are portrayed in mainstream media. Drug policy and global processes refer to macro-level considerations of how drug policy and globalization impact substance use and accessibility (Kolar et al., 2018).

The Drug Normalization Framework is attractive from a primary prevention standpoint because the focus on the social integration of drug use among mainstream populations fits the current context of cannabis use better than theoretical approaches that characterize substance use within a disease or deviance model, which are less appropriate to explain widespread moderate substance use and harm reduction approaches to limiting use of products available in a legal and profit-motivated market (Kolar et al., 2018). It will not be possible to measure every theoretical construct within the Drug Normalization Framework in this dissertation, but the Drug Normalization Framework nevertheless provides a valid epistemological structure to account for the backdrop of social influences against which local trends in accessibility, perceptions of risk and marijuana use behaviors occur in LA County.

A central critique of the Drug Normalization Framework has been that it overemphasizes the societal domain at the cost of adequately accounting for differences in adolescents’ experiences due to social, economic, and structural factors (Gossop et al., 2000; Measham & Shiner, 2009; Pilling et al., 2007; Pennay & Moore, 2010; Sterk, Elifson, & DePadilla, 2014). Subsequent research has supported the idea of “differentiated normalization” (Shildrick, 2002), i.e., that structural factors such as social inequality, family structure, and peer networks may lead to different drugs and ways of using becoming normalized for different groups of adolescents (Cheun & Cheung, 2006; Sandberg et al., 2012; Wilson, Bryant, Holt, and Treloar, 2010). In support of this idea, recent research investigating differences in the normalization of cannabis use among young adults found that accessibility, acceptability, and recent use differed by gender, nativity, and peer network cannabis use prevalence (Kolar et al., 2018), indicating
that where possible it is important to control for these effects when investigating youth access, attitudes, and marijuana use.

**Theoretical Constructs**

This dissertation will investigate the impacts of city dispensary ordinances on adolescents’ perceptions of the availability/accessibility of marijuana in their city, their perception of the risk of marijuana use, and their exposure to dispensaries near their school, which is of interest as a potential visual cue to substance use.

**Availability/Accessibility**

A primary cannabis policy is to prevent increased adult access to cannabis resulting in rising rates of youth use (California Blue Ribbon Commission on Marijuana Policy, 2015). Recent data from the Monitoring the Future study, a longitudinal, population-based survey, indicates that high school students perceive little difficulty obtaining cannabis if they want it. The report states that 81% of 12th grade students report that it would be “fairly” or “very” easy to get marijuana if they wanted some. The proportion of North American high school students who have reported the same ease of access has been between 80% and 90% since 1975 (Johnston et al., 2018).

Thus far there is little evidence to suggest that increased availability of marijuana for adults at a state or national level has resulted in easier access for youth or increases in youth use. This lack of evidence to date is in contrast to alcohol and tobacco research and could be due to higher standards of compliance with laws and regulations that prevent youth access in the current marijuana industry in comparison to business practices and compliance among alcohol and tobacco outlets. Recent premise surveys of marijuana outlets indicate that compliance with ID checks is almost universal (Berg et al, 2017, Berg et al., 2018), even among unlicensed outlets (Los Angeles County Cannabis Dispensary Premise Survey [2018/2019]). ID
checks are likely to be the most effective way to prevent youth accessing marijuana directly from dispensaries, but do not prevent adults from supplying marijuana to adolescents in other contexts. Therefore, the question of whether youth are more likely to be able to obtain marijuana in communities where adults have more convenient access to dispensaries merits further study.

City ordinances banning dispensaries could impact the availability of marijuana to underage youth if young people can purchase marijuana directly from a dispensary or if adults sell marijuana near the dispensary where it was obtained. New research on compliance with regulations intended to prevent youth access to marijuana indicates that dispensaries in three states almost universally required ID checks (Berg et al., 2017), suggesting that obtaining marijuana directly from a dispensary is the least likely of these options. Empirical research on the ability of underage youth to get adults to buy marijuana from a nearby dispensary is lacking, as is reliable data on adults offering marijuana to youth near dispensaries, although video evidence of this practice occurring in cities within LA County has been reported in news media (CBS News, 2015). For example, in 2015, the Compton Unified School district went so far as to sue the City of Compton, alleging that the City’s lax enforcement of its marijuana ban made it easy for students to obtain marijuana from some of the more than dozen dispensaries that were operating illegally in the city, three of which were operating within 500 feet of schools (Jennings, 2015 | The Los Angeles Times).

Perception of Risk
Students’ perceptions of the risk of frequent marijuana use represent a potential moderating factor in the likelihood of marijuana use. City policies allowing dispensaries may communicate to young people that marijuana use is socially acceptable in their community or that their local leaders consider it to present little risk to their health. Students’ perceptions of the risk of frequent marijuana use could then be expected to moderate their likelihood of using marijuana (Asbridge et al., 2016; D’Amico, Miles, & Tucker, 2015; Tucker & D’Amico, 2013).
Research on marijuana normalization has found that perception of health risk is an important driver of increased social acceptance (Asbridge et al., 2016). Barely over a quarter (26.7%) of 12th graders in the United State now report that regular marijuana use poses a great risk, which is half the proportion from 20 years ago (Johnston et al, 2018; Miech et al., 2018). The increase in favorable opinions about the health benefits of cannabis may prove to be warranted over time but to date much of the change in attitudes toward the safety and potential benefits of marijuana use is not based in reports of empirical, peer-reviewed research, let alone randomized controlled trials with human subjects. A comprehensive report from the U.S. National Academies of Science, Engineering, and Medicine (2017) found that there was adequate evidence to support cannabis use as a treatment for only a few of the many disorders for which it is commonly recommended.

Adolescent perceptions of the risk of marijuana use may also be based on the many recent changes in state laws in the U.S., where since California legalized use of medical marijuana in 1996, 33 other states have followed suit by approving “comprehensive, publicly available medical marijuana programs” and an additional 12 states allow “allow use of "low THC, high cannabidiol (CBD)" products for medical reasons in limited situations or as a legal defense” (National Council of State Legislatures, 2019). Multi-state epidemiological studies on the impact of state marijuana laws on adolescent perceptions of marijuana risk have shown that changes in cannabis risk perceptions are similar between states that pass medical cannabis laws and states that have not (Keyes et al., 2016; Schmidt et al., 2016). Several researchers have theorized that differences in adolescents’ attitudes toward marijuana may have been attenuated by nationwide media coverage of medical cannabis law passage that diffused the attitudinal effects of medical marijuana laws across state borders (Chen, 2016; Schmidt et al., 2016). Furthermore, as mentioned earlier, perceptions of marijuana use representing a low risk to health may be an important driver of normalization but may not necessarily drive greater rates of use as they once did (Sarvet et al., 2018).
Exposure to Visual Cues

An important construct for this dissertation is the idea that dispensaries located in communities could act as a visual cue to substance use similar to advertising. Exposure to visual reminders of the presence of alcohol and drugs in communities is a central theme in the literature about social norms and their impact on adolescent substance use and in the Drug Normalization Framework (Asbridge et al., 2016; Cousijn et al., 2013; Eisenberg et al., 2014; George et al., 2001; Lee et al., 2007; Wambeam, et al., 2014; Yanovitzky & Stryker, 2001). Students seeing a dispensary frequently because it is located near an area where they spend much of their time could represent repeated exposure to visual cues to marijuana use, which research has shown increases the likelihood of marijuana use (Cousijn et al., 2013; D’Amico, Miles, & Tucker, 2015; Slater, 2007; Tucker, Miles, & D’Amico, 2013). Visual cues to marijuana use such as billboard and magazine advertising for cannabis are strongly associated with adolescents’ intentions to use marijuana and eventual use (D’Amico, Miles, & Tucker, 2015).

The presence of dispensaries may be analogous to advertising because many dispensaries in LA County use their exterior walls as advertising space like any other store (Figure 3.1). It is therefore possible that repeatedly seeing dispensaries located near their school will have an impact on high school students’ likelihood to use marijuana, even if they are not able to obtain it directly from these outlets. Furthermore, among people who have already used a psychoactive substance, visual reminders of that substance activate a chemical response that triggers a craving for the substance, increasing their propensity to use substances to which they are frequently exposed to reminders of (Cousijn et al., 2013; George et al., 2001; Lee, Kwon, Choi, & Yang, 2007). This means that among high school students who have already tried marijuana, the sight of dispensaries may trigger cravings for marijuana and thus increase their propensity to use it.
Enforcement

Although measuring individual enforcement efforts by city or county police or code enforcement officers was beyond the scope of my analysis, enforcement is nevertheless an important construct in the conceptual model for this dissertation and the analyses that follow. In the conceptual model below, the effects of city policies banning or enacting stricter regulations on storefront dispensaries are hypothesized to be dependent on effective enforcement. For example, the impact of a city policy allowing dispensaries on adolescent substance, such as dispensary density in a city, is determined not just by how many dispensaries the city ordinance allows, but also on how many dispensaries are actually in operation. The extent to which these two measures may differ is dependent on enforcement. Similarly, city policies that allow dispensaries often require them to be located a specific distance away from schools, but dispensaries have often been found located near schools in violation of these policies. Keeping dispensaries away from sensitive areas is therefore also dependent on effective enforcement.
Key informant interviews conducted with city officials as part of the LA County Department of Public Health Cannabis Health Impact Evaluation (2019) indicate that preventing unlicensed outlets is a central goal for city dispensary ordinances. Therefore, the number of unlicensed outlets per 10,000 city residents was included as a proxy measure of the effectiveness of the city dispensary ordinance, with a higher proportion of unlicensed dispensaries per residents indicating less effective enforcement.

**Conceptual Model**

Figure 3.2 presents the conceptual model of this dissertation. At the individual level, the focal relationship is between city dispensary bans and students’ self-reported marijuana use (lifetime and past 30 days). The additional variables that explain and influence the focal relationship are described in the research questions and hypotheses that follow. The conceptual model also presents the backdrop of potentially confounding external influences, which include a general trend toward greater acceptance of marijuana use in American society, changes in state laws that have seen the majority of U.S. states enact laws that allow some level of access to marijuana, and changes in the Federal government’s stance on enforcement priorities concerning marijuana. Although these changes occur outside the scope of this dissertation, they are relevant from the standpoint of the Social Ecological Model and the Drug Normalization Framework and are accounted for in the study design wherever possible.

*Figure 3.2. Multilevel Conceptual Model to Test Dissertation Hypotheses.*
Research Questions and Hypotheses

**Research Question #1 (RQ1):** Are city dispensary bans and restrictions associated with lower rates of marijuana use among the adolescents living in/attending school in a city?

**RQ1 Hypothesis:**

**H1.1** Student attending schools in cities that enact dispensary bans will report lower rates of marijuana relative to students attending schools in cities that allow dispensaries.

**H1.2** Cities that enact more restrictions on dispensaries will experience declining trends in marijuana use among high school students relative to before the more restrictive dispensary policy was enacted.
Research Question #2 (RQ2): How does the density of dispensaries in a city effect the relationship between city dispensary bans and high school students’ marijuana use?

RQ2 Hypotheses:

H2.1 There is a direct relationship between city dispensary bans and the number of dispensaries in a city, where city dispensary bans are associated with lower numbers of dispensaries.

H2.2 There is a direct relationship between the number of dispensaries in a community and high school students’ marijuana use.

H2.3 The number of dispensaries in a city partially mediates the relationship between city ordinances banning dispensaries and high school students’ marijuana use.

Research Question #3 (RQ3): How do students’ perceptions of the risk of frequent marijuana use influence the relationship between city dispensary bans and high school students’ marijuana use?

RQ3 Hypotheses:

H3.1 There is a direct relationship between city dispensary bans and students’ perceptions of the risk of frequent marijuana use, so that dispensary bans are positively associated with perceived risk.

H3.2 There is a direct inverse relationship between students’ perception of the risk of frequent marijuana use and their likelihood of using marijuana, so that students who perceive great risk from frequent marijuana use are less likely to use marijuana.

H3.3 Students’ perception of the risk of frequent marijuana use moderates the relationship between city dispensary bans and student marijuana use.
**Research Question #4 (RQ4):** How does the proximity of the nearest dispensary to a student’s high school influence the relationship between city dispensary bans and high school students’ marijuana use?

**RQ4 Hypotheses:**

**H4.1** There is a direct relationship between city dispensary bans and the proximity of dispensaries to the students’ high school, so that dispensary bans are associated with longer distances from dispensaries.

**H4.2** There is a direct relationship between the proximity of dispensaries located within a mile of the school and students’ likelihood of using marijuana, so that the lesser the distance between the school and the closest dispensary, the greater a student’s likelihood to use marijuana.

**H4.3** The relationship between city dispensary bans and high school students’ marijuana use is partially mediated by dispensary bans keeping dispensaries locating further away from schools.

**Research Question #5 (RQ5):** How does the number of dispensaries near students’ high schools influence the relationship between city dispensary bans and high school students’ marijuana use?

**RQ5 Hypotheses:**

**H5.1** There is a direct relationship between city dispensary bans and the number of dispensaries being located near the students’ high school, so that dispensary bans are associated with less dispensaries being located within 2,000 feet of the school.

**H5.2** There is a direct relationship between the number of dispensaries located within 2,000 feet of the school and students’ likelihood of using marijuana, so that the number of dispensaries
located within 2,000 feet of the school is positively associated with students’ likelihood to use marijuana.

**H5.3** The relationship between city dispensary bans and high school students’ marijuana use is partially mediated by dispensary bans being associated with fewer dispensaries located near schools.
Chapter 4. Research Design and Methodology

This study draws upon diverse data sources and uses several different methodological approaches to arrive at a greater understanding of the impact that the dispensary bans enacted throughout Los Angeles County over the past decade have had on high school students’ marijuana use. In the five descriptive and explanatory data analyses for this dissertation that follow, I first used primary and secondary data sources to construct an administrative data set that documented which cities in LA County have enacted medical marijuana dispensary (dispensary) bans. Second, I used school-based CHKS survey data to measure marijuana use among 9th and 11th grade students in each city. Third, I geocoded school addresses from the California Department of Education school directory and mapped their locations within city and county boundaries. Fourth, I linked the CHKS data set to the geographic location of the schools using the unique ID assigned to each school by the California Department of Education. Lastly, I used street addresses from commercial listings of marijuana businesses to establish the location of dispensaries in cities and near schools. These data sources and methods were required to compare long term trends in student marijuana use by whether a city bans or allows dispensaries (Research Question 1) and to test different ways that city bans may influence high school students’ marijuana use (Research Questions 2-5).

Time Period

In the context of this research, I consider how adolescent marijuana use has been influenced by the history of policy implementation at state and local levels dating from the legalization of medical marijuana in 1996, to the establishment of medical marijuana dispensaries in 2004, and continuing today with early implementation of non-medical marijuana sales starting in 2018.
California Senate Bill 420, which passed in January of 2004, allowed for the establishment of non-profit storefront medical marijuana dispensaries throughout California. In 2006, the City of Diamond Bar was the first city in LA County to explicitly allow medical marijuana dispensaries (City of Diamond Bar, Ordinance No. 04-2006). Over the next ten years, 90% of the cities in LA County took the opposite approach by implementing bans or moratoria on medical marijuana dispensaries (Appendix A: Medical Marijuana Dispensary Ordinances in LA County).

Table 4.1. Year and date of city ordinances allowing dispensaries among incorporated cities in LA County. From city municipal codes accessed online and from City Clerks.

<table>
<thead>
<tr>
<th>City</th>
<th>Years dispensaries Allowed in City</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diamond Bar</td>
<td>4/2006 – 4/2014</td>
<td>Ordinance allowed one dispensary but per City Clerk none were in business there after it was shut down in a federal raid in 2012.</td>
</tr>
<tr>
<td>Huntington Park</td>
<td>3/2016 - Present</td>
<td>MMDS permitted only in Industrial/Manufacturing Planned Development (MPD) zones of the city.</td>
</tr>
<tr>
<td>Long Beach</td>
<td>1/2004 – 2/2012</td>
<td>Allowed to operate under CA law up to 3/2010, when increased restrictions were put into place, then banned in 2/2012. Allowed again per Measure MM, approved 11/2016, but no new dispensary licenses were issued by the end of the study period.</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>1/2004 - Present</td>
<td>Allowed to operate under CA law up to 9/2007, when increased restrictions were put into place.</td>
</tr>
<tr>
<td>Malibu</td>
<td>5/2008 - Present</td>
<td>Ordinance limits dispensaries to two operating in the city at any given time.</td>
</tr>
<tr>
<td>Santa Monica*</td>
<td>6/2015 - Present</td>
<td>No dispensaries licensed for operation to date.</td>
</tr>
<tr>
<td>South El Monte</td>
<td>1/2010 - Present</td>
<td>Code does not limit number of dispensaries, but the City Clerk says the city allows only one.</td>
</tr>
<tr>
<td>West Hollywood</td>
<td>1/2004 - Present</td>
<td>Allowed to operate under CA law up to 6/2013, when increased restrictions were put into place.</td>
</tr>
</tbody>
</table>

*A key hypothesis of this dissertation is that the passage of city ordinances allowing dispensaries may an effect on youth perceptions of the risk of marijuana use that is independent of the presence of dispensaries in a community. Santa Monica was therefore coded as allowing dispensaries from the 2015/2016 school year onward, even though the City had still not issued any licenses by the end of the study period.

Study Sample
Study Population

The population of interest for this dissertation was adolescents living within LA County. The study population was 9th and 11th grade students at public high schools that participated in the CHKS survey between the 2005/2006 and 2016/2017 school years. Students' demographic and socio-economic characteristics and their marijuana use behavior were recorded using restricted-use secondary data from a school-based survey of student health and school climate, the California Health Kids Survey. Dispensary policies for each of the 88 cities in Los Angeles were obtained from online municipal code databases and categorized by whether they allowed or banned dispensaries. City dispensary policies were linked to student behavior by the city where their high school was located, which according to California public school residency requirements is most often the city where they live (CA Dept of Education, 2019). Addresses of dispensaries were then downloaded from commercial listings of marijuana businesses and mapped to determine their location and density within cities and near schools. Each of these data sources were required to address the central question of this dissertation; whether dispensaries bans prevent adolescent marijuana use. The dependent variables, lifetime and recent marijuana use, are self-reported data from the CHKS survey. The independent variable is whether each city had a dispensary ban. I also conducted a mediation analysis using measures of marijuana density within cities and relative to schools as well as student perceptions of the health risks of marijuana use to test whether the effectiveness of MMD bans was dependent on any of these variables.

CHKS Survey Sample

The survey sample used for this dissertation was comprised of students who completed the California Healthy Kids Survey (CHKS) at LA County public high schools between the 2005/2006 school year and the 2016/2017 school year. The CHKS is a statewide survey that covers a range of health perceptions and behaviors and is administered annually in school
districts throughout the state. The initial population was 532,200 LA County high school
Angeles County during the school years studied, most high schools administered the CHKS
every other year to 9th and 11th grade students. However, about 10% (9.99%, 44,846 students)
of the surveys each year were administered to 10th and 12th grade students or students who
chose categories of “don’t know” or “ungraded/other” for grade. These students were excluded
to draw more precise conclusions about the behavior of students in 9th and 11th grade and for
comparability with the other research published using CHKS survey data, which focuses on
these grades. After excluding a handful of remaining students who attended special education
schools or who were missing important data, the population available for analysis over the 12
years of the study period numbered 487,354. Criteria for exclusion from the study sample are
presented below in Table 4.2.

<table>
<thead>
<tr>
<th>Exclusion Criteria</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attend special education school</td>
<td>24</td>
<td>0.01%</td>
</tr>
<tr>
<td>Grade missing</td>
<td>4,284</td>
<td>0.80%</td>
</tr>
<tr>
<td>Grade unknown within high school</td>
<td>822</td>
<td>0.16%</td>
</tr>
<tr>
<td>Grade “other” within high school</td>
<td>1,085</td>
<td>0.21%</td>
</tr>
<tr>
<td>10th grade</td>
<td>20,186</td>
<td>3.82%</td>
</tr>
<tr>
<td>12th grade</td>
<td>24,660</td>
<td>4.67%</td>
</tr>
<tr>
<td><strong>Total Excluded</strong></td>
<td><strong>51,061</strong></td>
<td><strong>9.67%</strong></td>
</tr>
</tbody>
</table>

There was a pattern of greater numbers of respondents in odd years compared to even
years, which corresponds with a greater number of schools in the Los Angeles Unified School
District implementing the survey on odd years. During the odd-numbered school years the
number of LA County high school students participating in the CHKS survey averaged 49,884
per year, whereas during even-numbered years the number of survey respondents averaged
38,815 per year. The overall average number of students per year throughout the study period
was 44,350.
The study period spanning the 2005/2006 school year and the 2016/2017 school year was chosen for several reasons. An original motivation for this study was to learn whether rates of marijuana use among LA County high school students increased overall as the number of cities in the County that allowed dispensaries increased after medical marijuana entered the formal marketplace after SB 420 in 2004 allowed medical marijuana collectives to operate as businesses. The endpoint for the study period, the 2016/2017 school year, preceded the licensure of non-medical marijuana storefronts throughout the state of California and LA County that began in January of 2018. Ending data collection in 2017 allowed this analysis to focus on the impacts of medical marijuana dispensaries and to serve as a comparison point for non-medical marijuana sales after 2018.

**Data Collection**

As noted above, the data presented in this dissertation were drawn from multiple sources. These sources are reviewed in more detail below. The data source used to measure high school students’ perceptions of the health risks of marijuana use and marijuana use behaviors is a restricted-use secondary data set obtained from a state-level survey of California middle and high school students; the California Healthy Kids Survey (CHKS). I documented whether the 88 incorporated cities within Los Angeles County had ordinances that banned or allowed dispensaries by reviewing municipal code texts using online municipal code databases such as Municode.com and categorizing city dispensary policies according to whether or not they allowed dispensaries and several other criteria (Appendix A: Medical Marijuana Dispensary Ordinances in LA County). The number and location of dispensaries within each city were obtained from online dispensary listing and rating services such as Weedmaps.com, which I then used to map dispensary locations using ArcMap 10.4 geographic information system (GIS) mapping software (Esri, 2019). The addresses of the high schools came from the California
Schools Directory, which was downloaded from the California Department of Education (CA Dept of Education, 2019).

**CHKS Survey**

**CHKS Survey Background and Psychometric Properties**

The CHKS survey is the largest statewide survey of resiliency, protective factors, and risk behaviors in the United States (CA Dept of Education, 2018). It administered annually and anonymously at most public schools in California (Austin et al., 2018) to measure middle and high school students’ attitudes and behaviors related to substance use and other health behaviors. Collecting data on student substance use has been an important goal of the survey dating from its inception. The precursor to the CHKS survey was the California Student Survey of Substance Use (CSS), which began collecting data from a representative state sample of secondary students in 1985. Over time, the focus of the CSS was expanded to include questions on other health-risk behaviors, resiliency, school climate, and school safety, which then formed the bulk of the CHKS Core Module when it was developed in 1998.

In 2003, the California Department of Education mandated that CHKS serve as the primary data collection tool to document change in alcohol, tobacco, and drug use among California schools (Hanson et al., 2007), which means that all school districts that receive funding under the federal Safe and Drug Free Schools and Communities Act or state Tobacco Use Prevention Education program must administer the CHKS survey at least once every two years and report the results publicly (Austin et al., 2015; Austin et al., 2018). As a consequence, the CHKS survey is administered by the majority of California secondary schools every other year on a staggered basis that means data is available for every year at state level but may need to be aggregated into two-year ranges to capture data for all the schools in a region.

In terms of psychometric properties, a 2007 evaluation of the CHKS survey’s psychometric properties indicated that the survey exhibited good internal consistency, adequate
reliability, and demonstrated measurement equivalence across racial/ethnic groups, males and females, and grades (Hanson & Kim, 2007). The current iteration of the CHKS survey is built around a general Core Module and five optional supplements. The analyses presented in this dissertation relied on the Core Module, which assesses demographic information, substance use, exposure to school violence, and other behaviors that contribute to physical and mental health. Most of the items used in the CHKS Core Module were derived from the biennial California Student Survey of Substance Use and the Centers for Disease Control and Prevention Youth Risk Behavior Surveillance System (Skager & Austin 1998).

**CHKS Data Collection and Survey Methodology**

Student participation in the CHKS survey is voluntary and requires written parental consent. In districts with 900 or fewer students per grade (which includes 85 percent of the districts in the state) all students in 7th, 9th, and 11th grade are surveyed. CHKS documentation (WestEd, 2018) states that in larger districts, 900 students per grade are randomly selected from required classes and that if there are over 10 schools per grade in the district, a minimum of 50 percent of schools are randomly sampled. However, in LA County, this may not have applied to any districts other than the Los Angeles Unified School District (LAUSD), as sample weights were only provided for LAUSD schools and all other schools were weighted as 1, which is equivalent to having no sample weight.

Due to the large size of the Los Angeles Unified School District (LAUSD), a stratified sampling plan at the classroom and school-level (WestEd, 2018) was used, and sampling weights are therefore available for LAUSD schools and classrooms. The school-level sampling weights were used in the analyses that follow, per CHKS documentation specifying use of the school sample weight to enhance validity in generalizing results beyond the level of the school (WestEd, 2018). However, the school weighting variable was only provided by WestEd for the
2016/2017 school year. Although it was included in all of the analyses presented here, it had no appreciable effect when I compared the weighted and unweighted analyses.

**Pooled Two-School-Year Ranges**

The analyses presented throughout this dissertation were conducted using two combined school years. This was necessary because school districts generally administer the CHKS survey every two years, at 9th and 11th grade. Therefore, on any given single school year, half of the schools in LA county may not have administered the survey, which could have introduced bias into the analysis. Preliminary analyses indicated that across all schools in the County, the number of participants for odd to even years varied in tandem with whether a majority of LA Unified School District schools had administered the survey that year. For example, the average number of City of Los Angeles schools on odd years was double the average number on even years. Among the small number of cities in LA County that allowed dispensaries, the City of Los Angeles had a significant and potentially confounding influence that varied between odd and even years to such a degree as to effect outcomes in students’ marijuana use from year to year. This concern was addressed by using a combined 2 school year period as the unit of analysis for time, which halved the amount of data points available for the trend analysis but provided a much more reliable estimate of trends in students’ marijuana use behaviors over the twelve-year study period.

**Limitations of the CHKS**

CHKS data is not without limitations. The CHKS survey data set that I obtained represents only the public high schools in LA County and the marijuana use behavior of public high school students may differ from students at private high schools who are not surveyed. Furthermore, the CHKS survey and sampling strategy was designed to measure student health and school climate over time by school district, rather than by city. In many cities these units are
interchangeable because there is one district high school district per city, but not this is not the case in every city. Although administering CHKS is a requirement for public schools receiving Tobacco-Use Prevention Education from the State of California (which assures that the majority of California schools are represented), participation by school districts, schools, and students is voluntary. Participation for some schools is relatively low (Austin & Bailey, 2008), although offering school districts incentives for participation after 2011 was effective in improving participation (Austin et al., 2015). Even though CHKS data has been sampled proportionally to generate population-based reports of student behavior at the state level, at the County level, where I have included every school that participated apart from special education schools, the protocol of voluntary participation makes the CHKS study sample more of a convenience sample. Ideally, the results of this study should not be generalized outside of LA County or to students at private high schools and should be followed by more extensive data collection efforts using a large enough population-based sample to study the impacts of city policies on adolescent health behaviors.

CHKS has been administered at a large enough majority of schools in LA County to provide estimates of student marijuana use that schools from 76 of the 88 incorporated cities in the County were represented in the data at some point during the study period. In the cross-sectional analysis using the 2015/2016 and 2016/2017 school years the number of cities that had schools that participated in the survey was less representative. Only 53 cities out of the 88 cities in LA County had schools that participated in the CHKS survey in the 2015/2016 and 2016/2017 school years. Although the cities that participated represent 87% of the LA County population, in an analysis of the impacts of city-level policies this is a serious limitation. Despite these limitations, the very large sample size, the opportunity to make comparisons to state-level data, and the consistency of data collected over multiple years make CHKS a valuable tool to measure substance use among California students. The Los Angeles County Department of Public Health has also used the CHKS in a recent impact assessment of the potential impacts of
allowing retail and medical marijuana outlets in the unincorporated areas of LA County on the health and safety of LA County residents (LA County DPH Cannabis Impact Assessment Workgroup, 2019).

California Department of Education Public Schools Directory

School Location Data Collection Methods

The addresses of all the public high schools in LA County were obtained online from a secondary source, the California Department of Education (CDE) website (https://www.cde.ca.gov/ds/si/ds/pubschls.asp). School directory data is available for download as an Excel file and contains the address and geographic coordinates of each public school within California, as well as administrative details such as school type (e.g., continuation high school). The school type variable was used to exclude special education schools from the dataset used for this analysis. The school directory file was downloaded, filtered to obtain all the public high schools that served LA County students during the 2015/2016 and 2016/2017 school years (N=433). The school addresses were then geocoded using ArcMap 10.4 to generate latitude and longitude (Y, X) coordinates for each school and thus identify where they were located within LA County. I then performed a spatial join to the city boundary shapefiles available from the LA County GIS portal to identify which city each high school was located in, as this information is not available in the CHKS dataset. The geocoded high schools were matched to schools in the CHKS dataset by their CDS code, a unique ID provided by the California Department of Education to all California public schools. Once matched to the CHKS data it was possible to link the geographic location of the school to the students’ behavioral data, which included rates of lifetime and recent marijuana use and perceptions of the risk of marijuana use, along with other behavioral and demographic data.

Limitations of School Directory Data
I used the locations of schools rather than home residences because information about students’ residential addresses are not available through the California Department of Education or CHKS data sources. Using the school location instead of the students’ home address could present a limitation if students are less sensitive to the impact of dispensaries near their school than they would be to dispensaries located near their home. After geocoding and verifying the location the addresses provided, the California Department of Education file was found to have a small amount of out of date information and errors. Therefore, school addresses for all schools included in the study were individually verified and corrected if needed prior to geographical allocation of schools within city boundaries.

City Dispensary Ordinance Data

Municipal codes and zoning laws are public information and are generally published by cities at their own expense for the benefit of city residents. The cities in LA County used online municipal database services like Municode.com (www.municode.com) and American Legal Publishing Corporation (http://www.amlegal.com) to publish searchable directories and archives of their city ordinances and zoning codes. Using these services, I was able to determine whether and when the cities in LA County passed ordinances banning or allowing dispensaries between 2005 and 2017. By September 2016, 79 out of the 88 cities in LA County had either specifically banned dispensaries or had zoning laws that prohibited any kind of land use not expressly listed in the municipal or zoning code. Among the remaining cities, six explicitly allowed dispensaries, and three had no business districts and therefore no commercial zoning codes. A simple tally of changes to medical marijuana ordinances within just two years documents that this was a dynamic era for city-level marijuana policy in LA County (Table 4.3).

Table 4.3: Change in city medical marijuana ordinances in LA County between August 2014 and August 2016. From municipal codes accessed online and from City Clerks.

<table>
<thead>
<tr>
<th>Policy</th>
<th>2014</th>
<th>2016</th>
</tr>
</thead>
</table>

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City Dispensary Ordinance Data Collection Methods

Data characterizing city dispensary ordinances were obtained via primary data collection. I reviewed municipal codes for the 88 incorporated cities within Los Angeles County semi-annually from August 2014 and through August 2016. For cities where municipal codes were available online, search terms such as “marijuana,” “cannabis,” and “dispensary” were used to find the sections of municipal and zoning codes that regulated medical marijuana dispensaries. For the cities without municipal codes accessible online, City Clerks were contacted via email and phone to obtain the full text of the city ordinance, but this was only necessary for the cities of Avalon and Maywood.

As I compiled the city policy data, I created a database listing whether the dispensary policies of the 88 incorporated cities within Los Angeles County banned or allowed dispensaries. The database included links to the full text of each ordinance and detailed notes about how it was obtained for each city. Three main categories of marijuana policy emerged as data collection proceeded; policies that addressed: storefront dispensaries, cultivation, and delivery services. In the case of delivery and cultivation policies, many communities did not explicitly state in their municipal code if these activities are allowed, but unless a local ordinance bans these activities, the local law defaults to the State law, which allows personal use cultivation and medical marijuana delivery to qualified medical marijuana patients.

Several cities presented special cases in this analysis. In the absence of a policy banning or specifically allowing dispensaries, the cities of Long Beach, Los Angeles, and West Hollywood initially allowed dispensaries to operate according to California law before passing
ordinances that restricted their number and enacted additional regulations (Long Beach Ordinance 10-007, 3/2010; Los Angeles Ordinance # 179027, 9/2007; West Hollywood Municipal Code Chapter 5.70, 4/2009). In the case of Long Beach, these restrictions were eventually followed by a dispensary ban (Long Beach Municipal Code Section 5.89.030, 2/2012), which has since been reversed again by a local ballot measure, Measure MM (passed November 2016 but not implemented until after the study period ended). As these three cities were known to have allowed dispensaries to operate openly within city borders after they became legal under state law (“Long Beach holds lottery for medical marijuana collective permits,” 2010, Redlands Daily Facts/Long Beach Press Telegram, 9/20/2010; “One Toke Over the Line | L.A. Weekly,” July 4, 2001), they were coded as allowing dispensaries starting from the 2005/2006 school year forward for this analysis. Although dispensaries likely cropped up in other cities and in the unincorporated areas of the County in advance of an official policy allowing them, my research of news reports and the background provided in city ordinance texts has not identified any other cities where dispensaries were sanctioned the way they were in Long Beach, Los Angeles, and West Hollywood prior to these cities enacting local ordinances that restricted their operation beyond California law. All the other cities and unincorporated LA County were therefore coded as not allowing dispensaries until an ordinance was passed that specifically stated that they were allowed.

Limitations of City Dispensary Ordinance Data

Unfortunately, all of the cities in Los Angeles County that had enacted a ban on personal use cultivation, commercial cultivation, or delivery services had also enacted a ban on storefront dispensaries, which precluded studying the effectiveness of these policies in comparison to dispensary bans. Nor was I able to characterize city dispensary ordinances by how strict they were or how consistently they were enforced, which may be key determinants of efficacy for dispensary regulations.
Dispensary Location Data

I recorded the location of dispensaries to measure their presence in communities directly, rather than assuming a city ban meant that there were no dispensaries operating in a city. As soon as I started collecting data on the number and locations of dispensaries in LA County it became clear that city dispensary bans were not a reliable determinant of whether dispensaries were actively operating in a city. This backed my theory that it would be important to adjust for discrepancies between expectations based on city policy and the practical availability of marijuana from dispensaries in a particular city based on how dispensaries were operating there.

Prevention research supports the idea that more convenient access to substances that are legal for adults, such as tobacco or alcohol, often has the end result of creating easier access for youth (Ahmad & Billimek, 2007; Flewelling et al., 2013; Harrison, Fulkerson, & Park, 2000). This finding implies that youth living in or attending school in a city that allows dispensaries might obtain cannabis more easily or more often from adults in their social network. Considering that adolescents report older relatives and the illicit market as their primary sources of cannabis (King, Merianos, & Vidourek, 2016; Reed et al., 2019), a dispensary ban making access less convenient for adults could have the additional effect of making it less conveniently obtained by teens.

Dispensary Location Data Collection Methods

Similar to previous studies of the health and social impacts of dispensaries (Freisthler, et al., 2016; Kepple & Freisthler, 2018; Kepple et al., 2016; Mair et al., 2015; Thomas & Freisthler, 2015), locations of storefront medical marijuana dispensaries were obtained from marijuana business directories such as WeedMaps (www.weedmaps.com) and Leafly (www.leafly.com)
that link medical marijuana patients with customer satisfaction ratings and location information for dispensaries. Lists for storefront medical marijuana dispensaries in Los Angeles County were compiled using three of these websites in the first two weeks of September 2016. After duplicate and delivery-only dispensaries were excluded, we had a list of 848 storefront dispensaries. During the last 2 weeks in September 2016, a coworker and I called each of these dispensaries during regular business hours to verify whether they were still in business and if their address was correct. Non-operational numbers and voicemail messages that did not match the listing were removed from the list. When the phone was not answered but a voicemail message identified a dispensary we called back three times before moving on to other verification methods.

The dispensaries we were not able to contact over the phone we looked up by address and business name on Google Maps Street View to verify whether the dispensary been located at that address at the time when the most recent Google street view image was photographed. Google Street View images are not dated but Google Street View Service Documentation states that street view images in urban areas are updated on every two to three years (Google Street View Service Documentation, 2019). We therefore performed an additional method of verification for the dispensaries we found on Google Street View, where we checked the dates of the most recent customer comments and ratings on the dispensary directory reviews. If there were customer comments dated within the previous month we verified the dispensary as being in current operation, otherwise they were excluded from that this list. We verified a total of 546 storefront dispensaries in Los Angeles County as of September 24, 2016. Of these, we determined that 146 were operating in cities where they were allowed. These “licensed” dispensaries included the 134 dispensaries operating under limited immunity in Los Angeles (“Pre-ICO” dispensaries, a definition that is explained in greater detail later in this chapter) but did not include the majority of Los Angeles dispensaries. The 433 dispensaries operating in
cities where they were not allowed or that were not granted limited immunity by the City of Los Angeles were coded as unlicensed dispensaries.

Limitations of Dispensary Location Data

The dispensary location data were not obtained from an official source and were intended to link medical marijuana customers to marijuana businesses rather than for research purposes. However, a greater limitation than the source of the marijuana location data is how quickly it can change. The marijuana market and policy environment in LA County is an environment where dispensaries are frequently shut down and found to crop up in other locations (Marcellino, 2018). Using the verified counts of the dispensaries helped address this limitation and assure that the influence of dispensaries was more contemporaneous with when marijuana use was measured among students (during the 2015/2016 and 2016/2017 school years).

Geographic Methods

Once obtained and de-duplicated, the addresses of the dispensaries and LA County Public High Schools were geocoded using ArcMap 10.4. Geocoding is a process where a Geographic Information Systems (GIS) software program matches an address to a database that contains latitude and longitude coordinates for all of the known addresses in an area, and then places the address locations as points on a map. For this analysis I used the “LA County Locator”, which is publicly available for download from the County of Los Angeles GIS Portal (https://egis3.lacounty.gov/dataportal/), a website that is maintained by the County of Los Angeles GIS Steering Committee to serve as a central location for GIS data created, maintained, licensed, and stored by LA County government agencies.
After placing the geocoded addresses of the dispensaries and high schools within a map of LA County as points, I associated the shapefiles that placed the location of the dispensaries as points within LA County with shapefiles that defined the borders of the cities and unincorporated areas of LA County using a spatial join. When a point layer is joined to a polygon layer, a count field is created that tallies the number of points (dispensary locations) that fall within the boundaries of each polygon (city boundary). I used this process to create dispensary counts per city in ArcMap. I then imported the .dbf file (a generic database file format) that ArcMap creates as part of each shapefile into SAS to be linked with the other data sources by city name.

The city boundary shapefiles I used contain information about the population of the cities and the unincorporated area within LA County, which I used to account for the different sizes of the cities in LA County by calculating rates of dispensaries by the city and unincorporated area population. To do this, the counts of MMDS per city were divided by the population of the city and multiplied by 10,000 to obtain a rate of dispensaries per 10,000 residents. The city population estimates included in the city boundary shapefiles are calculated by applying mortality and migration rates to the 2010 Census count and controlling for age, race-ethnicity, and gender proportions from the Census Bureau’s LA county population estimates for the previous year. These city boundary shapefiles are available for download and public use at the County of Los Angeles GIS Portal (http://egis3.lacounty.gov/dataportal/, LA County Enterprise GIS group, 2019).

To quantify the impact of multiple dispensaries being located near a school, I first calculated the association between the continuous distance between the school and the nearest dispensary in within a mile and within LA County. I wanted to know at which point a dispensary was located close enough to a school to have an influence on student marijuana use, so I also conducted sensitivity tests of distance within a mile using increments of a quarter mile. These distances are much further away from schools than the state requirement of 500 feet or and the
maximum distance dispensaries are required to be located away from schools by a city ordinance in LA County, which is 1,000 feet. I then constructed a series of “buffers” using ArcMap 10.4 GIS Software and recorded counts of how many dispensaries were located within each buffer. A buffer is created by specifying the length and unit of measurement for the radius around a point of interest, such as LA County public high schools. A series of 3 buffers were created for this analysis. The first buffer was 500 feet in radius; the minimum distance a city in LA County allowed dispensaries to be located near schools in 2016, when the city policy data was collected. I suspected that dispensaries could have an impact at greater distances from schools than at 500 feet so I tested the impact of dispensaries being located with 1,000 feet and 2,000 feet. The dispensary count within 500, 1,000, and 2,000 feet of each school were imported into SAS and matched with the data for each school that participated in the CHKS survey by CDS code. This allowed for information about student marijuana use to be associated with the number of dispensaries within a specific radius of each school. These buffer counts were then used as independent variables in the multilevel logistic regression analyses to determine the impact of the number of dispensaries near the schools on students' marijuana use behavior.

MEASURES

CHKS Survey Measures

Student Characteristics

Student characteristics assessed include gender, ethnicity (Latino or not), race, grade (age is not available in the 2016/2017 CHKS survey), highest level of parent education, whether the student qualified for free or reduced-price meals, and whether the student attended their school’s after school program at least one day a week. Male gender is sometimes associated with greater likelihood of and higher rates of marijuana use (Lev-Ran, Le Strat, Imtiaz, Rehm, &
Le Foll, 2013), whereas female gender has been associated with lower rates of use overall, but with younger ages of initiation and faster transition to regular use (Lev-Ran, Le Strat, Intiaz, Rehm, & Le Foll, 2013; Schepis et al., 2011; Tu, Ratner, & Johnson, 2008). Some studies have found that rates of marijuana use among people of Latino ethnicity are higher relative to other racial/ethnic groups in early adolescence but are often overtaken by rates of use by white people in later adolescence (Chen & Jacobson, 2012; Warner, 2015). The most recent year of the CHKS survey does not include age as a variable. Therefore, the analyses presented in this dissertation use the students’ grade in school as a measure of student’s age. Older age is almost universally correlated with greater substance use among adolescents (Tucker et al., 2005), so age (as approximated by grade) is an important factor to account for in any analysis of the risk of substance use among high school age youth. The analyses presented in this dissertation are based on students in the 9th and 11th grade, per CHKS study protocol. Higher grade is logically a powerful predictor of lifetime marijuana use due to it being determined by greater age, but has also been shown to be associated with a greater likelihood of recent marijuana use (Tu, Ratner, & Johnson, 2008), which is not necessarily dependent on greater age. Participation in after-school programs was included as a covariate because it has been shown to be a protective factor against adolescent substance use in general (Farb & Matjasko, 2012). The count of days each student participated in after school programs was only used in the cross-sectional analyses, as it was not available for all of the school years between the 2005/2006 and 2016/2017 school years. Eligibility for school meals and highest parent education were included as a measure of social economic status because some studies have found higher SES to be associated with greater rates of marijuana use (Patrick et al, 2012). Self-report of receiving free and reduced-price school meals was included as the only available proxy for low family income, based on California State eligibility criteria, e.g., annual income $32,630 for a family of four (“Income Eligibility Scales for School Year 2018–19 - Rates, Eligibility Scales, & Funding (CA Dept of Education),” n.d.). The school meals variable was ultimately
found to have a high rate of “don’t know” responses (~11%), which were grouped with “no” responses using the logic that the student would likely be receiving free-reduced price meals if they were eligible and therefore would be aware of their eligibility. This variable was only used in the cross-sectional analyses, as it was not available for all of the school years between the 2005/2006 and 2016/2017 school years. After-school program participation was operationalized using a variable in CHKS that asked “How many days a week do you usually go to your school’s after school program?” and had ordinal response categories ranging from 0 – 5 days per school week. The ordinal form of this variable was used as a covariate to account for how many days a week the student spent time at an after-school program in the regression analysis. This variable was only used in the cross-sectional analyses, as it was not available for all of the school years between the 2005/2006 and 2016/2017 school years.

School Type

An indicator variable for non-traditional schools was available in the CHKS dataset and a matched more detailed descriptions of school type from the CA Department of Education School Directory. The non-traditional school indicator variable was included in all of the cross-sectional analyses to account for the expectation that students attending non-traditional schools may be more likely to likely to use marijuana. This variable was included in the trend analysis as it was available for all of the school years between the 2005/2006 and 2016/2017 school years.

Lifetime Marijuana Use:

The frequency of students' lifetime marijuana use was measured using a binary variable constructed from an ordered categorical variable from the CHKS survey. Because this variable was measured using different ranges for the response categories during earlier versions of the survey, I had to dichotomize the responses to indicate whether the student had ever used
marijuana in their lifetime to be able to combine data and compare data from 2005 - 2017. The most recent version of the questionnaire item that asks about lifetime marijuana use reads: “During your life, how many times have you used the following substances?” which is followed by a list of psychoactive substances (emphasis in the original). The response categories are “0 times”, “1 time”, “2 times”, “3 times”, “4-6 times”, and “7 or more times”. Even though the questionnaire item asking about lifetime use was consistent across the 2015-2017 schools used for the cross-sectional analyses (Research Questions 2-5), whether a student used over 7 times in their life compared to once would not provide enough additional information to the cross-sectional analyses to justify using an ordered categorical variable instead of the binary variable indicating whether they had ever used marijuana, so I used the binary measure of lifetime marijuana use in all of the analyses for this dissertation.

Recent Marijuana Use (Dependent Variable)

Students’ recent marijuana use was also measured using a binary variable constructed from an ordered categorical variable from the CHKS survey. This variable was similarly measured using different ranges for the response categories during earlier versions of the survey, so I was again required to collapse the frequency of marijuana within the last 30 days and instead measure whether or not the student had used marijuana within the previous 30 days. The most recent version of the question reads: “During the past 30 days, on how many days did you use marijuana (pot, weed, grass, hash, bud)?” (emphasis in the original). The response categories are “0 days”, “1 day”, “2 days”, “3-9 days”, “10-19 days”, “20 – 30 days”.

Perception of the Risk of Marijuana Use (Dependent Variable)

Students’ perceived risk of marijuana use was measured using an ordered categorical variable in the CHKS that read: “How much do people risk harming themselves physically and in other ways when they smoke marijuana once or twice a week?” The response categories were
“Great”, “Moderate”, “Slight”, and “None” and referred to a list of substances that included marijuana. The responses were collapsed into a binary variable indicating whether or not the student perceived there to be great risk of harm from frequent (once or twice a week) marijuana use, as has been used in several publications reporting CHKS data (Austin et al., 2015, Austin et al., 2018).

**City Ordinance Measures**

*City Dispensary Ban (Independent Variable)*

Cities were categorized as having a dispensary ban (yes/no) if there was a direct statement in the municipal code stating that storefront dispensaries were prohibited, that anything not specifically stated as a permitted land use was not allowed in the city, or that any activity that violated State or Federal law was prohibited. Cities were categorized as allowing dispensaries if they had passed an ordinance that explicitly allowed storefront dispensaries to operate within city limits. Municipal codes document the date an ordinance is adopted, which allowed me to document which years each city had a dispensary ban in effect during the study period. Cities were coded as allowing dispensaries only for the years when they had a policy allowing dispensaries in effect. Several polices did not match exactly with school years and were coded to match school years according to which year they overlapped the most.

**Dispensary Location Measures (Mediating Variables)**

*Distance to Nearest Dispensary*

The distance between the school and the nearest dispensary within the County was calculated to measure the proximity of dispensaries to high schools. This calculation was repeated separately with licensed and unlicensed dispensaries to learn more about how their effect on students’ marijuana use might vary.
**Number of Dispensaries Located in the City**

The number of verified dispensaries per 10,000 city residents was used to measure dispensary density within each city. This number was also further differentiated by whether the dispensaries were licensed or unlicensed.

**Number of Dispensaries Located Near Schools**

The number of dispensaries within 500 feet, 1,000 feet, and 2,400 was initially used to measure the density of dispensaries near the students’ schools. I defined “near” as 2,000 feet, which was quadruple the distance of 500 feet that the State of California currently requires marijuana businesses to be located from schools (CCR 16.42, § 5026). The 600-foot distance from schools set by the State may be rather arbitrary, however, as no existing research has established the distance threshold at which dispensaries no longer influence students’ marijuana use. Some the LA County cities that allowed dispensaries specified that they be located greater distances from schools, such as 1,000 feet, but it is similarly unknown whether these requirements place dispensaries sufficiently far enough away from schools to prevent them from having an impact on rates of lifetime and recent marijuana use among high school students.

**Analytical Approaches by Research Question: Research Question 1**

**Research Question #1: Differences in Student Marijuana Use by City Policy**

My first research question concerned whether city regulations that ban or restrict dispensaries are associated with a lower prevalence of marijuana use among high school students (RQ1). I hypothesized that a higher prevalence of marijuana use would be reported by students attending schools in cities that allowed dispensaries compared to cities that had enacted dispensary bans (H1.1). I also hypothesized that cities that enacted dispensary bans
would experience declining trends in student marijuana use relative to before the dispensary ban was enacted (H1.2).

I had originally planned a cross-sectional repeated measures analysis of the impact of dispensary bans on student marijuana use over time across all the cities in Los Angeles County to test hypothesis 1.2. However, I soon found that there were unexplained trends in students’ marijuana use that needed further investigation. Frequencies of lifetime and recent marijuana use by combined school years showed an increase through the 2011-2013 school years, followed by a decline that was maintained to the end of the study period. Very similar trends were noted among students who attended schools in cities that allowed dispensaries and students who attended schools in cities that banned dispensaries. I was not surprised to see an increasing trend in marijuana use countywide because state laws allowing storefront sales of marijuana use were implemented shortly prior to the study period and more social norms toward marijuana use continued to become more accepting in California during this period. I had hypothesized that the prevalence of marijuana use would increase in cities that allowed dispensaries, but I did not expect to see the prevalence of marijuana use increased at a similar rate in cities that did not allow dispensaries. Most importantly, however, there was nothing in my analysis that could explain why the increasing trend in lifetime and recent marijuana use reversed after the 2011-2013 school years in cities that allowed dispensaries as well as cities with bans (Figures 4.1, 4.2).
I suspected that the decline in marijuana use noted in both groups after the 2011-2013 time period did not occur by chance. Ignoring any important events could confound my analysis and lead to false conclusions about the impact of dispensary bans on high school students’ marijuana use. I needed to learn more about any influential events could have impacted the
intervention and control groups differently and identify any important events that would have impacted only one of the study groups. I therefore investigated further two events that could have contributed to the decline in LA County high school students’ marijuana use after the 2011-2013 combined school years in further detail. As they were only briefly mentioned in Chapter 2, I will review them in further detail below.

**Important Events That Occurred During the Study Period**

*Los Angeles Proposition D*

The City of Los Angeles enacted Proposition D (Appendix B: City of Los Angeles Proposition D) in June of 2013. Proposition D represented a significant policy change that made the majority of dispensaries in Los Angeles illegal and preceded a significant enforcement effort to shut them down. The motivation for Proposition D is best described by a passage from the ordinance text citing that since 2007, local media reports, neighborhood sightings, and complaints had documented that “…more than 850 medical marijuana businesses had opened, closed and reopened storefront shops and commercial growing operations in the City without any land use approval under the Los Angeles Municipal Code…”.

In an attempt to control the chaotic situation described above, Proposition D granted limited immunity to 135 dispensaries that had been in continuous compliance and operation dating from before the enactment of an Interim Control Ordinance in 2007 (Appendix B: City of Los Angeles Proposition D). The dispensaries that were granted limited immunity were soon referred to as Pre-Interim Control Ordinance (“Pre-ICO”) dispensaries. The over 700 remaining marijuana businesses that did not qualify for limited immunity were ordered to close down. This represented a substantial policy shift for Los Angeles, which other than attempting to cap the
numbers of dispensaries in 2007 with the Interim Control Ordinance (City of Los Angeles, Ordinance # 179027), had allowed dispensaries to operate unregulated other than under State Law until in January 2010 (City of Los Angeles, Medical Marijuana Ordinance #181069).

Although efforts to close down all the dispensaries that were not eligible for limited immunity began after enactment of the Interim Control Ordinance in 2007 and were ongoing throughout the study period, they were not entirely effective. In April 2015, the LA City Attorney’s Office told the LA Weekly newspaper that 503 illegal shops had been shut down as part of the City’s effort to pare the number down to fewer than 135 and estimated that there were about 415 dispensaries left in current operation in the City of Los Angeles (Romero, 2015 | LA Weekly).

Enforcement of Proposition D continues to be a challenge to City resources. In 2017, the Los Angeles City Controller stated that 756 marijuana businesses held a Business Tax Registration Certificate in 2016, but that only 139 of these sellers were compliant with all Proposition D regulations and that the Los Angeles City Attorney’s office had filed criminal cases against 563 non-compliant marijuana businesses (Galperin, 2017). While Proposition D has not yet been successful in reducing the number of storefront marijuana outlets in the City of Los Angeles to 135, it has nevertheless disrupted the medical marijuana market in Los Angeles, reduced the number of dispensaries operating in the City of Los Angeles, and presented a stricter approach to marijuana regulation than the City of Los Angeles had practiced before. Proposition D may also have had an impact in less tangible ways, such as on young people’s perception of the risk of marijuana use.

*Federal Raids on dispensaries*
Based on my literature review, I knew that changes in U.S. Department of Justice enforcement approaches had preceded an expansion in the number of dispensaries in California after 2009 (October 19, 2009: David Ogden, Deputy Attorney General, United States Department of Justice) and a contraction after 2011 (June 29, 2011, James Cole, Deputy Attorney General, United States Department of Justice). However, I had also heard of LA County dispensaries being shut down by Federal agents in 2012. I first heard of this occurrence from the City Clerk for Diamond Bar, where Federal agents had shut down the one dispensary in Diamond Bar in a Federal raid in 2012.

Upon further research, I learned that over 500 dispensaries were shut down in California in 2012. Of these, over 200 were located in the Central District, which includes the Los Angeles, Ventura, San Luis Obispo, Santa Barbara, Orange, Riverside and San Bernardino Counties (Onishi, 2012 | New York Times). One news report alluded to Federal agents leaving the task of closing down dispensaries in Los Angeles to City law enforcement agencies (Onishi, 2012 | New York Times), but I was unable to find any other news or research sources to confirm whether that in fact occurred. I suspected, however, that the Federal raids on dispensaries that followed the Cole Memo of 2011 reduced the availability of marijuana from dispensaries in LA County and could possibly have influenced dispensary business practices for the dispensaries that remained in operation. Depending on how aware of the Federal raids LA County high school students were at the time, it could also have had in impact on their willingness to obtain and use marijuana illegally or had an influence on their perceptions of the health risks of marijuana use.

**Revised Hypothesis 1.2**
My preliminary analyses for the trend analysis indicated that I needed to revise the first hypothesis for Research Question 1 (whether city policies allowing dispensaries influenced trends in student marijuana use relative to cities that did not). While testing the parallel trends assumption for the difference in difference analysis, I compared frequencies by time (in two-school-year ranges) for both lifetime (Figure 4.1) and recent (Figure 4.2) marijuana use by whether the city the school was located in allowed dispensaries. Figures 4.1 and 4.2 indicate that the intervention and control groups exhibited remarkably similar trends, where lifetime and recent marijuana use increased in both groups from baseline through the 2011-2013 combined school years and was followed by a decline that was maintained through the 2015-2017 school years.

The evidence of similar trends between the intervention and control groups satisfied a key assumption of difference-in-difference analyses that trends in the outcomes under study were parallel between the intervention and control groups before an event of interest has occurred. However, the similar and non-linear nature of the trends in each group indicated a need to investigate if any events had occurred in LA County that could have influenced cities that allowed dispensaries and cities that did not in similar ways. After learning more about Proposition D and the impact it had on the medical marijuana market in the City of Los Angeles it was clear that Proposition D represented a significant event that affected the intervention group and not the control group. I felt that making any conclusions about trends in marijuana use differing between cities that allowed dispensaries and those that didn't within LA County without accounting for the impact of Proposition D on Los Angeles students would be invalid. It was less clear whether the federal raids that occurred in 2011 and 2012 affected one of the study groups more than the other, but if it did affect both groups equally, the difference-in-difference study design would account for any impact the federal raids had on the marijuana use behaviors of Los Angeles students. I therefore chose to address Research Question 1 by
analyzing the impact of enacting *stricter* regulations on dispensaries students’ marijuana use within the City of Los Angeles, using the cities that had never allowed dispensaries as a control group. Research Question 1 was therefore revised to ask “Do city restrictions on dispensaries have an influence on trends in adolescent marijuana use time?” The revised hypothesis for this question was that cities that enacted more restrictive MMDS policies would see a trend of declining marijuana use among students attending school there (Revised H1.2).

*Revised Study Period*

To focus on the impact of Proposition D on trends in student marijuana use in the City of Los Angeles, I excluded the 2005/2007 combined school years and used 2007/2009 as the baseline time period. The 2007/2009 time period was two time periods (four school years) before Proposition D was enacted and the 2015-2017 time period concluded one time period (two school years) after the enactment of Proposition D. The analysis plan for Research Question 1 was changed to focus on the impact of Proposition D within the City of Los Angeles compared to cities that did not allow dispensaries (but that may have been affected by the Federal enforcement raids that occurred in 2012).

*Study Sample Exclusions for Research Question 1*

I excluded all students from the six cities that had allowed dispensaries during part of the study but not all of it, to focus on consistent marijuana policies that either allowed or banned dispensaries during the study period. Although West Hollywood had allowed dispensaries throughout the study period and would therefore have been included along with Los Angeles, it was not represented due to missing data. The remaining cities included in the difference-in-difference analysis to test the hypothesis for Research Questions 1 were: Los Angeles, a city that had allowed dispensaries for the entire study period as the intervention group, and the cities
in LA County that had banned dispensaries for the entire study period, which include all LA County cities other than the six listed above and West Hollywood.

*Intervention and Control Groups*

The control group for this analysis includes the 436,834 students that attended school in the 70 LA County cities that had dispensaries bans in place throughout the study period. The cities excluded were cities that had changed dispensary policies between the 2005/2006 school year and the 2016/2017 school year, which excluded cases from the cities of Diamond Bar (n= 9,510), Huntington Park (n= 94), Long Beach (n= 3,253), Malibu (n= 1,751), Santa Monica (n= 6,132), South El Monte (n= 960), and West Hollywood (n= 0), and students from schools that could not be matched to CA Dept of Education addresses (n= 8,796).

City of Los Angeles students were chosen as the intervention group because Los Angeles and the City of West Hollywood were the only cities in LA County that allowed storefront dispensaries to operate within their borders for the entire 12-year study period. West Hollywood schools, however, did not participate in the CHKS survey during the study period and therefore could not be included in an intervention group of cities that allowed dispensaries throughout the study period. Using students who attended school in the City of Los Angeles as the intervention group was preferable for the difference-in-difference analysis of marijuana use trends because data was available for City of Los Angeles schools for every year of the study period and the population of students within this large and diverse city mirrored the population of the County as a whole (Table 4.3) for most racial/ethnic categories. Exceptions were that City of Los Angeles students were more likely to be Hispanic (65.8% vs. 49.0%) and less likely to be Asian (4.4% vs. 12.4%) or White (13.1% vs. 21.6%) than the control cities (Table 4.4).
<table>
<thead>
<tr>
<th>Variables</th>
<th>City of LA n (%)</th>
<th>Control Group n (%)</th>
<th>DinD Study Sample n (%)</th>
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<tr>
<td>Gender</td>
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<tr>
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<td>9,941 (50.6)</td>
<td>211,561 (49.0)</td>
<td>221,502 (49.1)</td>
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<tr>
<td>Grade</td>
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<tr>
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<td>10,306 (52.4)</td>
<td>227,950 (52.9)</td>
<td>238,256 (52.8)</td>
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<td>11th</td>
<td>9,368 (47.6)</td>
<td>203,401 (47.2)</td>
<td>212,769 (47.2)</td>
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<td>Race/ethnicity</td>
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<td>220,950 (50.0)</td>
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<td>48,703 (11.0)</td>
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<td>314 (1.6)</td>
<td>8,938 (2.1)</td>
<td>9,252 (2.0)</td>
</tr>
</tbody>
</table>

**Revised Hypothesis 1.2 Analytical Approach**

The association between policy changes and subsequent outcomes is often evaluated by pre-post assessments, where outcomes after implementation of the policy are compared with conditions and outcomes from before. This design is valid only if there are no underlying time-dependent trends in outcomes unrelated to the policy change (Dimick & Ryan, 2014). If, for example, outcomes were already improving before the policy was enacted, using a pre-post study would lead to the erroneous conclusion that the policy was associated with better outcomes. The difference-in-difference study design addresses this problem by using a comparison group that is experiencing the same trends but is not exposed to the policy change (Angrist & Pischke, 2008). Outcomes before and after the policy is implemented are compared between the study group and the comparison group, which allows the investigator to account for whether a general secular trend was influencing both groups.

**Difference-in-Differences Approach**
I compared high school students’ marijuana use trends in the City of Los Angeles to trends in the cities that never allowed dispensaries using a difference-in-design. difference-in-difference is a useful technique to use for observational studies, natural experiments, and other research analyses where it is not possible to randomize individuals into equivalent treatment and control groups (Lechner, 2011). It is used for comparing trends between two groups and therefore requires pre and post intervention data for a cohort, for individuals over time, or repeated cross-sectional data at the individual or group level (Donald & Lang, 2007). This design allowed me control for events and secular trends such as incremental changes in state laws that occurred during the study period, and general changes in social attitudes that may have been linked to changes in laws in other states and shifts in attitudes at a national level that could have impacted both the intervention and control groups.

Difference-in-difference analyses are based in traditional regression analyses and can be applied to linear or generalized linear regression models. To measure the relative difference between the intervention and control groups over time an interaction term is included that compares pre and post-intervention measures between the two groups and gives a parameter estimate for their combined effect. Where the difference-in-difference approach departs from traditional longitudinal or repeated measures trend analyses is that change over time is measured not within the intervention group relative to baseline, but instead by how much more (or less) the intervention group changed relative to the control group. Focusing on outcomes in the intervention group relative to the control group allows the researcher to isolate the effect of the intervention from any secular trends or background influences that may have contributed to the observed outcomes for the intervention group. The control group accounts for any background trends or influences that could have contributed to change in outcomes that were not measured or could not be included in the analysis.
An example of the interaction term between time and treatment group dummy variables in a regression model is shown in the linear regression equation below, where $\beta_0$ is the baseline average, $\beta_1$ is the time trend in the control group, $\beta_2$ is the difference between the two groups pre-intervention, and $\beta_3$ is the difference in changes over time. For the logistic models presented in this analysis I used a nonlinear link function to transform the outcomes and make the interaction terms interpretable (Norton, 2004).

Equation 4:

$$Y = \beta_0 + \beta_1[\text{Time}] + \beta_2[\text{Intervention}] + \beta_3[\text{Time} \times \text{Intervention}] + \beta_4[\text{Covariates}] + \epsilon$$

Testing Difference-in Differences Assumptions

The primary assumptions of a difference-in-difference analysis are that:

1. That intervention and control groups do not differ substantively at baseline;
2. The composition of the intervention and comparison groups does not change during the study period;
3. Allocation to the intervention group was not determined by the outcome of interest;
4. The intervention and control groups exhibit parallel trends in outcomes;
5. There is no diffusion of the effect of the intervention from the intervention group to the control group.

The intervention group, students who attended school in the City of Los Angeles, and the control group, students who attended school in cities that never allowed dispensaries during the study period, were similar in terms of social/economic and demographic characteristics, but City of LA students were more likely to be Hispanic and less likely to be Asian (Table 4.1). Social/economic and demographic characteristics also remained stable in the two groups over the ten-year study period. Assignment to the intervention and control groups was determined by
whether or not the city had banned dispensaries throughout the study period and not by any measure of student marijuana use. I used graphs to visually check the parallel trends assumption. The intervention and control groups exhibited parallel trends prior to implementation of Proposition D, which satisfied the assumption that if the policy had not occurred, the difference between the intervention and control groups would have remained stable over the study period (Figures 4.1 and 4.2, page 7).

_Poisson Regression Using Robust Standard Errors_

I used a robust Poisson regression for the multivariate regression analyses to test the impact of Proposition D in Los Angeles on students' lifetime and recent marijuana use. The CHKS survey asked the students to choose ranges of days or times to estimate the frequency of their marijuana use rather than specifying the discrete number of times they had used marijuana in their lifetime or within the previous 30 days. Because the response categories changed across study years I was required to collapse the frequency of marijuana use categories to the binary outcomes of whether a student had ever used marijuana (yes/no) and whether the student had used marijuana in the previous 30 days (yes/no).

Although my dependent variables were binary and not count variables, I chose to use a Poisson regression because I was reporting prevalence ratios of behaviors that were not rare, i.e., the prevalence of marijuana use for both measures was over 10%. Researchers in the medical and public health fields have pointed out that with prevalence of outcomes at more than 10% it is often more desirable to estimate the relative risk (or risk ratio, RR) since there is an increasing differential between risk ratios and odds ratios with increasing incidence rates (McNutt et al., 2003; Zou, 2004; Tamhane et al., 2016). Under these circumstances using
logistic regression and reporting odds ratios can overestimate the prevalence ratio (Barros & Hirakata, 2003), potentially leading to false conclusions about the volume and statistical significance of intervention effects (Ulluh & Giles, 2010).

I used clustered standard errors in the Poisson regression to account for the grouping of participants in clusters, the cities where they attended high school. In such circumstances there may be independence across clusters but correlation within clusters. When this is the case, statistical inference based on the usual assumption of independent observations is no longer appropriate (Cameron & Miller in Ulluh & Giles, 2015, p.9). A common approach to control for clustering is by computing cluster-robust standard errors that control for clustering at the level of the primary theoretical grouping, which in this case was city (Huber, 1967; Rogers, 1983). I will use this approach to account for the fact that students are nested in cities and there may be unmeasured city effects that influence marijuana use behavior (Bell & Jones, 2015). This approach was used to account for students being clustered within cities rather than a multilevel analysis for simplicity and because the level 2 analytical variables used to answer Research Questions 2-5 were not available for the survey years used in the trend analysis.

Research Questions 2 – 5: Mediation Analyses

Mediation Analysis Methods

For Research Questions 2 – 5 I conducted a mediation analysis using methodology proposed by Zhao, Lynch, & Chen (2010) as a modernization of the well-known Baron and Kenny (1986) method. Baron and Kenny (1986) describe three conditions that characterize a mediated relationship; that the independent variable is significantly related to the outcome variable (Path C), that the independent variable is significantly associated with the mediating variable (Path A), and that the mediating variable is significantly associated with the outcome
variable. A key test for mediation using the Baron and Kenny method is that when Paths A and B are controlled for, a previously significant association between the independent and outcome variables is no longer significant. Steps for testing these relationships include: first, regressing the mediator on the independent variable; second, regressing the dependent variable on the independent variable; and third, regressing the outcome variable on both the independent variable and on the mediator. Zhao and colleagues (2010) argue that a statistically significant relationship between the independent and outcome variable in the absence of the mediating variable is irrelevant, but otherwise follow the same steps to establish mediation. Figure 4.3 is a diagram of a mediated relationship as conceptualized by Baron & Kenney (1986).

Figure 4.3. Mediation Diagram Based on Baron & Kenny’s (1986) Product Method.

Hierarchical Generalized Linear Models (HGLMs)

The analyses that test Research Questions 2 – 5 and the cross-sectional analysis of the focal relationship between dispensary bans and student marijuana use (H1.1) will use HGLM models (multilevel logistic regression) that account for students being clustered in cities. Although they are based on the combined 2015/2016 and 2016/2017 school years (n=101,521), these two school years are pooled and these analyses are treated as cross-sectional analyses. I elected to use logistic instead of Poisson regressions analyses to test the hypotheses for Research Questions 2-5 because there was no substantive difference in the estimates and
conclusions between the Poisson and logistic regression analyses for the difference-in-difference analysis and logistic regression is the most common approach to analyze binary data.

Hierarchically organized data are commonplace in educational settings and in policy research (Ene et al., 2014). For example, students can be thought of as being nested within schools, and schools within cities. Conducting research while ignoring whether students within the same city are more alike each other than not can lead to erroneous conclusions. Research has shown that ignoring the levels and nesting that naturally occur in data according to organizational structures (e.g., classrooms) or how it was collected (e.g., the CHKS stratified sampling frames for LAUSD that included classrooms and schools within districts) can impact estimated variances and degrade the ability to detect treatment or covariate effects (Donner & Klar, 2000; Julian, 2001; Moerbeek, 2004; Murray, 1998; Shadish, Cook & Campbell, 2002). Ignoring nesting or clustering can also increase the odds Type I error (Wampold & Serlin, 2000) and lead to substantive errors in interpreting the results of statistical significance tests (Goldstein, 2003; Nich & Caroll, 1997).

Multilevel models were developed to avoid these model specification errors by properly accounting for data that is correlated by geographic, political, or administrative units (Heck & Thomas, 2000; Hox, 2002; Klein & Kozlowski, 2000; Raudenbush & Bryk, 2002; Snijders & Bosker, 1999). For example, for this dissertation I am interested in modeling lifetime and recent marijuana use by individual students (level-1) nested within cities (level-2). I am testing the dichotomous relationship (e.g., whether the student used marijuana), according to whether the city where they attend school allows dispensaries, while accounting for student characteristics such as grade level and city characteristics such as how many dispensaries are located in the city.

HGLMs are appropriate to use for multi-level models that use categorical, non-normally distributed response variables including binary, proportions, count, or ordinal data. When
dealing with categorical outcomes such as these, the assumptions of normally distributed, homoscedastic errors are violated (Hox, 2002; O’Connell, Goldstein, Rogers, & Peng, 2008) and a nonlinear link function is used to transform the outcomes. A non-normal error distribution also needs to be incorporated into the models so that the model building strategies and the interpretations used for hierarchical linear models will still be applicable (Luke, 2004). Multilevel models with dichotomous outcomes most commonly use the binomial distribution (i.e., Bernoulli) and the logit link to estimate for example the odds ratios and the impact of various characteristics at different levels on those odds (Mathur et al., 2013). The equations for the hierarchical generalized linear model used to test the relationships in this dissertation are presented below:

\[ n_{ij} = \beta_{0j} + \beta_{1j}X_{ij} \]

Equation 1 represents a simple level-1 model with one student-level predictor, where \( n_{ij} \) represents the log odds of having used marijuana for student \( i \) in school \( j \). \( \beta_{0j} \) is the intercept, or the average log odds of a student using marijuana in city \( j \). \( X_{ij} \) is a student-level predictor for student \( i \) in city \( j \), and \( \beta_{1j} \) represents the slope associated with \( X_{ij} \) showing the relationship between the student-level variable and the log odds of having used marijuana. Unlike hierarchical linear models, this model has no error variance at level-1. This statistic is not estimated separately for hierarchical generalized linear models with binary outcomes because the variance is a function of the population mean and is directly determined by this mean (Luke, 2004).

\[ \beta_{0j} = Y_{00} + Y_{01}W_j + u_{0j} \]
\[ \beta_{1j} = Y_{10} \]
Equation 2 represents a simple level-2 model with one school-level predictor, where $Y_{00}$ provides the log odds of having used marijuana in a typical city, and $W_j$ is a city-level predictor for city $j$. $Y_{01}$ is the slope associated with this predictor, $u_{0j}$ is the level-2 error term representing a unique effect associated with city $j$, and $Y_{10}$ is the average effect of the student-level predictor. As the effect of the student-level predictor is modeled as constant across cities, this represents a random intercept-only model.

Equation 3:

$$n_{ij} = Y_{00} + Y_{10}X_{ij} = Y_{01}W_j + u_{0j}$$

In Equation 3, the combined level-1 and level-2 model is created by substituting the values of $\beta_{0j}$ and $\beta_{1j}$ as shown in Equation 2 into the level-1 equation represented in Equation 1. As presented in this combined model, the log odds of passing the math test for student $i$ in school $j$ ($n_{ij}$) is determined by the log odds of a typical student having used marijuana at a typical school ($Y_{00}$), the effect of the student-level ($Y_{10}X_{ij}$) and city-level predictor ($Y_{01}W_j$), as well as the city-level error $[u_{0j}]$.

Testing Multilevel Structure

Conceptually it makes sense that there is a multilevel structure to the data given that the research questions and hypothesis focus on the impacts of city policy on student marijuana use and that students within the same city may be more like each other than students from other cities. It is best, however, to use the most parsimonious models that fit the data. To verify whether a multilevel approach was needed, I conducted a model building process that began with an unconditional model (i.e., a model containing no predictors) and compared model fit between the simpler and more complex models.
Model fit for HGLMs is assessed using a “quasi-likelihood” strategy such as Maximum Quadrature estimation, a common estimation technique available with PROC GLIMMIX. Using this quasi-likelihood technique, I assessed the need for using a multilevel structure by noting change in the -2 log likelihood (-2LL) between a single level model and the nested model with a deviance test. (Nested models are models that have been fit using the same data and where one model is a subset of the other.) Lower deviance implies better fit; however, models with more parameters will always have lower deviance. A likelihood ratio test is therefore used to investigate whether or not the change in the -2LL is statistically significant. This likelihood ratio test is analogous to a chi-square difference test, where $\chi^2$ is equal to the difference in the -2LL of the simpler model minus the -2LL of the more complex model, with degrees of freedom ($df$) equal to the difference in the number of parameters between the two nested models (Ene et al., 2014).

**Level 2 Unit: City**

The primary reason to use city as the level 2 unit was that the research questions focus on predictors of marijuana use according to city marijuana policy and city characteristics, rather than school-level predictors. To verify the use of city as the level 2 unit, I compared the intra-class correlation (ICC) within an empty model (i.e., with no predictor variables yet included) using school as the level 2 unit vs. city as the level 2 unit. This analysis indicated that intraclass correlations within the schools were smaller than the ICCs observed for city (0.09 for city, vs. 0.07 for school). Cities were also a more appropriate level 2 unit because more than half of the cities in the county were represented by only one school, which would have conflated clustering by school and by city if school was used as the cluster variable. Next, however, I needed to address whether school should be maintained as a level of the HGLM in addition to city. Design effect calculations ($1+\text{average cluster size } – 1)^\text{ICC}$ (Hox, Moerbeek, & Van de Schoot, 2017) for each outcome of interest (lifetime marijuana use, recent marijuana) all returned values less
than 2, indicating that for each of these variables, adding school as the second level in the analysis and keeping city as the third level would add more complexity than clarity to the analysis and was not necessary.

*Missing Data*

Missing data can introduce bias into regression analysis, so before testing my research questions I examined the frequency of missing responses in the CHKS dataset by generating frequency tables for each of the study variables. For the majority of the study variables, less than 5% of the responses were missing. It is assumed that a missing rate of 5% or less does not introduce bias into the analysis (Bücker, 2011) so the dataset was treated with listwise deletion (i.e. complete case analysis), the default method programmed into SAS regression procedures.

The most important variable used in this dissertation that had a high proportion of missing values was the race/ethnicity variable. For example, in the 2015-2017 dataset used for the cross-sectional analyses, 14.64% of the values were missing in the 2015/2016 school year, and 12.95% of the values were missing in the 2016/2017 school year, which averaged to 13.75% missing values within the race ethnicity variable in the pooled 15-17 dataset. These missing values were primarily found among students who had reported Hispanic ethnicity in a separate question. I therefore addressed the missing values for race/ethnicity by creating a combined race/ethnicity variable that included Hispanic as a racial/ethnic category. Because the proportion of missing values for the Hispanic ethnicity variable was only 1.94% for the pooled 15-17 data, this brought the proportion of missing values for race/ethnicity within acceptable parameters. I applied the same technique to the earlier years of data that asked about Hispanic ethnicity as a separate category. The school years 2005/2006 through 2007/2009 included Hispanic ethnicity among the other racial/ethnic categories rather than a separate questionnaire item and did not have a high proportion of missing values.
Sobel Test for Indirect Effects (Research Questions 2-5)

To assess for indirect effects between dispensary bans and student marijuana use, I calculated the point estimates by multiplying the a and b coefficients, also known as the product method (MacKinnon & Dwyer, 1994). Multiplying a by b makes it possible to test the mediating effect for a specific variable and can also be summed for total mediated effect (MacKinnon, Warsi, & Dwyer, 1995) for the relationship between the independent variable, dependent variable, and the mediating variable. To test whether the mediation effect was statistically significantly different from 0 (α=0.05), I used the Sobel test (Sobel, 1982). The Sobel test is a Z-test calculated by dividing the point estimate for the mediator variable by the standard error of the estimate of the influence using the following formula drawn from MacKinnon & Dwyer (1994) and from MacKinnon, Warsi, & Dwyer (1995):

\[
\text{z-value} = \frac{ab}{\sqrt{b^2s_a^2 + a^2s_b^2}}
\]

Equation 4.4. Sobel test equation

Logistic Regression Assumptions & Diagnostics

Before testing my hypotheses, I first checked the logistic regression assumptions and ran model diagnostics. The main assumptions for a logistic regression model are that:

- The true conditional probabilities are a logistic function of the independent variables (Goodness of Fit)
- The independent variables are measured without error (Influential Observations and Missing Data)
- The observations are independent. (Independence of Observations)
- The independent variables are not linear combinations of each other. (Multicollinearity)
- The mean and variance are equal. (Overdispersion)
**Goodness of Fit**

For the two binary dependent variables used in these analyses I used Pearson chi-squared goodness of fit tests to determine how well the logit distribution fit the empirical distribution in my data. In Chi-Square goodness of fit tests, sample data is divided into intervals. Then the numbers of points that fall into the interval are compared with the expected numbers of points in each interval. The test value indicates if the observed and expected proportions differed significantly. The Pearson chi-squared statistic is the sum of \((\text{observed} - \text{expected})^2 / \text{expected}\) with two constraints and \(n - 2\) degrees of freedom.

**Influential Observations**

To address the assumption that the independent variables are measured without error, I ran diagnostic analyses to check for influential observations among the continuous independent variables such as data errors or valid outlier values. I assessed whether any of these potentially influential points had an impact on the regression coefficient estimates using the INFLUENCE and IPLOTS options to produce index plots useful for identification of extreme values. These commands display standardized Pearson residuals, deviance residuals and the leverage (hat diagonal) and plot them against the predicted probabilities and index numbers. The vertical axis of an index plot represents the categorical value of the marijuana use outcome, and the horizontal axis represents the sequence (case number) of the observation.

The continuous measure of MMDS per 10,000 residents was the only source of extreme outliers in my data that could introduce bias into the parameter estimates, as the categorical nature of most of the other independent variables precluded extreme values. I identified extreme values for the number of dispensaries per 10,000 city residents in two communities that had several dispensaries but very small residential (and therefore student) populations. I compared the Poisson regressions between city dispensary density and student marijuana use with
students from these cities excluded to a model that included them. Due to the small number of cases they represented, there were no major differences in -2LL likelihood or parameter estimates between the models that excluded students from the cities with very high ratios of dispensaries per 10,000 population and the models that retained them. Because these were true ratios rather than data or coding errors I therefore retained all of the observations in the dataset.

Independence of Observations Check

The assumption of the independence of observations was partially met. Because the CHKS survey is anonymous, each year of data is treated as an independent sample of students. Although a student may have taken the survey in a previous year there is not a way to link their data from one survey year to the next and then no way to account for these within-person effects. Treating each year as an independent sample ignores the inherent dependence of any repeated observations of the same student across different survey years and represents a limitation of this data and analysis. To address this limitation, I used a method common to cross-sectional repeated measures survey data, where the unit of analysis for each year is the batch of students who completed the survey that year, and the mode of the dependent variable at the school level was included to adjust for the effect of each school (Lippert, 2016).

That students are clustered in schools and cities could also violate the independence of error assumption, as one could expect that the students within each school and city will tend to be more like each other than respondents from different communities and that errors associated with one observation would therefore be correlated with the errors of another observation. I accounted for this structure using multilevel models for the cross-sectional analyses and clustered standard errors in the repeated measures analysis.

Multicollinearity Check
I took steps to avoid multicollinearity from the outset by avoiding similar measures of the same construct. For example, I chose to use the measure of dispensaries normalized by 10,000 city residents rather than an alternative measure I explored that normalized the number of dispensaries by city area in square miles. To check for potential multicollinearity between the remaining independent variables, I generated correlation matrices of the continuous independent variables to check for high correlations between them and assessed the variance inflation factor (VIF) of the various independent and control variables, which assesses how much the variance of an estimated regression coefficient increases if your predictors are correlated. The VIFs for the independent and control variables were all below 5, which indicates that using them in the regression models should not have adverse effects on regression coefficients.

**Research Question #1 (RQ1) (Cross-Sectional Analysis):** Are city dispensary bans associated with a lower prevalence of marijuana use among adolescents?

I hypothesized that the prevalence of marijuana use among students attending school in cities with dispensary bans would be lower than among students attending school in cities that allowed dispensaries (Hypothesis 1.1). To both characterize and quantify the relationship between city dispensary bans and student marijuana use I used a variable that indicated whether each city banned or allowed dispensaries. The values for this variable were based in my review of city ordinances regulating marijuana as recorded in the municipal codes of the cities of LA County.

**Research Question #2 (RQ2):** Is the effect of dispensary bans on student marijuana use dependent on the number of dispensaries operating in a city?
To test the hypotheses associated with Research Question 2, I used the rate of verified dispensaries per 10,000 city residents as the moderating variable and controlled for factors known to influence marijuana use among adolescents, such as gender, race/ethnicity, and social/economic status. The independent variable was whether or not a city had a dispensary ban and was determined by the city policy that was in effect when the count of dispensaries per city was obtained in September 2016. The outcome (dependent) variables were self-reported student lifetime and recent marijuana use.

The research question was broken up into three testable hypotheses: H2.1) there is a direct relationship between city dispensary bans and the number of dispensaries in a city, where city dispensary bans are associated with lower numbers of dispensaries; H2.2) fewer dispensaries in a city is associated with less availability of marijuana to high school students; H2.3) the effect of city dispensary bans on adolescent marijuana use is dependent on them having a suppressing effect on the number of dispensaries operating in a city.

Study Sample Exclusions for Research Question 2

For the analyses used to test Hypotheses 2.1 – 2.3, I excluded 14 cases that had no CDS code because the lack of CDS code prevented me from associating the CHKS data for those participants to a specific school, and based on what city that school was located in, a city policy. An additional 16 cases had invalid CDS codes, but based on their school district I was able to assign these cases to the City of Pasadena (the Pasadena Unified District includes only schools located within the City of Pasadena). The resulting sample size for the analyses to test Hypotheses 2.1 – 2.3 was 101,507.
Research Question #3 (RQ3): Is the effectiveness of city dispensary bans dependent on dispensary bans being associated with an increase in students’ perceptions of the risk of frequent marijuana use?

To test the hypotheses associated with Research Question 3, I used a variable that indicated whether students perceived great risk from frequent marijuana use (defined in the CHKS survey as 1-2 times a week) as the mediating variable and controlled for factors known to influence marijuana use among adolescents, such as gender, race/ethnicity, and social/economic status. As with Research Question 2, the independent variable was whether the city had a dispensary ban and was determined by the city policy that was in effect when the count of dispensaries per city was obtained in September 2016. The outcome (dependent) variable was self-reported student marijuana use (lifetime and within the past month, assessed using separate regression models).

Research Question 3 was broken up into three testable hypotheses: H3.1) there is a direct relationship between city dispensary bans and students’ perceptions of the risk of frequent marijuana use, so that dispensary bans are positively associated with perceived risk; H3.2) there is a direct inverse relationship between students’ perception of the risk of frequent marijuana use and their likelihood of using marijuana, so that students who perceive great risk from frequent marijuana use are less likely to use marijuana; and H3.3) the relationship between city dispensary bans and student marijuana use is dependent on dispensary bans being associated with greater perceptions of the risk of frequent marijuana use among students and an inverse relationship between perceptions of risk and student marijuana use.

To assess the mediating effect of perceived risk on student marijuana use and test hypothesis H3.1 (Path A) I calculated the association between city dispensary bans and whether students perceived great risk from frequent marijuana use. If the coefficient was significant and positive, then H3.2 was supported. The second step was to test H3.3 by
establishing whether there was a significant positive association between the moderating variable and the outcome variable (Path B). This model contained both the focal independent variable (dispensary bans) and the moderator (whether students perceived great risk from frequent [1-2 times a week] marijuana use). Finally, using the same regression model, I assessed the net direct effect of the focal independent variable on the outcome variable while accounting for the indirect effect of the moderator (Path C).

I hypothesized that students’ perceptions of risk mediated the effect of city policy to some degree, and that the direct effect of the focal relationship coefficient (Path C) would therefore decrease in magnitude when I controlled for students’ perceptions of risk. To test whether the mediation effect of students’ perceptions of risk was statistically significant from zero, I used a Sobel Test. Because perceived risk was measured at the individual level, I used the single level of the model to test the mediated relationship.

Study Sample Exclusions for Research Question 3

For the analyses used to test Hypotheses 3.1 – 3.3, I excluded 14 cases that had no CDS code because the lack of CDS code prevented me from associating the CHKS data for those participants to a specific school, and based on what city that school was located in, a city policy. An additional 16 cases had invalid CDS codes, but based on their school district I was able to assign these cases to the City of Pasadena (the Pasadena Unified District includes only schools located within the City of Pasadena). The resulting sample size for the analyses to test Hypotheses 3.1 – 3.3 was 101,507.

Research Question #4 (RQ4): Is the effect of dispensary bans on student marijuana use dependent on the proximity of the nearest dispensary to a student’s high school?

To test the hypotheses associated with Research Question 4, I used a continuous measure of the distance in miles between the school and the closest dispensary in LA County
as the mediating variable and controlled for factors known to influence marijuana use among adolescents, such as gender, race/ethnicity, and social/economic status. As with Research Questions 2 - 3, the independent variable was whether or not a city had a dispensary ban and was determined by the city policy that was in effect when the count of dispensaries per city was obtained in September 2016. The outcome (dependent) variable was self-reported student marijuana use (lifetime and within the past month, assessed using separate regression models).

Research Question 4 was similarly broken up into three testable hypotheses: H4.1) there is a direct relationship between city dispensary bans and the proximity of dispensaries to the students’ high school, so that dispensary bans are associated with longer distances from dispensaries; H4.2) there is a direct relationship between the proximity of dispensaries and students’ likelihood of using marijuana, so that the lesser the distance between the school and the closest dispensary, the greater a student’s likelihood to use marijuana; and H4.3) the relationship between city dispensary bans and high school students’ marijuana use is mediated to some degree by dispensary bans being associated with a longer distance between dispensaries and schools.

To assess the mediating effect of the distance to the closest dispensary located within a mile of their high school on students’ marijuana use, I first tested hypothesis H4.1 by determining whether there was a relationship between the independent variable and the moderating variable (Path A) by calculating the association between city dispensary bans and the continuous distance to the nearest dispensary within LA County. If the coefficient was significant and positive, then H4.2 was supported. The second step was to test H4.3 by establishing whether there was a significant positive association between the moderating variable and the outcome variable (Path B). This model contained both the focal independent variable (dispensary bans) and the moderator (the distance between the school and the nearest dispensary within LA County). Finally, using the same regression model, I assessed the net
direct effect of the focal independent variable on the outcome variable while accounting for the indirect effect of the moderator (Path C). I hypothesized that city dispensary bans would be associated with longer distances between participants’ schools and the nearest dispensary in the County and that the association between dispensary bans and student marijuana use (Path C) would be statistically significant when accounting for this factor. I used a Sobel Test to determine whether the mediation effect of the distance to the nearest dispensary from the school was statistically significant.

**Study Sample Exclusions for Research Question 4**

For the analyses used to test Hypotheses 4.1 – 4.3, I excluded the 14 cases that had no CDS code because the lack of CDS code prevented me from associating the CHKS data for those participants to a specific school, and based on what city that school was located in, a city policy. I also excluded an additional 16 cases that had invalid CDS codes from the analyses to test Hypotheses 5.1 – 5.3. Because I could not associate those cases with a school, I could not by extension measure how far it was from the school to the nearest dispensary. The resulting sample size for the analyses to test Hypotheses 4.1 – 4.3 was 101,491.

**Research Question #5 (RQ5): Is the effectiveness of dispensary bans dependent on preventing dispensaries from locating near high schools?**

To test the hypotheses associated with Research Question 5, I used the number of verified dispensaries located within 2,000 feet of the students’ high schools as the mediating variable and controlled for factors known to influence marijuana use among adolescents, such as gender, race/ethnicity, and social/economic status. I also explored whether there were any different effects for the number of unlicensed dispensaries compared to licensed dispensaries. As with Research Questions 2 - 4, the independent variable was whether or not a city had a dispensary ban and was determined by the city policy that was in effect when the count of
dispensaries per city was obtained in September 2016. The outcome (dependent) variable was self-reported student marijuana use (lifetime and within the past month, assessed using separate regression models).

Research Question 5 was similarly broken up into three testable hypotheses: H5.1) there is a direct relationship between city dispensary bans and the number of dispensaries located within 2,000 feet of the students’ high school, such that dispensary bans are associated with less dispensaries being located within a quarter mile of the school; H5.2) there is a direct relationship between the number of dispensaries located within 2,000 feet of the school and students’ likelihood of using marijuana, so that the number of dispensaries located within 2,000 feet is positively associated with students’ likelihood to use marijuana; and H5.3) the relationship between city dispensary bans and high school students’ marijuana use is mediated to some degree by dispensary bans being more effective at preventing dispensaries from locating near schools than city policies that allow dispensaries.

To assess the mediating effect of the number of dispensaries located within 2,000 feet of their high school on students’ marijuana use, I first tested hypothesis H5.1 by determining whether there was a relationship between the independent variable and the moderating variable (Path A) by calculating the association between city dispensary bans and how many dispensaries were located within 2,000 feet of each school. If the coefficient was significant and positive, then H5.2 was supported. The second step was to test H5.3 by establishing whether there was a significant positive association between the moderating variable and the outcome variable (Path B). Finally, using the same regression model, I assessed the net direct effect of the focal independent variable on the outcome variable while accounting for the indirect effect of the moderator (Path C). I hypothesized that the number of dispensaries located within 2000 of their school would mediate the effect of city policy to some degree, and that the direct effect of the focal relationship coefficient (Path C) would therefore decrease in magnitude when I
controlled for the number of dispensaries located within 2,000 feet the school. To test whether the mediation effect of having dispensaries located near the students’ high schools was statistically significant from zero, I used Sobel Test.

Study Sample Exclusions for Research Question 5

No additional exclusions were made from the sample size for the analyses to test Hypotheses 5.1 – 5.3 compared to Hypotheses 4.1 – 4.3 and the final sample size was 101,491 students.

Limitations

The analyses presented above had several important limitations. The trend analysis relied on a series of cross-sectional surveys, so I was not able to follow the same students over time. The students surveyed were also limited to students who participated in a school-based survey, so the findings from these analyses cannot be generalized to students who are out of school. The students surveyed were also exclusively public high school students, and may have differed in substantial ways from students attending private high schools. The results of this analysis should therefore not be generalized to students attending private high schools. The results may also not be generalizable to LA County as a whole, as only 57 cities out the 88 cities in the County had schools that participated in the CHKS survey during the 2015/2016 and 2016/2017 school years. Instead, this research should be taken as evidence of the need for representative data that can be used for further study of the effects of city dispensary policies on the neighborhood-level conditions that were shown to have a significant influence on students’ marijuana use behaviors; the distance to the nearest dispensary and the number of dispensaries located within several blocks of schools. Finally, I was unable to measure compliance with city or state laws regulating business practices among dispensary owners. I could not measure efforts to enforce dispensary bans or restrictions and did not undertake to
measure how strict city dispensary ordinances were relative to each other. Future studies of city and county dispensary ordinances should assess these factors to determine how they may mediate or moderate the effect of dispensary ordinances on local conditions that facilitate adolescent marijuana use.
Chapter 5. Results: Cross-Sectional, Multivariate Associations Between City dispensary Bans and High School Student Marijuana Use

The basic question and focal relationship that motivated this research was whether city regulations banning storefront dispensaries are effective in preventing youth marijuana use. Due to data limitations, I was unable to test the impact of dispensary bans over time among all the cities in LA County. Nevertheless, I was able to conduct a cross-sectional comparison of the prevalence of marijuana use among students attending schools in cities with dispensary bans and student in cities that allowed dispensaries. I used a multivel logistic regression analysis to quantify this relationship while accounting for for students being clustered in cities and student characteristics that may also be associated with marijuana use.

In response to Research Question 1, “Are dispensary bans associated with lower rates of marijuana use among a city’s high school students?”, I will test the hypothesis that dispensary bans will be negatively associated with rates of lifetime and recent marijuana use among a city’s high school students (H1.1). I based this hypothesis on the body of literature reviewed in Chapter 2, which suggests that the biggest increases in marijuana use in California and Los Angeles County have paralleled periods of expansion in the number of dispensaries. One of these periods occurred in 2009 after the United States Department of Justice released a memo stating that it would not prosecute dispensary owners under Federal law if they were in compliance with state medical marijuana laws (The “Ogden Memo” October 19, 2009: David Ogden, Deputy Attorney General, United States Department of Justice). Statewide, the most notable increases in marijuana use among California youth ages 12-17 occurred in 2010 and 2011, years that coincided with the first dispensaries becoming established in many California and LA County communities for the first time (Figure 5.1).

Figure 5.1. Trends in past 30 days marijuana use in California among youth aged 12-17 years before and after passage of California Senate Bill 420, NSDUH. Adapted from Azofeifa, Mattson, & Lyerla, 2016.
Although there are compelling reasons to believe the presence of dispensaries would be correlated with adolescent marijuana use, there is equally credible evidence to suggest that dispensary bans may have little effect on students’ marijuana use. For example, a notable result from the preliminary analyses presented in Chapter 4 (Tables 4.2 and 4.2) was that rates of marijuana use increased from baseline through the 2011/2013 timepoint even among cities that banned dispensaries. The proportion of students in LA County attending school in a city that allowed dispensaries more than quadrupled during the study period from 3.48% in 2005/2006 to 14.45% in 2016/2017. During the same period, the proportion of students in the County reporting lifetime marijuana use declined from 30% to 25% and recent marijuana use declined from 16% to 14% (Figure 5.2). These findings suggest that whether their city allows dispensaries may not the primary determinant of rates of marijuana use among LA County high school students.
Overview of Hypotheses and Methods

This chapter will address the first hypothesis for Research Question 1: “Are city dispensary bans and restrictions associated with lower rates of marijuana use among the adolescents living in/attending school in a city?” It will test the focal relationship for this dissertation using a cross-sectional analysis, which precludes making any conclusions about causation, but will still provide the opportunity quantify the association of dispensary bans on a city level and thus establish if there is a statistically significant association dispensary bans and rates of marijuana use among high school students. Testing the focal relationship between dispensary bans and student marijuana use will set the foundation for the mediation analyses that follow by establishing whether an independent cross-sectional association exists between city dispensary bans and high school student marijuana use. I hypothesize that dispensary bans will be associated with lower rates of marijuana use among high school students relative to cities that allow dispensaries (H1.1).
Analytical Approach

For this analysis, I used a 2-level Hierarchical Generalized Linear Model with students as the level 1 variable and city as the level 2 variable to compare the proportion of students who reported lifetime and recent marijuana use among all the LA County cities that had students participating in the CHKS survey during the 2015/2016 and 2016/2017 school years. The independent variable is whether the city the students lived in/attended school in a city that allowed or banned dispensaries as of September 2016. Covariates included gender, grade, race/ethnicity, participation in after school programs, whether the student received free or low-cost meals (a proxy measure of low family income), whether one or more of the students’ parents had a college degree, and whether they attended a non-traditional school.

This analysis uses two pooled years of CHKS survey data, for a combined total of 101,521 students. Combining two school years of CHKS data was necessary because most schools administer the survey every other year and therefore, in any given year half of them are off cycle. More importantly, preliminary analyses indicated that the average number of participants from Los Angeles schools on odd years was approximately double the average from even years. Among the small number of cities in LA County that allowed dispensaries, this variation in the number of students from the City of Los Angeles had such a significant influence as to effect estimates of marijuana use among the cities that allowed dispensaries from year to year. Using two combined school years solved this problem and resulted in a greater number of schools being included in the sample, which increased the validity of the geographic analyses in the chapters that follow.

Sample Characteristics: Descriptive Statistics

The study sample for the cross-sectional analyses is primarily Hispanic (64%) and over half are eligible for school meals (56%), but 38% had a parent who was a college graduate.
About a third attended an after-school program at least 1 day a week (29%) and less than 3% attended non-traditional schools. Over 90% attended schools in cities that banned dispensaries.

*Table 5.1. Sample characteristics (N=101,521). Public high school students attending schools that participated in the CHKS survey during the 2015/2016 and 2016/2017 school years.*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (students)</th>
<th>%</th>
</tr>
</thead>
<tbody>
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</tr>
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<td>Ninth</td>
<td>53418</td>
<td>52.62</td>
</tr>
<tr>
<td>Eleventh</td>
<td>48103</td>
<td>47.38</td>
</tr>
<tr>
<td>Attend after school program 1+ days a week</td>
<td>27906</td>
<td>29.26</td>
</tr>
<tr>
<td>Eligible for F/RP school meals</td>
<td>56572</td>
<td>56.36</td>
</tr>
<tr>
<td>Parent college grad</td>
<td>18938</td>
<td>37.99</td>
</tr>
<tr>
<td>School Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-traditional</td>
<td>2621</td>
<td>2.58</td>
</tr>
<tr>
<td>Traditional</td>
<td>98900</td>
<td>97.42</td>
</tr>
<tr>
<td>City bans dispensaries</td>
<td>93608</td>
<td>92.21</td>
</tr>
</tbody>
</table>

**Bivariate Associations Between Covariates and Student Marijuana Use**

*Lifetime Marijuana Use*

Table 5.2 displays results for the cross-tabulations between city dispensary bans and student and school characteristics that I hypothesized would be associated with high school students’ self-report of lifetime marijuana use. Just under a quarter of the students in the cross-sectional sample reported having ever used marijuana. Similar numbers of males and female students reported having ever used marijuana, so this marijuana use was not found to differ significantly by gender. Reports of lifetime marijuana use did vary significantly by race/ethnicity ($p<.0001$) and was higher among Hispanic students and African American students than among
White students, while use among Asian students was lower than among White students. 
Attending an after-school program at least 1 day a week was significantly associated with lower rates of lifetime use, while receiving free or reduced-price school meals was significantly associated with higher rates of marijuana use (both, p<.0001). The proportion of students attending non-traditional schools who reported lifetime marijuana was more than double the proportion reported by students attending traditional schools. Finally, students attending school in a city that banned dispensaries were significantly less likely to have reported lifetime marijuana use than students who attended schools in cities that allowed dispensaries (p<.0001).

Table 5.2. Bivariate associations between student, school, and city policy characteristics and self-reported lifetime marijuana use (N=101,521).

<table>
<thead>
<tr>
<th>Variable</th>
<th>% Ever Used Marijuana</th>
<th>DF</th>
<th>Value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>24.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Student Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>24.29</td>
<td>1</td>
<td>1.9941</td>
<td>0.1579</td>
</tr>
<tr>
<td>Female</td>
<td>23.90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>8.44</td>
<td>4</td>
<td>1207.6085</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>African American</td>
<td>25.62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>26.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>22.74</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>24.36</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eleventh grade</td>
<td>31.72</td>
<td>1</td>
<td>2685.2098</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Ninth grade</td>
<td>17.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attend after-school Program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23.37</td>
<td>1</td>
<td>12.6945</td>
<td>0.0004</td>
</tr>
<tr>
<td>No</td>
<td>24.46</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Eligible for F/RP school meals</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>25.47</td>
<td>1</td>
<td>128.8531</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>No</td>
<td>22.28</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent college grad</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>19.65</td>
<td>1</td>
<td>522.4591</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>No</td>
<td>26.41</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Attend a non-traditional school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>55.66</td>
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<td>1358.4453</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>No</td>
<td>23.30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Recent Marijuana Use

Table 5.3 displays results for the cross-tabulations between city dispensary bans and student and school characteristics that I hypothesized would be associated with high school students' self-report of recent marijuana use. The number of students who reported having used marijuana within the previous 30 days was a little over half the number who reported ever having used it (13% vs. 24%). Similar numbers of males and female students had reported having ever used marijuana, but significantly more males reported using marijuana within the last 30 days compared to females. Reports of recent marijuana use also varied significantly by race/ethnicity (p<.0001) and was highest among Hispanic students (14%) while (5%) recent use among Asian students was less than half the proportion reported among the all the other racial/ethnic categories. Attending an after-school program at least 1 day a week was significantly associated with lower rates of recent use (p<.0001). Interestingly, while receiving free or reduced-price school meals was significantly associated with higher rates of lifetime marijuana use (both, p<.0001), it was associated with significantly lower rates of recent use, indicating that low family income may present a barrier to more frequent use. The proportion of students attending non-traditional schools who reported lifetime marijuana was almost triple the proportion reported by students attending traditional schools (38% vs. 13%). Finally, the proportion of students attending school in a city that banned dispensaries who reported recent marijuana use was greater than the proportion who reported recent use among students who attended school in a city that allowed dispensaries (14% vs. 13%), but the difference fell just short of statistical significance (p=0.0584).

Table 5.3. Bivariate associations between student, school, and city policy characteristics and self-reported recent marijuana use (N=101,521).
<table>
<thead>
<tr>
<th>Variable</th>
<th>% Ever Used Marijuana</th>
<th>DF</th>
<th>Value</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>13.33</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Student Characteristics</strong></td>
<td></td>
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<td>13.82</td>
<td>1</td>
<td>22.1270</td>
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<tr>
<td>Female</td>
<td>12.78</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
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<td>African American</td>
<td>13.96</td>
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<td></td>
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</tr>
<tr>
<td>Hispanic</td>
<td>14.23</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>13.70</td>
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<tr>
<td>Other</td>
<td>13.92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eleventh grade</td>
<td>16.96</td>
<td>1</td>
<td>968.7326</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Ninth grade</td>
<td>10.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attend after-school Program</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
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<tr>
<td>No</td>
<td>13.60</td>
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<tr>
<td>Eligible for F/RP school meals</td>
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<td>12.91</td>
<td>1</td>
<td>8.0984</td>
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<tr>
<td>No</td>
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</tr>
<tr>
<td>Parent college grad</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11.11</td>
<td>1</td>
<td>201.1779</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>No</td>
<td>14.44</td>
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<td></td>
</tr>
<tr>
<td>Attend a non-traditional school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>37.68</td>
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<td>&lt;.0001</td>
</tr>
<tr>
<td>No</td>
<td>12.69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City bans dispensaries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>13.27</td>
<td>1</td>
<td>3.5829</td>
<td>0.0584</td>
</tr>
<tr>
<td>No</td>
<td>14.05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Multivariate Analyses**

After assessing bivariate associations, I ran separate multilevel logistic regression models for lifetime and recent marijuana use to assess the impact of city bans on each measure of student marijuana use, while controlling for the student and school characteristics that the bivariate analyses had revealed were significantly associated with each measure of marijuana use. Two-level random intercept HGLM models were conducted using PROC GLIMMIX in SAS 9.4 with city as the level-2 variable to account for the multilevel structure of individuals being clustered in cities.
School-level weights for the LA Unified School District schools were included in each model, per CHKS documentation (Appendix C: CHKS Weighting Guidelines).

**Multivariate Logistic Regression Results**

*Lifetime Marijuana Use*

The results presented in Table 5.4, the estimates presented for Model 1 indicate that city dispensary bans are inversely associated with students reporting having ever used marijuana, but that the difference is not statistically significant (OR = 0.732, 95% CI = 0.425 - 1.261). Model 2 indicates individual characteristics such as African-American race/ethnicity (OR = 1.121, 95% CI = 1.033 – 1.216) and being in eleventh grade compared to 9th grade (OR = 2.258, 95% CI = 2.187 – 2.331) were significantly associated with greater odds of lifetime marijuana use, whereas characteristics such as attending an afterschool program (OR = 0.899, 95% CI = 0.868 – 0.931) and Asian race/ethnicity (OR = 0.335, 95% CI = 0.304 - 0.369) or having a parent who was a college graduate were significantly associated with lower odds of lifetime use (OR = 0.750, 95% CI = 0.726 - 0.786). Low family income as measured by receiving free and reduced-price school lunches was not significantly associated with the odds of a student reporting having ever used marijuana. Model 3 indicates that the odds of students who attended a non-traditional school reporting lifetime marijuana use were over twice the odds compared to students attending traditional schools (OR = 2.728, 95% CI = 2.501 - 2.976).

*Table 5.4. Multilevel logistic regression analysis of lifetime marijuana use among high school students in Los Angeles County, CHKS Survey (2015/2016 and 2016/2017 school years), (N= 101,521).*
### Recent Marijuana Use

The results presented in Table 5.5, Model 1 indicate that city dispensary bans are inversely associated with students reporting recent marijuana use, but that the difference is not statistically significant (OR = 0.829, 95% CI = 0.575 - 1.196). Model 2 indicates that among the racial/ethnic categories only Asian race/ethnicity had a statistically significant association with recent marijuana use, where there were significantly lower odds of Asian students reporting

<table>
<thead>
<tr>
<th>LIFETIME MARIJUANA USE</th>
<th>MODEL 1</th>
<th>MODEL 2</th>
<th>MODEL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR(^a)</td>
<td>95% CI</td>
<td>OR</td>
</tr>
<tr>
<td>City Policy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dispensary ban</td>
<td>0.732</td>
<td>0.425 - 1.261</td>
<td>0.762</td>
</tr>
<tr>
<td>Student Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.335(^*)</td>
<td>0.304 - 0.369</td>
<td>0.341(^*)</td>
</tr>
<tr>
<td>African-American</td>
<td>1.121(^*)</td>
<td>1.033 – 1.216</td>
<td>1.088(^*)</td>
</tr>
<tr>
<td>Latino</td>
<td>1.081(^*)</td>
<td>1.022 – 1.144</td>
<td>1.065(^*)</td>
</tr>
<tr>
<td>Other</td>
<td>1.142(^*)</td>
<td>1.065 – 1.224</td>
<td>1.127(^*)</td>
</tr>
<tr>
<td>Eleventh Grade (v. 9(^{th}))</td>
<td>2.258(^*)</td>
<td>2.187 – 2.331</td>
<td>2.139(^*)</td>
</tr>
<tr>
<td>After-school Program</td>
<td>0.899(^*)</td>
<td>0.868 – 0.931</td>
<td>0.921(^*)</td>
</tr>
<tr>
<td>Parent College Grad</td>
<td>0.755(^*)</td>
<td>0.726 – 0.786</td>
<td>0.772(^*)</td>
</tr>
<tr>
<td>School Meals</td>
<td>0.986(^*)</td>
<td>0.951 – 1.022</td>
<td>0.988(^*)</td>
</tr>
<tr>
<td>School Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-traditional</td>
<td></td>
<td></td>
<td>2.728(^*)</td>
</tr>
</tbody>
</table>

\(^a\) OR = Odds Ratio  
\(^b\) CI = Confidence Interval  
\(^c\) Log-Likelihood Ratio  
\(^*\) Indicates statistical significance at \(a = .05\) for odds ratio or difference between log-likelihood ratio tests.  
Note: Estimation method is Maximum Quadrature, Level 1 is individual students, Level 2 is cities.
recent marijuana use compared to White students, the reference group (OR= 0.350, 95% CI = 0.310 – 0.397. Students in eleventh grade compared to 9th grade were 84% more likely to report recent marijuana use (OR = 1.843, 95% CI = 1.771 – 1.917), whereas characteristics such as attending an afterschool program (OR = 0.889, 95% CI = 0.851 – 0.929) and having a parent who was a college graduate were significantly associated with lower odds of lifetime use (OR = 0.754, 95% CI = 0.718 -0.793). Low family income was significantly associated with lower odds of a student reporting recent marijuana use (OR = 0.931, 95% CI = 0.890 – 0.974), whereas it did not have a significant association with lifetime marijuana use. Model 3 indicates that the odds of students who attended a non-traditional school had more than triple the odds of reporting recent marijuana use compared to students attending traditional schools (OR = 3.058, 95% CI = 2.791 – 3.349).

Table 5.5. Multilevel logistic regression analysis of recent marijuana use among high school students in Los Angeles County, CHKS Survey (2015/2016 and 2016/2017 school years), (N= 101,521).

<table>
<thead>
<tr>
<th>RECENT MARIJUANA USE</th>
<th>MODEL 1</th>
<th>MODEL 2</th>
<th>MODEL 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR a</td>
<td>95% CI b</td>
<td>OR</td>
</tr>
<tr>
<td>City Policy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dispensary ban</td>
<td>0.777</td>
<td>0.490 – 1.231</td>
<td>0.801</td>
</tr>
<tr>
<td>Student Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.350*</td>
<td>0.310 – 0.397</td>
<td>0.358*</td>
</tr>
<tr>
<td>African-American</td>
<td>1.068</td>
<td>0.965 – 1.182</td>
<td>1.028</td>
</tr>
<tr>
<td>Latino</td>
<td>1.1014</td>
<td>0.946 – 1.086</td>
<td>0.994</td>
</tr>
<tr>
<td>Other</td>
<td>1.089</td>
<td>1.00 – 1.185</td>
<td>1.070</td>
</tr>
<tr>
<td>Eleventh Grade (v. 9th)</td>
<td>1.843*</td>
<td>1.771 – 1.917</td>
<td>1.712*</td>
</tr>
<tr>
<td>After-school Program</td>
<td>0.889*</td>
<td>0.851 – 0.929</td>
<td>0.918*</td>
</tr>
<tr>
<td>Parent College Grad</td>
<td>0.754*</td>
<td>0.718 – 0.793</td>
<td>0.777*</td>
</tr>
</tbody>
</table>
### Summary

The multivariate models presented here show that most of the student and school characteristics that I hypothesized would be important influences on students’ marijuana use based on the body of literature were indeed strongly associated with these outcomes. It was therefore important to control for these characteristics when attempting to quantify the effect of dispensary bans in student marijuana use. By controlling for these characteristics, I was able to demonstrate that city dispensary bans do not have a direct association with lower rates of marijuana use among high school students in LA County and conclude that hypotheses H1.1 was not supported. It is possible that city dispensary policies are too many links above students in the marijuana supply chain to directly have an impact on how much marijuana they can access or how reliably. It also possible, however, that the effectiveness of marijuana policies is dependent on factors that I did not include in the models above, such as enforcement practices.

Further research and interventions are needed to address marijuana use among youth at non-traditional schools. This population represents an excellent target for school-based secondary prevention interventions and screening for clinical levels of substance use disorder. The finding that receiving free or reduced-price school meals was significantly associated with...
higher rates of lifetime marijuana use but was associated with significantly lower rates of recent use is consistent with literature demonstrating that adolescent substance use is responsive to pricing. It’s possible that the adolescents from low income families may have had less money to spend on marijuana than their peers and thus were able to use marijuana less frequently, although the higher rates of lifetime use may indicate that they are just as likely or more likely to have access to it for experimentation or occasional use. That finding that participation in after school programs was protective against both lifetime and recent marijuana is consistent with research showing that youth who participate in after school programs are less likely to report substance use (Farb & Matjasko, 2012). This finding also supports an important function of the Adult Use Marijuana Act that mandates that a portion of the tax revenue from recreational marijuana be used to support after school programs (CA Health and Safety Code Section 11362.775).

The cross-sectional analysis presented here measured the association between city dispensaries and student marijuana while controlling for students being clustered in cities and for potentially confounding student and school characteristics. City dispensary policies, however, are not the exclusive determinant of the actual availability of marijuana in a community. As will be demonstrated in the following chapters, factors such as enforcement and local context also determine access to marijuana in a city. To expand on the relationship between city dispensary policies and adolescent marijuana use, the following chapter will investigate the long-term effects of implementing a more restrictive dispensary policy in the City of Los Angeles. Chapter 7 will continue to elaborate on the relationship by testing indirect mechanisms through which city dispensary policies may influence students’ marijuana behaviors, such as by preventing excessive density of dispensaries in a city, signaling to youth that marijuana use represents a risk to their health, and/or by preventing dispensaries from operating near their high schools.
CHAPTER 6. Results: Trends in High School Students’ Marijuana Use in the City of Los Angeles Following Enactment of More Restrictive Dispensary Regulations

Prevention research supports the idea that more convenient access to legal substances for adults often has the end result of creating easier access for youth (Ahmad & Billimek, 2007; Flewelling et al., 2013; Harrison, Fulkerson, & Park, 2000), which may mean that youth living in or attending school in a city that allows dispensaries can obtain cannabis more easily or more often from adults in their social network. If this is the case, a dispensary policy making access less convenient for adults could have the additional effect of making it less conveniently obtained by teens. Considering that adolescents report older relatives and the illicit market as their primary sources of cannabis (King, Merianos, & Vidourek, 2016) tightening dispensary regulations could have a dampening effect on youth marijuana use in Los Angeles even though adolescents are not allowed to access dispensaries directly.

To date, little is known about the effectiveness of dispensary bans or other dispensary regulations at preventing youth access to marijuana. By comparing how students’ marijuana use changed over time in a city that allowed dispensaries compared to a group of cities that did not, I hoped to provide some insight into how city policies regulating dispensaries influence marijuana use among youth. I undertook this task by comparing marijuana use rates among City of Los Angeles high school students before and after the City enacted Proposition D, a voter-approved ballot measure that capped the number of outlets allowed to operate in the City at a fraction of their existing number, ordered hundreds of remaining dispensaries to close down, and prohibited all new outlets (Appendix B: City of Los Angeles Proposition D). I hypothesized that this radical policy change would have an important influence on the availability of marijuana in the City and that rates of adolescent marijuana use in the city would decline after the policy was enacted (H1.2).
To test this hypothesis, I used a difference-in-difference approach to compare change in student marijuana use in the city of Los Angeles, to change in a group of cities that had banned dispensaries throughout the study period. By using the control group to account for any trends in high school students’ marijuana use unrelated to the implementation of Proposition D in the City of Los Angeles I could determine whether the stricter regulations enacted in the City of Los Angeles had a discrete impact on rates of marijuana use among the City’s students (Donald & Lang, 2007). This hypothesis was also a good fit for analysis using a difference-in-difference design given that Proposition D represented a discrete policy change that could be used to clearly distinguish pre- and post-intervention periods in Los Angeles.

**Overview of Hypothesis and Methods**

The focus of this chapter is to summarize the results of my second analyses exploring Research Question 1, “Do city regulations that ban or restrict dispensaries influence trends in high school students’ marijuana use?”. To answer this question, I tested the revised hypothesis (H1.2) “Following enactment of Proposition D, which made the majority of the dispensaries in the City of Los Angeles illegal, marijuana use among City of Los Angeles high school students will decline.”. This hypothesis proposes that enactment of Proposition D in the City of Los Angeles would be followed by declining trends in student marijuana use relative to the cities in LA County that never allowed dispensaries during the study period.

For clarity, this analysis excluded cities that changed their dispensary policies during the study period (Diamond Bar, Huntington Park, Long Beach, Malibu, Santa Monica, and South El Monte). The remaining cities either allowed dispensaries throughout the study period (Los Angeles) or had banned them throughout the study period. The exception was the City of West Hollywood, which allowed dispensaries throughout the study period but was not included due to missing data. This analysis is therefore a comparison between a city that allowed dispensaries through the study period but enacted stricter regulations in 2013 to a group of cities where dispensary policies did not change. To focus on the effect of Proposition D, I also limited the
number of years included in the analysis to the 2007/2009 combined school years through the 2015/2017 school years and excluded the 2005/2007 combined school years from the analysis. The 2007/2009 combined school years represent the baseline measurement, which was two time periods (4 years) before Proposition D was enacted. The 2015/2017 school years represent the endpoint of the analysis, which was measured one timepoint (two years) after Proposition D was enacted. The resulting sample size for the difference-in-difference analysis was 385,650 students.

**Analytical Approach**

*Poisson Regression Using Robust Standard Errors*

Difference-in-difference analyses can be performed using different regression techniques. The difference-in-difference coefficient is an interaction term included in a regression equation that compares the difference in change between the two groups over time. In the case of these analyses, it quantifies the impact of Proposition D in Los Angeles relative to the cities where it did not apply. The difference-in-difference coefficients for the covariates presented in this chapter are presented as risk ratios and can be interpreted as they would be in any Poisson regression model. In this case, they represent the relative risk of a Los Angeles student reporting marijuana use relative to the reference group reporting marijuana use and holding constant all the other covariates in the model.

I used robust Poisson regression analyses to test the impact of Proposition D in Los Angeles on the dependent variables, student self-reports of lifetime and recent marijuana use. Although my dependent variables were binary and not count variables, I chose to use a Poisson regression because I was reporting prevalence ratios of behaviors that were not rare, i.e., the prevalence of marijuana use for both measures was over 10%. Under these circumstances using logistic regression and reporting odds ratios can overestimate the prevalence ratio (Barros...
& Hirakata, 2003), potentially leading to false conclusions about the volume and statistical significance of intervention effects.

I used clustered standard errors in the Poisson regression to account for the grouping of participants in the cities where they attended high school. In such circumstances there may be independence across clusters but correlation within clusters. When this is the case, statistical inference based on the usual assumption of independent observations is no longer appropriate (Cameron & Miller in Ulluh & Giles, 2015, p.9). A common approach to control for clustering is by computing cluster-robust standard errors that control for clustering at the level of the primary theoretical grouping, which in this case was city (Huber, 1967; Rogers, 1983). I will use this approach to account for the fact that students are nested in cities and there may be unmeasured city effects that influence marijuana use behavior (Bell & Jones, 2015). This approach was used to account for students being clustered within cities rather than a multilevel analysis for simplicity and because the city-level (level 2) analytical variables used to answer Research Questions 2-5 were not available for the survey years used in the trend analysis.

Study weights were included in the descriptive and regression analyses presented below but were available only for LA Unified Students and for the 2016/2017 school year in the datasets I obtained from WestEd. I compared results including and excluding the weights and there were no differences, but I included the school weight where applicable in the descriptive statistics and regression analyses to control for the survey design to the extent that I could. All models controlled for gender, grade, race/ethnicity, and whether the student attended a non-traditional school. I assessed the parallel trends assumption of the difference-in-difference design by graphing simple prevalence of the marijuana outcomes among Los Angeles and the control group students over the study and visually assessing whether the trends were parallel. The assumption of parallel pretreatment trends was confirmed by the notably parallel trends before Proposition D was enacted.
Descriptive Statistics

Prior to testing this hypothesis, I first generated descriptive statistics to understand the demographics of the study population and the prevalence of marijuana use among the public high school students of LA County between the 2007 and 2017 school years. I began with cross-tabulations of the marijuana use variables with students’ demographic characteristics between students in the City of Los Angeles and students in the control group cities. Table 5.1 presents the socio-demographic characteristics of the study population that was included in the difference-in-difference analysis, including the school-level weight for the 2016/2017 school year. The majority of respondents were female (50.9%), in ninth grade (52.8%), and Hispanic (50.0%). Generally, these demographics reflect similar distributions of gender and race/ethnicity for youth aged 15-19 in Los Angeles County based on data from the 2010 Census (ACS, 2019). The majority of students in the study sample attended traditional schools (98.0%).

Table 6.1 Comparison of demographic characteristics of students among City of Los Angeles and control group students, California Healthy Kids Survey, 2007 - 2017 school years (n=385,650)

<table>
<thead>
<tr>
<th>Variables</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male 188,100 (49.30)</td>
</tr>
<tr>
<td></td>
<td>9th 200,565 (52.60)</td>
</tr>
<tr>
<td></td>
<td>11th 180,754 (47.40)</td>
</tr>
<tr>
<td>Grade</td>
<td>White 79,721 (21.04)</td>
</tr>
<tr>
<td></td>
<td>African American 21,897 (5.78)</td>
</tr>
<tr>
<td></td>
<td>Asian 42,910 (11.32)</td>
</tr>
<tr>
<td></td>
<td>Hispanic 192,087 (50.69)</td>
</tr>
<tr>
<td></td>
<td>Other 42,360 (11.18)</td>
</tr>
<tr>
<td>Non-traditional school</td>
<td>Yes 7,772 (2.02)</td>
</tr>
</tbody>
</table>

Bivariate Analyses of Marijuana Use Measures and Covariates

Table 6.2 presents the results of cross tabulation frequencies of the two marijuana measures with student demographic characteristics. Most of the results were consistent with expectations based on the body of literature, such as marijuana use among males being higher than females, use among Asian students being low, and use among students attending non-
traditional schools being markedly higher than among students at traditional schools. Among all students the number who reported lifetime marijuana was about one-third (29.6%) but varied considerably by grade, which is not unexpected given that “lifetime” is a longer period of time among eleventh grade students than among ninth grade students. Recent marijuana use was also more common among eleventh grade students, however, with 19% reporting recent (within the previous 30 days) use compared to 13% of ninth grade students. These frequencies are consistent with both national and state-level reports. The national Monitoring the Future Study reports that as of 2017 prevalence for lifetime use ranged between 31% for 10th grade students to 45% for 12th grade students, whereas prevalence of past month use ranged from 16% for 10th grade students to 23% for 12th grade students (Miech et al., 2018). State-level reports using a random sample of CHKS participants from 2015-2017 surveys found that 17% of 9th grade students and 32% of 11th grade students reported lifetime marijuana use, whereas prevalence of recent use was 9% and 17%, respectively, in the 2015-2017 survey years (Austin et al., 2018).

Table 6.2 Comparison of lifetime and recent marijuana use by demographic characteristics among students attending schools in the City of Los Angeles and control group cities, CHKS survey, 2007 - 2017 school years (n= 385,650).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lifetime Use</th>
<th>Recent Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>All Students</td>
<td>110,378 (29.60)</td>
<td>60,282 (16.28)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>56,550 (31.19)*</td>
<td>32,242 (17.93)*</td>
</tr>
<tr>
<td>Female</td>
<td>52,544 (27.92)</td>
<td>27,172 (14.52)</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9th</td>
<td>44,405 (22.89)*</td>
<td>25,526 (13.25)*</td>
</tr>
<tr>
<td>11th</td>
<td>64,263 (36.63)</td>
<td>33,495 (19.22%)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>21,624 (28.05)*</td>
<td>12,167 (15.86)*</td>
</tr>
<tr>
<td>African American</td>
<td>7,015 (33.61)</td>
<td>4,089 (19.80)</td>
</tr>
<tr>
<td>Asian</td>
<td>4,615 (10.98)</td>
<td>2,532 (6.04)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>62,569 (33.63)</td>
<td>33,152 (17.96)</td>
</tr>
<tr>
<td>Other</td>
<td>12,613 (30.76)</td>
<td>7,226 (17.76)</td>
</tr>
</tbody>
</table>
To explore the bivariate relationships between city dispensary bans and students’ self-reported lifetime and recent marijuana use, I ran chi-square tests to assess whether there was a statistically significant difference in rates of lifetime and recent marijuana use between the City of LA and the control group cities. Results from these models are presented in Table 6.3 and Figures 6.1 and 6.2. There were statistically significant differences in student reports of both lifetime and recent marijuana use between the City of Los Angeles and the control group cities over all the study years combined. However, this does not tell us whether the higher rates of marijuana use among Los Angeles high school students are attributable to the City allowing dispensaries.

Table 6.3 Chi-square comparison of self-reported lifetime and recent marijuana use among students attending schools in the City of Los Angeles and control group cities, CHKS survey, 2007 - 2017 school years (n= 385,650).

<table>
<thead>
<tr>
<th>Student Marijuana Use</th>
<th>City of LA (dispensaries Allowed) (n=17,414)</th>
<th>Control Group (dispensaries not allowed) (n=368,236)</th>
<th>Pearson chi2(1)</th>
<th>Pr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime</td>
<td>5,420 (32.29)</td>
<td>104,958 (29.48)</td>
<td>60.8647</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Recent</td>
<td>2,896 (17.45)</td>
<td>57,386 (16.22)</td>
<td>17.5126</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

Difference-in-Difference Analysis Results

Table 6.4 presents trends in student marijuana use over time between the control cities and the City of Los Angeles. An overall decline occurred in both groups, but if the decline in the City of Los Angeles can be attributed to the stricter regulations that were enacted with Proposition D in 2013, the decline in marijuana use rates among City of LA students should be significantly greater than the decline among the control cities, where dispensary policies were unchanged.

<table>
<thead>
<tr>
<th>Student Marijuana Use</th>
<th>Pre-Proposition D</th>
<th>Post-Proposition D</th>
<th>Pre-Post Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lifetime</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City of Los Angeles</td>
<td>37.80</td>
<td>40.43</td>
<td>39.82</td>
</tr>
<tr>
<td>Control Group Cities</td>
<td>29.95</td>
<td>32.89</td>
<td>34.44</td>
</tr>
<tr>
<td><strong>Recent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City of Los Angeles</td>
<td>21.47</td>
<td>22.67</td>
<td>21.54</td>
</tr>
<tr>
<td>Control Group Cities</td>
<td>16.35</td>
<td>18.49</td>
<td>18.85</td>
</tr>
</tbody>
</table>

The trends in lifetime marijuana were notably non-linear in Los Angeles as well as the control group. Student reports of lifetime marijuana in both groups initially increased from baseline through the 2009-2011 timepoint and then declined after the 2011-2013 timepoint, ending at lower rates of use than were recorded at baseline. A steeper decline was noted for the City of Los Angeles, however, where rates of lifetime marijuana use were higher from baseline but nearly met rates among to the control group by the end of the study period (Figure 6.1).

*Figure 6.1 Trends in lifetime marijuana use among high school students in the City of Los Angeles and control group, 2007 – 2017 school years (n= 385,650).*
Similar non-linear trends of an increase from baseline through the 2009/2011 timepoint were observed for recent marijuana use among City of Los Angeles students and control group students. Rates in both groups then declined after the 2011/2013 timepoint and ended below baseline. A steeper rate of decline was noted for the City of Los Angeles, where higher rates were reported for each timepoint prior to the 2015/2017 timepoint, when they approached rates like were observed in the control group (Figure 6.2).

Figure 6.2. Trends in recent (past 30 days) marijuana use among high school students in the City of Los Angeles and control group, 2007 - 2017 school years (n= 385,650).

Figures 6.1 and 6.2 illustrate that lifetime and recent marijuana use declined among students in the control groups as well as among City of Los Angeles students. Rates of student marijuana use were expected to remain flat in the control group cities unaffected by the stricter regulations enacted with Proposition D, so the observed decline in the control group was unexpected. Both lifetime and recent marijuana use rates declined to a greater degree in the City of Los Angeles and by the end of the study period converged with the rates of lifetime and recent marijuana use observed among the control group cities.
Table 6.6 presents the difference-in-difference estimates from the Poisson regression comparing marijuana use over time between the City of Los Angeles and the control group cities. The difference-in-difference coefficient is an interaction term comparing the difference in change between the two groups over time and quantifies the impact of Proposition D. Presented below as a risk ratio, the value for the estimate was less than one (RR = 0.85; 95% CI=0.77, 0.95), which indicated a lower risk of lifetime marijuana use over time and a greater decline relative to the control group cities. That the coefficient was statistically significant means the decline in students’ marijuana use in Los Angeles surpassed the declining countywide trend to such a degree that it is unlikely to have occurred by chance (H1.2). This result suggests that the decline in rates of lifetime marijuana use among City of Los Angeles high school students is attributable to the stricter regulations enacted with Proposition D and supports H1.2 for lifetime marijuana use.

The difference-in-difference coefficients for the covariates presented in Table 6.6 are similarly presented as risk ratios. In this case, they represent the risk of a student within a category reporting lifetime marijuana use relative to the reference group for that category and holding constant all of the other covariates in the model. For example, the risk ratio for males reporting lifetime marijuana were 1.11, or 11% higher than the risk for females reporting lifetime marijuana use. (Risk ratios for the reference category are always 1.00 and therefore are not reported.) Within racial/ethnic characteristics, students within the African-American, Hispanic, and Other racial/ethnic categories had significantly higher relative risk of reporting lifetime marijuana use than the reference category, Whites. In contrast, Asian students had significantly lower relative risk compared to Whites (RR=0.38, 95% CI = 0.34, 0.42). The relative risk of eleventh grade students reporting lifetime marijuana use (RR=1.57, 95% CI = 1.50, 1.63) significantly higher than for ninth grade students, as indicated by the 95% confidence interval not including 1. The results for non-traditional schools were in the expected direction as well, with the relative risk of lifetime marijuana among students attending these schools reporting
lifetime marijuana was estimated to be almost 75% higher (RR = 1.74, 95% CI = 1.68, 1.81) compared to risk of lifetime marijuana use among students attending traditional schools.

The most interesting finding among the covariates was the association between the relative risk of students reporting lifetime marijuana by time. The risk ratios for the pre-Proposition D time periods were all greater than one, indicating that reports of lifetime marijuana use during these periods were significantly greater than baseline (the reference category). In contrast, the risk ratios for the post-Proposition D time periods were all lower than one, indicating significantly less risk of students reporting lifetime marijuana use during those time periods compared to baseline.


<table>
<thead>
<tr>
<th>Difference in Lifetime Marijuana Use Pre vs. Post (DinD Estimate)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Los Angeles (vs. Control Group)</td>
<td>0.85 (0.77, 0.95)**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lifetime Marijuana Use</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Los Angeles (vs. Control Group)</td>
<td>1.13 (1.04, 1.22)**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Covariates</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>Eleventh (vs. Ninth)</td>
<td>1.57 (1.50, 1.63)***</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male (vs. Female)</td>
<td>1.11 (1.09, 1.14)***</td>
</tr>
<tr>
<td>Race/Ethnicity (vs. White)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>1.18 (1.11, 1.25)***</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.19 (1.14, 1.25)***</td>
</tr>
<tr>
<td>Asian</td>
<td>0.38 (0.34, 0.42)***</td>
</tr>
<tr>
<td>Other</td>
<td>1.11 (1.06, 1.16)***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>School Type</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Traditional (vs. Traditional)</td>
<td>1.74 (1.68, 1.81)***</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timepoint (vs. 2007/2009)</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009/2011</td>
<td>1.1 (1.07, 1.13)***</td>
</tr>
<tr>
<td>2011/2013</td>
<td>1.08 (1.04, 1.12)***</td>
</tr>
<tr>
<td>2013/2015</td>
<td>0.92 (0.89, 0.95)***</td>
</tr>
<tr>
<td>2015/2017</td>
<td>0.76 (0.73, 0.79)***</td>
</tr>
</tbody>
</table>

Note: RR = risk ratio; CI = confidence interval; DinD = difference-in-difference. Policy changes refer to when, in June 2013, Los Angeles enacted Proposition D, a voter-
approved city ballot measure that granted limited immunity to 135 dispensaries, ordered all others to close, and prohibited new dispensaries from opening. Results are relative risk/risk ratios and 95% confidence intervals from robust Poisson regression.

*** P<.0001

As presented in Table 6.7, the difference-in-difference coefficient comparing change in recent marijuana use over time between the City of Los Angeles and the control group cities was also less than one, and therefore in the expected direction (RR = 0.85, 95% CI = 0.71, 1.02). Although the difference-in-difference estimate for recent marijuana was the same, the 95% confidence interval indicates that the range of the values we are 95% sure contain the true value also contains the number 1, which is equivalent to no effect. I could therefore not conclude that the observed decline in recent marijuana use relative to countywide trends was due to Proposition D rather than to chance. H1.2 was therefore not supported for recent marijuana use.


<table>
<thead>
<tr>
<th></th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Difference in Recent Marijuana Use Pre vs. Post</strong></td>
<td></td>
</tr>
<tr>
<td>(DinD Estimate)</td>
<td></td>
</tr>
<tr>
<td>City of Los Angeles (vs. Control Group)</td>
<td>0.85 (0.71, 1.02)</td>
</tr>
<tr>
<td><strong>Lifetime Marijuana Use</strong></td>
<td></td>
</tr>
<tr>
<td>City of Los Angeles (vs. Control Group)</td>
<td>1.12 (1.00, 1.26)</td>
</tr>
<tr>
<td><strong>Covariates</strong></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
<td></td>
</tr>
<tr>
<td>Eleventh (vs. Ninth)</td>
<td>1.39 (1.32, 1.47)***</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male (vs. Female)</td>
<td>1.22 (1.19, 1.26)***</td>
</tr>
<tr>
<td>Race/Ethnicity (vs. White)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>1.19 (1.11, 1.29)***</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.12 (1.06, 1.18)***</td>
</tr>
<tr>
<td>Asian</td>
<td>0.36 (0.32, 0.40)***</td>
</tr>
<tr>
<td>Other</td>
<td>1.11 (1.05, 1.17)***</td>
</tr>
<tr>
<td>School Type</td>
<td></td>
</tr>
<tr>
<td>Non-Traditional (vs. Traditional)</td>
<td>2.23 (2.10, 2.37)***</td>
</tr>
<tr>
<td>Timepoint (vs. 2007/2009)</td>
<td></td>
</tr>
</tbody>
</table>
The associations observed among the covariates and the relative risk of students reporting recent marijuana use were similar to those observed for lifetime marijuana use. One noticeable exception was that the risk of students attending non-traditional schools reporting recent marijuana use was more than double the risk of students who attended traditional schools, which represented a larger difference in risk than was observed for lifetime marijuana use.

**Discussion**

These results indicate that marijuana use among high school students is responsive to changes in city policy. The tighter regulations enacted in Los Angeles with Proposition D were followed with lower rates of lifetime marijuana use among high school students when accounting for regional trends and covarying factors. Parallel trends were observed in Los Angeles and the control cities for both lifetime and recent marijuana use, but declines in both these measures were steeper in the City of Los Angeles following enactment of Proposition D. This result supports the hypothesis of a causal effect, although it was not large enough relative to the control group to be statistically significant for recent marijuana use.

These results supported Hypothesis 1.2, that cities that enacted more restrictive dispensaries policies would see a trend of declining marijuana use among students attending school there. That a decline in student reports of marijuana use was observed among the control group was unexpected. The similar trend among the control group cities may indicate...
that marijuana use among high school students is driven less by whether their city allows dispensaries than by secular trends driven by the media, by state and federal laws that impact availability and legal risk for adults. This finding also justified use of the difference-in-difference design to control for background trends in the outcome variable that cannot be attributed to the policy or event of interest. By using the control cities to represent the counterfactual case for student marijuana use trends in Los Angeles had Proposition D not been enacted, I was able to isolate the effect that can be attributed to the policy change and avoid making false conclusions about its impact on students’ marijuana use behaviors.

The decline in rates of lifetime and recent marijuana use among the control group cities may have been related to federal enforcement efforts that closed down over 200 dispensaries in the LA County area in 2012 (Onishi, 2012), but very little information is available about which dispensaries were closed down in which cities and how many dispensaries were in operation countywide before the raid. It is unknown whether the Federal raids targeted the city of LA and the control cities equally, but if they did than these raids may have played part in the declines in marijuana use that was noted among students in the control group cities as well as among Los Angeles students. It is difficult to attribute any impacts on student marijuana use to these enforcement actions due to the limited information available but further study of these events is certainly merited.

I was not able to conclude that the decline in recent marijuana use observed to occur in the post-Proposition D period was not due to chance. Recent marijuana use is a less common behavior than lifetime marijuana use, and while the effect was in the expected direction, the smaller number of students reporting this behavior produced a wider confidence interval that included a null effect. Policies take time to have a measurable effect and the City of Los Angeles has experienced significant challenges to enforcing Proposition D’s limits on the number of dispensaries. Hundreds of unlicensed storefront dispensaries continue to operate throughout Los Angeles and each one of them could be expected to weaken the impact of
Proposition D. It is possible that given more time and continued investment in enforcement an effect for recent marijuana could be documented as well.

An additional explanation for why an effect was not observed for recent marijuana use could be contamination, or “spillover effects”, where people living in other cities in LA County may have obtained marijuana from the many dispensaries located in the City of Los Angeles. Car culture is firmly established in Southern California and vehicle ownership is high; close to 8 million (7,762,453) vehicles were registered in LA County last in 2017 (CA Department of Motor Vehicles, 2018), for a county with an estimated population in 2017 of just over 10 million (10,118,759) (U.S. Census, 2018). Given the geographic sprawl of Los Angeles and the many other incorporated cities and unincorporated areas it borders, it is not difficult to imagine that LA County residents who lived outside of Los Angeles obtained marijuana from dispensaries located in Los Angeles if they couldn’t get it in their own city. This could be expected to make events that impact access to marijuana in the City of Los Angeles also have an impact in the other cities. It could also be expected to weaken the impact of dispensary bans altogether, as people could obtain marijuana from other cities if it is banned in theirs.

The ability for high school youth to travel to another city to get marijuana could be less of a concern than for adults but given that youth largely obtain marijuana from adults via the illicit market or their social networks (King et al., 2016), events impacting adult access could be expected to in turn affect youth access. Additionally, even if a city is successful in enforcing dispensary bans or caps on the number of outlets like Proposition D, policies such as these that restrict access to storefront outlets may still have a limited effect on the availability of marijuana given the many other sources by which residents can obtain it, such as from delivery services or by cultivating their own.
Chapter 7. Results: Indirect Effects of City dispensary Bans on High School Students

Marijuana Use

In this chapter I will present results from analyses that tested several theories for why city dispensary bans may have an indirect effect on student marijuana use (Research Questions 2-5). The results presented in Chapter 5 tested the focal relationship for this dissertation (Hypothesis 1.1) using a cross-sectional sample that included students from 57 cities in LA County. That analyses did not provide evidence of a direct effect between city dispensary bans and high school students’ marijuana use when controlling for student and school characteristics known to be associated with adolescent marijuana use. In contrast, the trend analysis presented in Chapter 6 showed that in the City of Los Angeles enacting and implementing a policy intended to reduce the number of dispensaries and place additional controls on their operation was followed by a decline in lifetime marijuana use among students attending the city’s public high schools. Furthermore, city dispensaries were negatively associated with student marijuana, despite the associations falling short of statistical significance. In this chapter, I therefore conducted a series of mediation analyses to elaborate on the relationship between city dispensary bans and student marijuana use and whether their effect was dependent on some factor I had not accounted for. In this chapter I investigate indirect effects; circumstances where the effect of a variable is dependent on another variable. Identifying dependent relationships is important to elucidate some of the mechanisms by which restrictive city regulations on legal, adult-use products might be effective in preventing substance use among adolescents. The analyses that follow in this chapter tested indirect mechanisms through which I theorized city dispensary policies may influence students’ marijuana behaviors, such as by preventing excessive density of dispensaries in a city, signaling to youth that marijuana use represents a
health risk, and/or by preventing dispensaries from operating near their high schools. These analyses will test the hypotheses for Research Questions 2-5.

**Overview of Hypotheses and Methods**

*Mediation effects*

As described in the methods chapter (Chapter 4), I used a variation of Baron and Kenney's Product Method, which described in detail in Zhou et al., 2010, to test for mediation. Baron and Kenney's Product Method (Figure 7.1) first tests for direct relationship between the independent and dependent variable as a condition of testing for mediation ('c' in the diagram below), but this approach has been criticized (Preacher & Hayes, 2004; Hayes, 2009) as a relationship between the independent and dependent variables can be masked by a mediating variable or competing mediators (Zhou et al., 2010). In the case of this research, the focal relationship is the influence of dispensary bans on student marijuana use and I will investigate the effect of several different mediators on this relationship.

A variable is generally considered a mediator if it carries the influence of a given independent variable (IV) to a given dependent variable (DV). Mediation is often assessed by how much the independent variable affects the mediator, and how much the mediator affects the dependent variable, and whether the effect of the independent variable on the dependent variable is reduced upon the addition of the mediator to the model, i.e., by controlling for the mediator. This would be the case if complementary mediation is occurring, but this is not the only pattern of mediated relationships. Instead, Zhou et al. (2010) describe three patterns consistent with mediation. The first, complementary mediation, is described above. The second, competitive mediation, occurs when the direct effect (path c) and the mediated effect (paths a x b) both exist but point in opposite directions. The third pattern is indirect-only mediation, where a mediated effect (paths a x b) exists, but no direct effect (path c). In other words, the independent variable is dependent on the mediator to have an effect. This third pattern, indirect
mediation, is what I will be testing for in this chapter. In cases of indirect mediation, adding the mediator to the model would be expected to strengthen the association rather than reduce it (Zhou et al., 2010).

*Figure 7.1. Mediation Diagram Based on Baron & Kenny’s (1986) Product Method.*

Zhou and colleagues’ (2010) method for testing for mediation is identical to the Baron & Kenny Product Method except that they dispense with the test for a statistically significant relationship between the independent and dependent variables, path c in the diagram (Figure 7.1). (The primary differences between the Zhou et al., and Baron & Kenney approaches are in how they categorize and interpret results rather than in the steps to test mediation.) The mediation analyses I present in this chapter involved three steps, where I first quantified the relationship between the independent variable and the mediator (path a), and then between the mediator and the dependent variable (path b). I then compared the change in the relationship between the independent variable and the dependent variable when controlling for the mediator (path c’). For models that provided evidence of mediation through the mediation analysis steps, I then conducted a Sobel test to determine if the mediation coefficient was statistically significant.

Throughout this chapter I will report beta coefficient estimates for the independent variable, dispensary bans, at each step of each the mediation analyses. Each of the three
mediation tests that will be presented will use dispensary bans (yes/no) as the independent variable and either lifetime and recent marijuana use as the dependent variable. Each of the models presented include student and school characteristics known to be correlated with adolescent marijuana use as covariates. Student characteristics include gender, grade, race/ethnicity, after-school program participation, whether the parent has a college degree, and low family income. School characteristics are measured at the student level by a variable included in the CHKS data that indicates whether the school they attend is a non-traditional school. There was also a random intercept to account for multilevel structure of the data.

To test the indirect relationship hypothesized in H2.1 I used the count of dispensaries per city, normalized per 10,000 residents as the mediator. To test H3.1, I used a binary indicator of whether the student perceived great risk of “harming themselves physically and in other ways” from frequent (defined as 1-2 times per week) marijuana use as the mediator. To test H4.1, I used a continuous measure of the distance (e.g., .79 miles) between the school and the closest dispensary in LA County as the mediator. Finally, to test H5.1, I used the number of dispensaries located within 2,000 feet of the school as the mediator.

**Research Question 2: Dispensary Density by City Mediation Analysis**

**Background**

Recent studies have demonstrated that dispensary density on a neighborhood level is positively associated with rates of marijuana use on a local level (Freisthler & Gruenwald, 2014). Furthermore, even though California legalized medical marijuana use in 1996, the largest increase in the rate of recent marijuana use among California and adolescents did not occur after 1996 but instead occurred between 2009-2011, which followed a period of rapid proliferation of marijuana dispensaries throughout the state (Center for Behavioral Health Statistics and Quality, NSDUH online query system, 2019).
The number of dispensaries in a city could be a measure of how strict a dispensary policy is if it accurately reflects the number of dispensaries that the city has allowed. It could also (or instead) reflect how effectively the policy is enforced, for example if the number of dispensaries is greater than the number allowed. I therefore compared three related measures of the density of dispensaries within a city: the number of verified licensed dispensaries, the number of verified unlicensed dispensaries, and the overall number of verified dispensaries for the city. Each of these measures were normalized by city population and converted to rates of dispensaries per 10,000 city residents.

The first research question that this chapter will address is Research Question 2: “Is the effect of dispensary bans on student marijuana use dependent on the number of dispensaries operating in a city?”. The hypotheses associated with RQ2 propose that H2.1) dispensary bans are negatively associated with the number of dispensaries operating in a city, H2.2) the number of dispensaries in a city is positively associated with greater odds of marijuana use among students, and H2.3) the number of dispensaries in a city mediates the relationship between city policies banning dispensaries and high school students’ marijuana use behaviors.

The need to account for the actual number of dispensaries in a city rather than assuming cities that had dispensary bans had no dispensaries in operation was evident when I mapped the location of the dispensaries throughout the County based on the addresses I had obtained from commercial dispensary listings (Figure 7.2). In support of reports of numerous unlicensed outlets from city and county governments (Marcellino, 2018), I verified 433 unlicensed outlets and 146 licensed outlets operating in the County in September of 2016, a ratio of unlicensed to licensed outlets of over 3 to 1.

Figure 7.2. Map of verified unlicensed and licensed dispensaries in LA County as of September 2016.
Unlicensed dispensaries were more common in cities that allowed dispensaries, but this was primarily the case for Los Angeles, where policy changes had seen several hundred dispensaries ordered shut down in 2013 and limited immunity granted only to the 135 that had been in continuous operation since 2007 (City of Los Angeles, Medical Marijuana Regulation
and Taxation Ordinance [Proposition D], June 2013). The average number of unlicensed outlets per 10,000 residents in cities that allowed dispensaries other than Los Angeles was comparable to cities that banned dispensaries (Figure 7.3) and was lower than some cities that had dispensary bans.

Figure 7.3. Number of unlicensed marijuana outlets per 10,000 city residents as of September 2016.
Descriptive Statistics

Table 7.1 displays the mean rate of dispensaries per 10,000 residents among the LA County cities that had dispensary bans in September 2016 compared to cities that allowed dispensaries, excluding the City of Industry, which had an extreme value for this measure due to having very low residential population.

Table 7.1. T-tests comparing mean rate of dispensaries per 10,000 residents among cities and unincorporated areas in LA County that had dispensary bans and cities and unincorporated areas that allowed dispensaries as of September 2016 (n= 101,152), all verified dispensaries and all verified unlicensed dispensaries. Note: Excludes City of Industry.

<table>
<thead>
<tr>
<th>All Verified dispensaries</th>
<th>N Students Within Cities</th>
<th>Mean Rate per 10,000 City Residents</th>
<th>Std. Dev</th>
<th>T-Test Value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Bans dispensaries</td>
<td>93113</td>
<td>0.0649</td>
<td>0.1850</td>
<td>493.22</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>City Allows dispensaries</td>
<td>7913</td>
<td>1.1206</td>
<td>0.1544</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unlicensed dispensaries</th>
<th>N Students Within Cities</th>
<th>Mean Rate per 10,000 City Residents</th>
<th>Std. Dev</th>
<th>T-Test Value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Bans dispensaries</td>
<td>93113</td>
<td>0.0607</td>
<td>0.1766</td>
<td>321.83</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>City Allows dispensaries</td>
<td>7913</td>
<td>0.7408</td>
<td>0.2212</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As indicated in Table 7.1, there was considerable variation in the rates of dispensaries per 10,000 city residents and the rates did not correspond with whether the city had a dispensary ban to the expected degree. For example, other than the extreme value for the City of Industry, the highest rate of verified dispensaries per city residents in LA County was 1.6 dispensaries per 10,000 city residents in Compton, a city that has banned dispensaries since 2008 (Compton Municipal Code, Section 9-24.3). The second highest rate of dispensaries (1.2 dispensaries per 10,000 city residents) was found in Los Angeles, a city that allows dispensaries but is working toward enforcing a cap of 135 dispensaries for the city. It was evident from these results that dispensary bans among the cities of LA County could not be extrapolated to mean there were no dispensaries operating in those cities, but only five of the 79 cities that had dispensary bans had a dispensary actively operating there in 2016 and the mean
number of dispensaries was lower among all the cities that had dispensary bans compared to cities that did not (Table 7.2), so I held to my hypothesis that dispensary bans would be associated with less dispensaries in a city.

Table 7.2. Verified dispensary counts and ratio per 10,000 residents among cities that had active, verified dispensaries, CHKS survey, pooled school years 2015/2016 and 2017, (N = 20, 926).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N (dispensaries)</th>
<th>Ratio per 10,000 city residents</th>
<th>N (students)</th>
<th>City/Area Allows dispensaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malibu</td>
<td>1</td>
<td>0.79</td>
<td>555</td>
<td>Yes</td>
</tr>
<tr>
<td>Bellflower</td>
<td>2</td>
<td>0.26</td>
<td>1,527</td>
<td>No</td>
</tr>
<tr>
<td>Industry</td>
<td>2</td>
<td>90.09</td>
<td>369</td>
<td>No</td>
</tr>
<tr>
<td>Inglewood</td>
<td>3</td>
<td>0.27</td>
<td>420</td>
<td>No</td>
</tr>
<tr>
<td>Pasadena</td>
<td>8</td>
<td>0.58</td>
<td>1,561</td>
<td>No</td>
</tr>
<tr>
<td>Compton</td>
<td>15</td>
<td>1.56</td>
<td>492</td>
<td>No</td>
</tr>
<tr>
<td>Unincorporated Areas LA County (Combined)</td>
<td>49</td>
<td>0.45</td>
<td>8,611</td>
<td>No</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>440</td>
<td>1.16</td>
<td>7,265</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Mediation Analysis: Dispensary Bans, Dispensary Density, and Lifetime Marijuana Use

To test the hypotheses associated with Research Question 2, I used the number of verified dispensaries located within a city per 10,000 residents as the mediating variable and controlled for factors known to be associated with marijuana use among adolescents, such as gender, race/ethnicity, and social/economic status. The independent variable of whether a city had a dispensary ban was determined by the city policy that was in effect when the count of dispensaries per city was obtained in September 2016. The outcome (dependent) variable was self-reported student marijuana use (lifetime and within the past month, assessed using separate regression models).

As previously presented in Chapter 5, there was a not a statistically significant negative relationship (path c) between dispensary bans and lifetime marijuana use (b = -0.2517, 0.1656).
I theorized that this relationship might depend on the number of dispensaries operating in a city, given that the reality of dispensary density in many cities did not reflect what one would expect based on the city dispensary policy. I tested this theory by regressing the indicator variable for dispensary bans on the number of dispensaries in a city (path a) using a hierarchical linear regression model with the number of dispensaries per 10,000 residents as the dependent variable and whether the city had a dispensary ban as the independent variable. I included the covariates mentioned earlier and a random intercept for city. As shown in the t-test results comparing the mean rate of dispensaries per 10,000 residents by whether the city had a dispensary in September 2016 (Table 7.2), there was a statistically significant negative association between dispensary bans and the number of dispensaries in a city. This result was replicated using a single-level linear regression (b = -0.60261, p= <.0001) (controlling for student characteristics associated with marijuana use or students being clustered in cities was not relevant when testing the association of dispensary bans and the number of dispensaries in cities). The significant association between dispensary bans and less dispensaries per city resident supported H2.1. The number of dispensaries per 10,000 residents was then regressed on the likelihood of lifetime marijuana use (path b), which revealed that the rate of dispensaries per residents in the city was not significantly associated with student reports of lifetime marijuana use (b = 0.002307, p= 0.6606). This finding refuted H2.2, where I theorized that the number of dispensaries was the key determinant of marijuana use among students. In the final model, which accounts for path c’, the dispensary ban indicator variable was regressed on both lifetime marijuana use and the rate of dispensaries in the city. The coefficient for dispensary bans (path c’) after controlling for the rate of dispensaries in the city changed very little and remained negative and statistically insignificant (b = -0.2915, p= 0.1095). These results indicated that while there is a statistically significant relationship between dispensary bans and the number of dispensaries in a city (H2.1), the number of dispensaries actually operating in the city is not a significant determinant of lifetime marijuana use among the city’s high school
students (H2.2). Furthermore, the relationship between dispensary bans and lifetime marijuana use among the high school students in a city is not dependent on dispensary bans limiting the number of dispensaries operating in a city, which negated hypothesis 2.3.

Dispensary Bans, Dispensary Density, and Recent Marijuana Use

I repeated the steps described above for recent marijuana, with similar outcomes, which are also reported Table 7.3. There was not a statistically significant relationship between dispensary bans and student reports of recent marijuana use (b = -0.2448, 0.1829), Table 7.3 presents the results of the analysis of the number of dispensaries in a city as a potential mediator of the effectiveness of dispensary bans in preventing recent marijuana use among high school students policy. As reported above, there was a statistically significant negative association between dispensary bans and the average number of unlicensed dispensaries in a city (path a) (b = -0.60261, p<.0001), which supported H2.1. The number of active dispensaries was then regressed on recent marijuana use. The number of dispensaries operating in the city was not significantly positively associated with student reports of recent marijuana use (path b) (b = 0.000605, p = 0.8659). This finding refuted H2.2 for recent marijuana use, which proposed that there would be a direct positive association between the number of dispensaries in a city and the likelihood of students attending school in that city to report recent marijuana use. In the final model (path c'), the dispensary bans variable was regressed on the number of dispensaries in the city and self-reported recent marijuana use among the students. The estimate for dispensary bans remained positive but not statistically significant after controlling for the number of dispensaries in the city and changed very little in magnitude (b = -0.2458, p= 0.1809). This suggests that the impact of dispensary bans on the likelihood of a student reporting having recently used marijuana is neither significant nor dependent on the association between dispensary bans and lower dispensary density in a city (H2.3).
Table 7.3 Mediation analysis of dispensary density per 10,000 city residents on the relationship between dispensary bans and high school student reports of lifetime and recent marijuana use from multivariate HGLM (n=101,521)\(^a\)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Beta Coefficients (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 1 (c)</td>
</tr>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-0.2517 (0.1656)</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.2448 (0.1829)</td>
</tr>
</tbody>
</table>

\(^a\) Controlling for grade, race/ethnicity, afterschool program participation, highest parent education family income, and school type.

The Sobel significance test presented in Table 7.4 confirms that a relationship between dispensary bans and marijuana use among a city’s high school students was not dependent on the dispensary density in each city.

Table 7.4 Coefficient estimates for Sobel tests of mediation effects of dispensaries per 10,000 city residents on the relationship between dispensary bans and lifetime and recent marijuana use from multivariable hierarchical generalized linear regression (n=101,521)\(^a\)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Mediation coefficient estimate (SE)(^b)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-1.0450 (0.0464)</td>
<td>0.2959</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-1.0397 (0.0466)</td>
<td>0.2984</td>
</tr>
</tbody>
</table>

\(^a\) Controlling for grade, race/ethnicity, afterschool program participation, highest parent education family income, and school type.

Comparing Measures of Dispensary Density

Given that the overall number of dispensaries located in a city did not have a statistically significant association with lifetime or recent marijuana use among a city’s high school students, I wondered if there could be a different result for unlicensed outlets. As indicated in Table 7.5, neither the number unlicensed dispensary nor all dispensaries was significantly associated with student marijuana use.

Table 7.5 Regression results comparing verified counts per 10,000 residents of all, licensed, and unlicensed dispensaries by city by association with lifetime and recent marijuana use, from generalized linear regression, CHKS 2015-2017. (n=101,521).
### Dependent Variable Measures

| Dependent Variable | Measures                        | Estimate | Standard Error | Wald Chi-Square | Pr > |t|
|--------------------|---------------------------------|----------|----------------|----------------|-------|
| Lifetime Marijuana Use | Rate per 10,000 city residents |          |                |                |       |
| All dispensaries   | 0.00153                         | 0.00139  | 1.2195         | 0.2695         |       |
| Unlicensed dispensaries | 0.00141                     | 0.00139  | 1.0244         | 0.3115         |       |
| Recent Marijuana Use | Rate per 10,000 city residents |          |                |                |       |
| All dispensaries   | 0.000874                        | 0.00176  | 0.2480         | 0.6185         |       |
| Unlicensed dispensaries | 0.000740                   | 0.00176  | 0.1761         | 0.6747         |       |

*Denotes statistical significance at α = .05.

**Dispensary Density by City Mediation Discussion**

Included as a measure of the actual exposure to dispensaries in communities, the number of dispensaries per 10,000 city residents had surprisingly little influence on the outcomes of interest for this study. As youth are not allowed to access these storefront outlets directly, the presence of dispensaries in their city may have little impact on the availability of marijuana within their social circles. The finding that the rate of dispensaries per 10,000 residents in their community had no effect on high school students’ marijuana use was in line with research indicating that adolescents generally do not get marijuana directly from dispensaries, but rather from social sources like relatives or friends (King et al., 2016). I hypothesized that a greater number of dispensaries located within a city could create more convenient access for the adults that act as a conduit of marijuana to adolescents. However, creating easy access for adults through legitimate sources like dispensaries may have also shrunk the illicit market as a source for adolescents. Further investigation of this effect is needed, such as to determine if effects differ within cities or are confounded by any variables that were not measured here.

**Research Question 3: Perceived Risk of Marijuana Use Mediation**

Research Question #3 (RQ3) was “Is the effectiveness of city dispensary bans dependent on increasing students’ perceptions of the risk of frequent marijuana use?”. The hypotheses associated with RQ3 propose that H3.1) dispensary bans are positively associated
with high school students’ perceptions of the risk of marijuana use, H3.2) student perceptions of risk are negatively associated with marijuana use, and H3.3) student perceptions of risk mediate the relationship between city dispensary bans and the likelihood of high school students using marijuana.

Background

Attitudes toward drugs and alcohol are known to be powerful predictors of adolescent substance use (Schmidt et al., 2016), and changing attitudes to perceive cannabis use as more acceptable and less risky have been noted among youth populations (Miech et al, 2018). For example, qualitative research with at-risk youth in LA County indicates that many view marijuana use as having fewer negative consequences than alcohol use (D'Amico, et al., 2015). A community assessment conducted in LA County also found that the risks of cannabis use were rated much lower among cannabis users than among non-users (LA County Department of Public Health, 2018), indicating a potentially important relationship between perceptions of the risk of marijuana use and the willingness to use it.

Mediation Analysis: Dispensary Bans, Perceived Risk, and Lifetime Marijuana Use

Table 7.6 presents the results of the perceived risk mediation analysis for lifetime and recent marijuana use. The relationship between dispensary bans and lifetime marijuana use (path c) was negative and non-significant (b=-0.2517, p = 0.1656). Whether a city had a dispensary ban was then regressed on whether students perceived great risk from frequent marijuana use (path a) using a HGLM model controlling for the covariates and with a random intercept for city. There association between dispensary bans and student perceptions of risk was positive but not statistically significant (b= 0.1854, p= 0.1428), refuting my hypotheses (H3.1) that dispensary bans would have a significant positive association with perceived risk.
among the students who attend school there. Perceived risk was then regressed on the likelihood of lifetime marijuana use, which revealed a statistically significant negative association between perceived risk and lifetime marijuana use ($b = -1.0980$, $p = <.0001$), confirming the hypotheses that perceived risk is a determinant of student marijuana use behavior (H3.2).

Finally, the regression analysis of dispensary and lifetime marijuana use was repeated including perceived risk in the model. Adding perceived risk to the model changed the relationship between dispensary bans and lifetime marijuana use ($b = -0.2614$, 0.1402) very little. Although including perceived risk in the regression of dispensary bans on lifetime marijuana changed the coefficient only slightly, adding it to the model strengthened the relationship, indicating a small and not statistically significant dependent relationship between dispensary bans and lifetime use, and at indirect mediation (H3.3). These steps were repeated for the recent marijuana use outcome, with similar results, reported below.

**Table 7.6 Mediation analysis of perceived risk of marijuana use on the relationship between dispensary bans and lifetime marijuana use from multivariable hierarchical generalized linear regression ($n=101,521$)**a

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Step 1 (c)</th>
<th>Step 2 (a)</th>
<th>Step 3 (b)</th>
<th>Step 4 (c')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-0.2517</td>
<td>0.1854</td>
<td>-1.0980,</td>
<td>-0.2614</td>
</tr>
<tr>
<td></td>
<td>(0.1656)</td>
<td>(0.1428)</td>
<td>(&lt;.0001)</td>
<td>(0.1402)</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.2448</td>
<td>0.1854</td>
<td>-1.1753,</td>
<td>-0.2135</td>
</tr>
<tr>
<td></td>
<td>(0.1829)</td>
<td>(0.1428)</td>
<td>(&lt;.0001)</td>
<td>(0.2330)</td>
</tr>
</tbody>
</table>

*a Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.

The results in Table 7.7 confirm that the relationship between dispensary bans and student marijuana use was not dependent on student perceptions of great risk from frequent marijuana use and that therefore indirect mediation was not occurring.

**Table 7.7 Coefficient estimates for Sobel tests of mediation effects of perceptions of great risk from frequent marijuana use on the relationship between dispensary bans and student and lifetime and recent marijuana use from multivariable hierarchical generalized linear regression ($n=101,521$)**a
<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Mediation coefficient estimate (SE)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-1.0654 (0.0454)</td>
<td>0.2866</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.7486 (0.0528)</td>
<td>0.4540</td>
</tr>
</tbody>
</table>

*a* Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.  
*b* SE=Standard Error

### Mediation Analysis: Dispensary Bans, Perceived Risk, and Recent Marijuana Use

Table 7.8 presents the results of the perceived risk mediation analysis for lifetime and recent marijuana use. The relationship between dispensary bans and recent marijuana use (path c) was negative and non-significant (b=-0.2517, p = 0.1656). Whether a city had a dispensary ban was then regressed on whether students perceived great risk from frequent marijuana use (path a) using a HGLM model controlling for the covariates and with a random intercept for city. There association between dispensary bans and student perceptions of risk was positive but not statistically significant (b= 0.1854, p= 0.1428), refuting my hypotheses (H3.1) that dispensary bans would have a significant positive association with perceived risk among the students who attend school there. Perceived risk was then regressed on the likelihood of recent marijuana use, which revealed a statistically significant negative association between perceived risk and recent marijuana use (b= -1.1753, p <.0001 ), confirming the hypotheses that perceived risk is a determinant of student marijuana use behavior (H3.2). Finally, the regression analysis of dispensary and recent marijuana use was repeated including perceived risk in the model. Adding perceived risk to the model changed the relationship between dispensary bans and recent marijuana use (b= -0.2135, p = 0.2330) very little. Although including perceived risk in the regression of dispensary bans on recent marijuana changed the coefficient only slightly, adding it to the model strengthened the relationship,
indicating a small and not statistically significant dependent relationship between dispensary bans and recent use, i.e., a non-significant degree of indirect mediation (H3.3).

**Table 7.8** Mediation analysis of perceived risk of marijuana use on the relationship between dispensary bans and recent marijuana use from multivariable hierarchical generalized linear regression (n=101,521)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Beta coefficient (p value)</th>
<th>Step 1 (c)</th>
<th>Step 2 (a)</th>
<th>Step 3 (b)</th>
<th>Step 4 (c')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-0.2517 (0.1656)</td>
<td>0.1854</td>
<td>-1.0980 (&lt;.0001)</td>
<td>-0.2614 (0.1402)</td>
<td></td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.2448 (0.1829)</td>
<td>0.1854</td>
<td>-1.1753 (&lt;.0001)</td>
<td>-0.2135 (0.2330)</td>
<td></td>
</tr>
</tbody>
</table>

*a Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.

The results in Table 7.9 confirm that the relationship between dispensary bans and student marijuana use was not dependent on student perceptions of great risk from frequent marijuana use and that therefore indirect mediation was not occurring.

**Table 7.9** Coefficient estimates for Sobel tests of mediation effects of perceptions of great risk from frequent marijuana use on the relationship between dispensary bans and student and lifetime and recent marijuana use from multivariable hierarchical generalized linear regression (n=101,521)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Mediation coefficient estimate (SE)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-1.0654 (0.0454)</td>
<td>0.2866</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.7486 (0.0528)</td>
<td>0.4540</td>
</tr>
</tbody>
</table>

*a Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.

**Perceived Risk Mediation Discussion**

Although perceived risk had a significant association with students’ lifetime and recent marijuana use, it was not influenced by whether their city allowed dispensaries. I had theorized that perhaps dispensary bans would signal to youth that marijuana presents a health risk, but it
is likely they are basing their perceptions of the risk of marijuana use on other factors. Future research is needed to identify what influences adolescents’ perceptions of their health risk from marijuana use. Possible factors could include exposure to marijuana prevention campaigns, increasingly liberal state and national marijuana laws, and cultural influences where marijuana is depicted as normal and enjoyable in cultural media.

**Research Question 4: Proximity of Dispensaries to Schools Mediation**

Proximity to dispensaries in neighborhoods has been shown to have a positive association with more frequent marijuana use among adults (Freisthler & Gruenewald, 2014; Mair et al., 2015), but the effect of proximity to marijuana outlets to schools on adolescent marijuana use is unknown. Research Question #4 (RQ4) was: “Is the effect of dispensary bans on student marijuana use dependent on the distance of the nearest dispensary from a student’s high school? The hypotheses associated with RQ4 propose that H4.1) dispensary bans are associated with longer distances between dispensaries and schools; H4.2) the proximity of dispensaries is positively associated with students’ likelihood of using marijuana; and H4.3) the relationship between city dispensary bans and high school students’ marijuana use is mediated by dispensary bans effectiveness at keeping dispensaries a greater minimum distance from schools than city policies that allow dispensaries.

**Descriptive Statistics**

Table 7.10 presents results comparing the mean distance from the students’ high school to the nearest licensed and unlicensed dispensaries within one mile and within LA County by whether the city banned dispensaries. In cities that banned dispensaries the mean distance to the nearest unlicensed dispensary within one mile was significantly smaller than for cities that allowed dispensaries (.45 miles) compared to cities that banned them (.56 miles) (t = -30.12, p
<.0001), a distance that was statistically significant, although qualitatively small. The average distance within one mile to the nearest licensed dispensary was not compared between schools in cities that allowed dispensaries and schools in cities with bans, as among the cities with dispensary bans it would only have applied to schools that had licensed dispensaries in an adjacent city located within one mile.

Without restricting the analysis to schools that had a dispensary of either type within one mile, dispensary bans were associated with a significantly longer mean distance to both licensed and unlicensed dispensaries. The average distance from the participants’ high schools to the nearest licensed dispensary in the County was exactly double in cities with dispensary bans compared cities that allowed dispensaries (2.2 miles compared to 1.1 miles, respectively). The average distance from schools in cities that banned dispensary was over 6 times longer than in cities that allowed dispensaries (12.1 miles vs. 1.8 miles, respectively). This makes sense because for the schools located in cities that banned dispensaries the nearest licensed dispensaries would have to be in adjacent cities.

Table 7.10. Mean distance in miles from participating schools to the nearest dispensary in LA County and within one mile by whether the city has a dispensary ban.

| dispensary Ban | N  | dispensary Type | Mean Distance in Miles | Std Dev | Difference in mean distance (Allow dispensaries – dispensary Ban) | t Value | Pr > |t| |
|----------------|----|----------------|------------------------|---------|---------------------------------------------------------------|---------|------|---|
| No             | 7265 | Unlicensed | 0.4538 | 0.3080 | -0.1076 | -30.12 | <.0001 |
| Yes            | 19993 | Unlicensed | 0.5614 | 0.2413 | -5.0735 | -78.47 | <.0001 |

Mean Distance to Nearest dispensary Within LA County
| dispensary Ban | N | dispensary Type | Mean Distance in Miles | Std Dev | Difference in mean distance (Allow dispensaries – dispensary Ban) | t Value | Pr > |t| |
|---------------|---|----------------|-----------------------|---------|-------------------------------------------------|---------|------|
| No            | 7913 | Unlicensed     | 1.0702                | 2.2275  | -1.1485                                         | -59.35  | <.0001 |
|               |      | Licensed       | 1.8195                | 2.1968  |                                                 |         |      |
| Yes           | 93608 | Unlicensed    | 2.2186                | 1.5947  |                                                 |         |      |
|               |      | Licensed       | 12.0604               | 9.5593  | -10.2408                                        | -95.12  | <.0001 |

As indicated in Table 7.11, over a quarter of the study participants had a dispensary located within mile of their school (26.9%). Unlicensed dispensaries were more numerous in LA County overall (433 vs. 146) but were also more likely to be found at closer distances to schools the study participants attended. Almost 14% of students had an unlicensed dispensary located near within a half mile of their school while less than 2% of students had a licensed dispensary located within a half mile of their school. There were no licensed dispensaries located within a quarter mile (1320 feet) of a school, but a small percentage of students had an unlicensed dispensary located within a quarter mile of their school (2.5%).

Table 7.11. Number and Percent of Students with a Dispensary Within 1 mile, CHKS Survey 2015-2017 (n=101,521).
Table 7.12 presents the results of the mediation analysis assessing the mediating effect of the distance to the nearest dispensary within LA County on lifetime marijuana use. As reported earlier, the relationship between dispensary bans and lifetime marijuana use (path c) was negative and non-significant (b=-0.2517, 0.1656). Whether a city had a dispensary ban was regressed on the distance in miles from the participant’s school to the nearest unlicensed dispensary (path a) using an HLM model controlling for the covariates and with a random intercept for city. The association between dispensary bans and the distance between the students’ high school and the nearest unlicensed dispensary (path a) was positive and statistically significant (b= 1.13949, p = <.0001), which supports H4.1 for lifetime marijuana use, i.e., my theory that dispensary bans would be associated with a greater average distance from schools than in cities that allow dispensaries. The distance in miles from the school to the nearest unlicensed dispensary was then regressed on the lifetime marijuana use, which revealed a statistically significant negative association between distance and reports of lifetime use, meaning that students in schools located further from unlicensed dispensaries were less like likely to report lifetime marijuana use (b= -0.04446, p= <.0001), confirming H4.2., that shorter distances between the participants’ schools and the nearest dispensary were associated with higher prevalence of lifetime marijuana use. Finally, the regression analysis of dispensary bans and lifetime marijuana use was repeated including the distance in miles from the school to

<table>
<thead>
<tr>
<th>Distance to Nearest Dispensary</th>
<th>Cases</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlicensed dispensary within ½ mile</td>
<td>14,055</td>
<td>13.84</td>
</tr>
<tr>
<td>Nearest dispensary is Within ¼ Mile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any dispensary within ¼ mile</td>
<td>2,583</td>
<td>2.54</td>
</tr>
<tr>
<td>Licensed dispensary within ¼ mile</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unlicensed dispensary within ¼ mile</td>
<td>2,583</td>
<td>2.54</td>
</tr>
</tbody>
</table>
the nearest unlicensed dispensary. Adding the distance measure increased the effect of
dispensary bans and in the expected direction, i.e., it was hypothesized that dispensary bans
would be negatively associated with marijuana use and adding the variable quantifying the
distance to the nearest dispensary into the regression strengthened the negative association
between dispensary bans and lifetime marijuana use, but the overall relationship still fell just
short of statistical significance (b = -0.3531, p = 0.0754). This result indicates that indirect
mediation was occurring, where the effectiveness of dispensary bans was partially dependent
on how far away they keep unlicensed dispensaries from high schools compared to city policies
that allow dispensaries.

Mediation Analysis: Dispensary Bans, Distance to Nearest Unlicensed Dispensary from School,
and Recent Marijuana Use

The above steps were repeated for the recent marijuana use outcome, with similar
results. The focal relationship (path c) between dispensary bans was negative and not
statistically significant, as reported earlier. Path a, the association between dispensary bans and
the distance to the nearest dispensary was the same as described above for recent use. Path b,
the effect of the distance between the nearest unlicensed dispensary and recent marijuana use
was negative and statistically significant (b = -0.03268, p = 0.0079), indicating the further away
unlicensed dispensaries were located from the participants’ schools, the less likely they were to
report recent marijuana use (H4.2). Path c’, the relationship between dispensary bans and
recent marijuana use was strengthened substantially and in the expected direction but fell short
of statistical significance, which indicated partial mediation. Hypothesis 4.3 was therefore
partially supported.

Table 7.12 Mediation analysis of the continuous distance from the school to the nearest
unlicensed dispensary on the relationship between dispensary bans and lifetime marijuana use
from multivariable hierarchical generalized linear regression (n=101,521)
Dependent variable | Beta coefficient (p value)  
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 1 (c)</td>
<td>Step 2 (a)</td>
<td>Step 3 (b)</td>
<td>Step 4 (c')</td>
</tr>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-0.2517 (0.1656)</td>
<td>1.13949 (&lt;.0001)</td>
<td>-0.04446 (&lt;.0001)</td>
<td>-0.3531 (0.0754)</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.2448 (0.1829)</td>
<td>1.13949 (&lt;.0001)</td>
<td>-0.03268 (0.0079)</td>
<td>-0.2909 (0.1385)</td>
</tr>
</tbody>
</table>

\(^a\text{Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.}\)

The results in Table 7.13 indicate that the distance to the nearest unlicensed dispensary is a significant indirect mediator of the relationship between dispensary bans and student marijuana use.

Table 7.13 Coefficient estimates for Sobel tests of mediation effects of the distance from school to the nearest unlicensed dispensary on the relationship between dispensary bans and student and lifetime and recent marijuana use, from multivariable hierarchical generalized linear regression (n=101,521)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Mediation coefficient estimate (SE)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-4.3631 (0.0116)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-2.6518 (0.0140)</td>
<td>.00800</td>
</tr>
</tbody>
</table>

\(^a\text{Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.}\)  
\(^b\text{SE=Standard Error}\)

Sensitivity Tests

Although it is important to learn that there is a statistically significant relationship between how close schools are located to unauthorized MMDs and student marijuana use, the purpose of this dissertation is to inform city policy. In my talks with prevention advocates and city leaders the primary question of marijuana regulation is “How far do MMDS need to be from sensitive areas to prevent community harm?”. I therefore examined the effects of distance from the participants’ schools to the nearest unauthorized MMD in further detail to try to determine the distance threshold at which unauthorized MMDs no longer have an impact on student marijuana use.
In Table 7.14 I present the results of a sensitivity analysis conducted a series of multilevel logistic regression models on increments of one mile, continuing to increments of a quarter mile for recent marijuana use, where the distance to the nearest MMD was not statistically significant at one mile. For each measure of marijuana use I started with a distance of over five miles and worked inward in increments of one mile, until I reached the point at which the distance to the nearest MMD had a statistically significant association with student marijuana use. For lifetime marijuana use, this occurred at a distance of one mile. For recent marijuana use, the distance from the school to the nearest MMD was not statistically significant at one mile, so I continued using smaller distances in quarter mile increments until I reached the point where the distance between the school and the nearest unauthorized MMD became statistically significant, which occurred at a distance of between ½ mile and ¾ mile of the nearest unauthorized MMD and the participant’s school.

This analysis also revealed that the distance from the school to the nearest MMD became significantly negatively associated with student marijuana use at longer distances. The distance at which both lifetime and recent marijuana use. The association of distance becomes protective against lifetime marijuana use at a distance of over 5 miles from the participants’ school and for recent marijuana use this occurs between 3 and 4 miles. As the distance used was the distance from school to only the nearest MMD from the participant’s school, these distances were not cumulative. The ranges of distances were treated as bands, where if the nearest dispensary was located within a certain range of distance from the participants’ school distance from their school the value for that range of distance was coded as ‘1’ and all other rangers of distance were coded as ‘0’.

For the distances within one mile I chose increments of a quarter mile because it is hard to visualize distance by feet at longer distances. I created variables using the distance to the nearest MMD from each student’s school to indicate whether the nearest MMD to the student was located within 1 mile (5280 feet), between three quarters of a mile (3960 feet) and one mile,
and between three quarters of a mile and a half mile (2640 feet). There were too few MMDs located within a half mile from schools to produce statistically significant and reliable results without including all of them instead of only the nearest (as is explored in the next section), so I stopped at a distance of a half mile from the school. Students that did not have MMDs located within any of these distances had a zero value for each of these variables. As these were binary variables I present odds ratios in Table 7.14.

Table 7.14. Associations between student marijuana use and distances to the nearest unlicensed MMD, CHKS survey 2015-2017, from multivariable hierarchical generalized linear regression (n=101,521)

<table>
<thead>
<tr>
<th>Distance to Nearest Unlicensed MMD</th>
<th>OR(^{b})</th>
<th>DF</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within ½ to ¾ mile</td>
<td>1.178(^*)</td>
<td>91927</td>
<td>1.095 1.267</td>
</tr>
<tr>
<td>Within ¾ to 1 mile</td>
<td>0.985</td>
<td>91927</td>
<td>0.866 1.121</td>
</tr>
<tr>
<td>Within 1 mile</td>
<td>1.060(^*)</td>
<td>91930</td>
<td>1.002 1.121</td>
</tr>
<tr>
<td>Within 1 to 2 miles</td>
<td>1.013</td>
<td>91930</td>
<td>0.953 1.076</td>
</tr>
<tr>
<td>Within 2 to 3 miles</td>
<td>1.040</td>
<td>91930</td>
<td>0.968 1.117</td>
</tr>
<tr>
<td>Within 3 to 4 miles</td>
<td>0.982</td>
<td>91930</td>
<td>0.918 1.051</td>
</tr>
<tr>
<td>Within 4 to 5 miles</td>
<td>0.919(^*)</td>
<td>91930</td>
<td>0.829 1.019</td>
</tr>
<tr>
<td>Over 5 miles</td>
<td>0.879(^*)</td>
<td>91927</td>
<td>0.809 0.955</td>
</tr>
</tbody>
</table>

The sensitivity analysis indicates that there was no “safe distance” within a mile that unauthorized MMDs could be located near schools without having an association with significantly higher rates of lifetime marijuana use among students. The distance between the school and the nearest unauthorized MMD was significantly associated with greater prevalence of recent marijuana use at a distance of a ½ mile to a ¾ mile. The association between the

\(^a\) Controlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.

\(^b\) OR=Odds Ratio
The distance between participants’ schools and the nearest unlicensed dispensaries was remarkably consistent for lifetime marijuana use with the exception of a non-statistically-significant result for distance between ½ and ¾ mile and lifetime use. Overall, there is a clear relationship with the distance between participants’ schools and the nearest unlicensed MMD, where shorter distances were associated with significantly greater odds of marijuana use. The association with distance to the nearest unlicensed dispensary then decreased in size and lost statistical significance at longer distances until eventually becoming associated with lower odds of marijuana use as distances increased.

The distances at which this research showed statistically significant associations with student marijuana use are much further away from schools than the state requirement of 600 feet, but it is important to note the same associations did not apply for licensed dispensaries. In contrast to the associations with distance from schools found for unlicensed dispensaries, there was not a consistent association with the distance that licensed dispensaries were located from participants’ schools and their odds of reporting lifetime or recent marijuana use (Table 7.15). It is therefore possible that smaller distances such as 600 feet are sufficient to prevent licensed outlets from being associated with greater prevalence of marijuana use among students, as licensed marijuana outlets seem to have less of an effect on student use than unlicensed outlets.

Table 7.15. Associations between student marijuana use and distances to the nearest licensed MMD, CHKS survey 2015-2017, from multivariable hierarchical generalized linear regression (n=101,521)\textsuperscript{a}

<table>
<thead>
<tr>
<th>Lifetime Marijuana Use</th>
<th>OR\textsuperscript{b}</th>
<th>DF</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to Nearest Licensed MMD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Within ½ to ¾ mile</td>
<td>0.961</td>
<td>91927</td>
<td>0.819</td>
</tr>
<tr>
<td>Within ¾ to 1 mile</td>
<td>0.998</td>
<td>91927</td>
<td>0.860</td>
</tr>
<tr>
<td>Within 1 mile</td>
<td>0.834*</td>
<td>91927</td>
<td>0.747</td>
</tr>
<tr>
<td>Within 1 to 2 miles</td>
<td>1.118*</td>
<td>91927</td>
<td>1.018</td>
</tr>
<tr>
<td>Within 2 to 3 miles</td>
<td>0.611*</td>
<td>91927</td>
<td>0.534</td>
</tr>
<tr>
<td>Within 3 to 4 miles</td>
<td>1.113*</td>
<td>91927</td>
<td>1.017</td>
</tr>
<tr>
<td>Within 4 to 5 miles</td>
<td>0.996</td>
<td>91927</td>
<td>0.875</td>
</tr>
<tr>
<td>Over 5 miles</td>
<td>1.149</td>
<td>91927</td>
<td>1.055</td>
</tr>
</tbody>
</table>
As presented in Table 7.15, the associations between the distance from the participants’ schools to the nearest unlicensed MMDs were largely inconsistent or were not statistically significant. For lifetime marijuana use the associations were consistently negative for distances below a mile, meaning that shorter distances to licensed MMDs were associated with lower odds of lifetime marijuana use among students, but these associations were not statistically significant below a mile and were inconsistent at distances greater than a mile. The inconsistent results for distances greater than a mile may indicate confounding effects from city borders, indicating that measurements of distance to authorized outlets greater than mile should be interpreted with caution and may be of limited utility in studies of the effects of distances between schools and dispensaries on high school students’ marijuana use behavior. Similarly, the association between the distance from participants’ schools to the nearest licensed MMDs and recent marijuana use was significant and protective at one mile, but was not statistically significant below one mile and inconsistent with any discernable pattern at distances greater than one mile.

Rather than concluding that the presence of licensed MMDs is protective against marijuana use among high school students at distances of one mile, I think it is safer to conclude that there is not a clear relationship between the distance to licensed MMDs and student marijuana use and that any future studies of the effect of this distance should be bound
by city borders to avoid any confounding effects of authorized dispensaries being found only within cities that allow them, while unlicensed dispensaries were found both in cities that allowed MMDs and cities with bans.

That there was not a clear pattern of association with the distance from schools to the nearest licensed MMD when the association was clear for unlicensed dispensaries is surprising. This finding has important implications for marijuana regulation at a city level, as it suggests that any associations between the proximity of MMDs to areas young people frequent and their marijuana use behavior may be driven by unlicensed outlets. It also reflects a need for further study of why the effects of unlicensed and licensed MMDs should be so noticeably different.

_Distance Analysis Discussion_

It is evident from the results presented above that the continuous distance between schools and unlicensed dispensaries is a mediator of effectiveness for dispensary bans, while there appears to be little association between student marijuana use and the distance to the nearest licensed dispensary. Although I found in Chapter 5 that dispensary bans were not effective on their own, they were associated with a longer distance between participants’ schools and the nearest unlicensed dispensary, which was in turn strongly correlated with a lower prevalence of student marijuana use. It is therefore important to consider what is actually driving adolescent marijuana use and how best to prevent it using city policy. This research suggests that it may need not necessarily be a ban. Although dispensary bans were associated with longer distances to the nearest unlicensed marijuana outlet, strict enforcement of distance requirements and closing down unauthorized outlets while allowing some dispensaries to operate far from sensitive areas could possibly achieve the same aim.

**Research Question 5: Dispensary Density Near Schools Mediation**
The cities in LA County that allow dispensaries have use local ordinances that specify the conditions under which dispensaries can operate in the city. All six of the cities that allowed dispensaries in September of 2016 required them to be at least 500 feet from schools. Current State regulations require a minimum distance of 600 feet, but at the time of data collection, the distances dispensaries were required to be kept from schools in these six cities ranged between 500 – 1,000 feet (Appendix A: Medical Marijuana Dispensary Ordinances in LA County). Distances specified in dispensary ordinances may be based on somewhat arbitrary criteria, as no empirical research has established what a “safe” distance is. I suspected the presence and number of dispensaries within a larger radius could still be influential and therefore tested the mediating role of the number of dispensaries located 2,000 feet of the study participants’ schools.

Research Question #5 (RQ4) was “Is the effectiveness of dispensary bans dependent on them being associated with less dispensaries located near high schools?” The hypotheses associated with RQ5 propose that, H5.1) dispensary bans are negatively associated with the number of dispensaries being located near high schools; H5.2) the number of dispensaries located near schools is positively associated with students’ likelihood of using marijuana; and H5.3) the relationship between city dispensary bans and high school students’ marijuana use is mediated by the number of dispensaries operating near schools.

Descriptive Statistics

The number and proportion of schools with dispensaries located within a specific radius is presented in Table 7.16. Almost a quarter (23.3%) of the public high schools in LA County had a dispensary located within 2,000 feet of their school, whereas the number of schools with a dispensary located within 1,000 feet was closer to 5% (4.85%). Four schools had a dispensary located within 500 feet, which represented about 1% of the total schools (0.92%).
Table 7.16. Number of dispensaries within 2,000 feet of LA County Public High Schools (N = 433).

<table>
<thead>
<tr>
<th>Dispensary within 500 feet of school</th>
<th>N (Schools)</th>
<th>Percent of total (schools)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>429</td>
<td>99.08</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0.92</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.69</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0.23</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dispensary within 1,000 feet of school</th>
<th>N (Schools)</th>
<th>Percent of total (schools)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>412</td>
<td>95.15</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>3.70</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.69</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>0.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dispensary within 2,000 feet of school</th>
<th>N (Schools)</th>
<th>Percent of total (schools)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>332</td>
<td>76.67</td>
</tr>
<tr>
<td>1</td>
<td>57</td>
<td>13.16</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>5.77</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>0.69</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>2.31</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>0.46</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>0.46</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>0.46</td>
</tr>
</tbody>
</table>

The corresponding percentages of students attending schools located near dispensaries are presented in Table 7.16. These figures include only the schools that participated in the CHKS survey (n=184).

Table 7.17. CHKS Students attending schools with a dispensary within 2,000 feet (n=10,081).

<table>
<thead>
<tr>
<th>Dispensary within 500 feet of school</th>
<th>N (students)</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>189</td>
<td>0.17</td>
</tr>
<tr>
<td>2</td>
<td>9892</td>
<td>8.79</td>
</tr>
</tbody>
</table>

Table 7.18 presents the number of dispensaries within buffer zones of 1000 and 2,000 feet from a school attended by a study participant.

Table 7.18. Number of dispensaries within 1,000 and 2,000 feet of a school attended by CHKS study participants, CHKS survey 2015-2017 (n=101,521).

<table>
<thead>
<tr>
<th>Dispensaries within 1,000 feet of school</th>
<th>Number Dispensaries</th>
<th>N (students)</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>112,354</td>
<td>99.83</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>189</td>
<td>0.17</td>
<td></td>
</tr>
</tbody>
</table>
Comparing Measures of Dispensary Density Near Schools

Before proceeding, I again wanted to investigate whether there were different effects for licensed and unlicensed dispensaries located within 2,000 feet of a participant’s high school, as this could determine which measure of dispensary density would be the most appropriate to use in the mediation analysis. As indicated in Table 7.19, statistically significant effects were observed for the counts of unlicensed outlets and licensed outlets, but not for all outlets combined.

<table>
<thead>
<tr>
<th>Dispensaries within 2,000 feet of school</th>
<th>Number Dispensaries</th>
<th>N (students)</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>102,651</td>
<td>91.21</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6,772</td>
<td>6.02</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1,937</td>
<td>1.72</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>888</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>107</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>188</td>
<td>0.17</td>
<td></td>
</tr>
</tbody>
</table>

| Dependent Variable | Measures          | Estimate | Standard Error | Wald Chi-Square | Pr > |t| |
|--------------------|-------------------|----------|----------------|----------------|-------|
| Lifetime Marijuana Use | Counts           |          |                |                |       |
|                     | Number licensed dispensaries | -0.2182* | 0.07022        | 94262          | 0.0019 |
|                     | Number unlicensed dispensaries | 0.1033* | 0.03320        | 94262          | 0.0019 |
|                     | Number all dispensaries      | 0.04274 | 0.03087        | 94262          | 0.1662 |
| Recent Marijuana Use | Counts       |          |                |                |       |
|                     | Number licensed dispensaries | -0.2739* | 0.09227        | 94262          | 0.0030 |
|                     | Number unlicensed dispensaries | 0.04553 | 0.04259        | 94262          | 0.2851 |
|                     | Number All dispensaries      | -0.01606 | 0.04012        | 94262          | 0.6890 |

*Denotes statistical significance at α = .05.

After noting that the number of unlicensed dispensaries within 2,000 feet of schools was significantly associated with lifetime marijuana use while the total number of dispensaries was not, I decided to use the count of unlicensed dispensaries within 2,000 feet as the measure of
dispensary density near schools in the mediation analysis as it had a stronger association with student marijuana use than the number of dispensaries overall. I chose to use only unlicensed outlets rather than all outlets, because including all dispensaries within a buffer would have combined mediating variables with opposing effects that would cancel each other out. Evidence of the opposite associations each type of dispensary had with student marijuana use can be seen in the table below, where there were statistically significant effects in different directions for licensed and unlicensed dispensaries, but when combined there was not a statistically significant relationship with between all dispensaries within 2,000 feet and either measure student marijuana use.

Dispensary Bans, Unlicensed Dispensary Density Within 2,000 feet of Schools, and Lifetime Marijuana Use

Table 7.20 presents the results of the mediation analysis assessing the association between the count of unlicensed dispensaries located within 2,000 feet of a school on students’ lifetime marijuana use. The relationship between dispensary bans and lifetime marijuana use (path c) was negative and non-significant (b=-0.2517, 0.1656), as reported in Chapter 5. Whether a city had a dispensary ban was then regressed on the number of unlicensed dispensaries located within 2,000 feet of a participant’s school (path a). The association between dispensary bans and dispensaries being located within 2,000 feet of a student’s high school was negative and statistically significant (b= -0.39309, p = <.0001), which supports H5.1 for lifetime marijuana use, i.e., that dispensary bans would be associated with less unlicensed dispensaries being located near schools than policies that allow dispensaries. The number of unlicensed dispensaries within 2,000 feet of the school was then regressed on the likelihood of lifetime marijuana use, which revealed a statistically significant positive association between unlicensed dispensaries being located near a high school and the proportion of students there
reporting lifetime marijuana use (b= 0.1430, p= 0.0028), confirming H5.2., that the number of unlicensed dispensaries located near a school is positively correlated with lifetime marijuana use. Finally, the regression analysis of dispensary bans and lifetime marijuana use was repeated including the number of unlicensed dispensaries within 2,000 feet of the school in the model. Accounting for the number of unlicensed dispensaries within a 2000-foot radius of the school slightly increased the association between dispensary bans and lifetime marijuana use among participating high school students but did not make it statistically significant (b=--0.2687, p = 0.1459), therefore refuting H5.3, that the effectiveness of dispensary bans is dependent on how well they prevent unlicensed dispensaries from being located near schools compared to city policies that allow dispensaries.

Dispensary Bans, Unlicensed Dispensary Density Within 2,000 feet of Schools, and Recent Marijuana Use

These steps were repeated for the recent marijuana use outcome. As path c and a were the same for recent marijuana I began by regressing the number of unlicensed dispensaries within 2,000 feet of the school on the likelihood of recent marijuana use, which revealed a non-statistically significant positive association with the proportion of students there reporting recent marijuana use (b= 0.06235, p = 0.2981), which in contrast to the relationship observed for the number of dispensaries located near a school and lifetime marijuana use, did not support the hypothesis that the number of unlicensed dispensaries located near schools is positively correlated with recent marijuana use among the students attending that school (H5.2). Finally, the regression analysis of dispensary bans and lifetime marijuana use was repeated including the number of dispensaries within 2,000 feet in the model. Accounting for the number of dispensaries within a 2000-foot radius of the school slightly increased the effect but did not make the association between dispensary bans and lifetime marijuana use among participating high school students statistically significant (b=--0.2687, p = 0.1459), and therefore did not
support (H5.3), my theory that there was an indirect relationship masking an association between dispensary bans and lower rates of recent marijuana use among students, i.e., that the effectiveness of dispensary bans was dependent on them allowing less dispensaries to be located within 2,000 feet of schools compared to city policies that allow dispensaries.

Table 7.20 Mediation analysis of the number of dispensaries within 2,000 feet of the school on the relationship between dispensary bans and lifetime marijuana use from multivariable hierarchical generalized linear regression (n=101,521)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Beta coefficient (p value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Step 1 (c)</td>
</tr>
<tr>
<td>Lifetime Marijuana Use</td>
<td>-0.2517</td>
</tr>
<tr>
<td></td>
<td>(0.1656)</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>-0.2448</td>
</tr>
<tr>
<td></td>
<td>(0.1829)</td>
</tr>
</tbody>
</table>

*aControlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.

The results in Table 7.21 confirm that that indirect mediation was not occurring between the number of dispensaries located within 2,000 feet of a school and student marijuana use.

Table 7.21 Coefficient estimates for Sobel tests of mediation effects of dispensaries being located within a 2000-foot radius of a participating student’s school on the relationship between dispensary bans and student and lifetime and recent marijuana use, from multivariable hierarchical generalized linear regression (n=101,521)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Mediation coefficient estimate (SE)b</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lifetime Marijuana Use</td>
<td>1.4539 (0.0288)</td>
<td>0.1459</td>
</tr>
<tr>
<td>Recent Marijuana Use</td>
<td>1.2673 (0.0729)</td>
<td>0.2050</td>
</tr>
</tbody>
</table>

*aControlling for grade, race/ethnicity, afterschool program participation, highest parent education, family income, and school type.

bSE=Standard Error

Density of Unlicensed Dispensaries Near Schools Mediation Discussion

The results presented here show that the number of unlicensed dispensaries within 2,000 feet was significantly associated with lifetime marijuana use among the 9th and 11th grade students in this study. This is a distance more than 3 times the minimum distance the State of
California requires of 600 feet, which indicates that the distances the State requires and that the distances between 600 and 1,000 feet that the cities in LA County have chosen to define as buffers between schools and dispensaries may not be nearly wide enough when it applies to unlicensed dispensaries.

Despite the density of unlicensed dispensaries near schools being significantly associated with lifetime marijuana use, there was no evidence that the effectiveness of city dispensary bans were significantly mediated by (and therefore dependent on) this factor. The finding that there was a stronger association between unlicensed dispensaries and student marijuana use is an important contribution to the literature, as there has been very little research to date that distinguishes between unlicensed and licensed dispensaries and none that has compared their effects on youth use.
Chapter 8: Discussion

Summary of the Dissertation

Experimentation with marijuana typically begins in adolescence (Ellickson, Tucker, Klein, & Saner, 2004; Tang & Orwin, 2009; Verweij et al., 2010) but the later in life and less frequently a young person uses marijuana, the less likely they will be to experience mental, physical, or social problems related to marijuana use (Volkow et al., 2014). Preventing youth use is a frequently stated goal of dispensary bans (LA County Department of Public Health, 2019) but to date there have been no known studies focusing on the effectiveness of dispensary bans in preventing adolescent marijuana use. Despite the frustration that the California tradition of local control has caused for medical marijuana consumers and law enforcement, it has also provided a valuable opportunity to evaluate whether city policies that ban marijuana outlets have a localized impact on youth marijuana use. This is important because there are few tools available at a city level to prevent underage youth marijuana use.

The question that logically follows whether dispensary bans are effective in preventing youth marijuana use is how they influence adolescent marijuana use behavior. For example, does the effectiveness of dispensary bans depend on how successful they are in keeping dispensaries out of city? Do city dispensary bans signal to youth that the adults in their city consider marijuana use to be harmful? Or, is the effectiveness of dispensary bans dependent on them being more effective at preventing dispensaries from being located near high schools? To answer these questions, I examined trends in high school students’ marijuana use behavior before and after a restrictive dispensary policy was enacted in the City of Los Angeles, tested for cross-sectional associations between dispensary bans and student marijuana use and
explored explanatory theories for why dispensary bans and more restrictive policies might have an effect.

Overall, I found limited support for the efficacy of dispensary bans but strong support for enforcement-related factors. The focal relationship for this dissertation, the effect of MMD bans on adolescent marijuana use was not statistically significant among 57 cities in LA County. There was nevertheless a great deal of information learned from the difference-in-difference analysis. I found that in the City of Los Angeles, Proposition D represented a clear voter mandate for better enforcement and tighter regulations on dispensaries that when carried out was powerful enough to reverse an increasing trend in lifetime marijuana use among city students despite the continued presence of dispensaries in the city.

I found that only the continuous distance to the nearest dispensary within LA County had a statistically significant mediating effect on the relationship between dispensary bans and student marijuana use (H4.3), although it fell short of making the relationship between dispensary bans and student marijuana use statistically significant. This result indicates that the preventative influence of dispensary bans is partially dependent on the degree to which they are associated with longer distances between schools and the nearest unlicensed MMD. The results from the mediation analyses also supported the importance of enforcement, particularly when it concerns closing down or preventing unlicensed outlets and the need for further study of localized effects. It is possible there was data missing for too many cities to detect an effect for city MMD bans or the rate of MMDs at a city level but that results were found for local measures and not for comparisons conducted by city could indicate that variation in adolescent marijuana use occurs within cities. In this study, students’ marijuana use was more strongly associated with the proximity of the nearest unlicensed dispensary to their school and the density of dispensaries within a several blocks from their school. These localized effects highlight the importance of enforcing city regulations that restrict dispensaries from operating near schools, whether those regulations are minimum distance requirements or policies that ban dispensaries
altogether. Furthermore, that localized effects were noted only for unlicensed outlets and not for licensed dispensaries indicates that enforcing existing ordinances by closing unlicensed outlets near schools could be an excellent first step for cities looking to prevent marijuana use among their students.

**Research Question #1: Differences in Marijuana Use Trends by City Dispensary Policy Analysis**

My first research question concerned whether city regulations that ban or restrict dispensaries influenced trends in high school students’ marijuana use (RQ1). I hypothesized that over time, cities that allow dispensaries would experience greater increases in marijuana use among high school students relative to cities that allowed dispensaries throughout the study period (H1.2). I was unable to test the impact of dispensary bans over time among the all the cities in LA County due data limitations, but when I tested the impact of policy that significantly tightened regulations on dispensaries in the City of Los Angeles I found that enacting tighter dispensary regulations can have an impact on rates of high school students’ marijuana use, even as a smaller number of dispensaries remain in active in a city. This hints at a threshold effect, suggesting that the impacts of dispensaries in at a city level can be minimized if their number is kept below a certain point. However, this would not prevent localized effects within cities in the neighborhoods where the dispensaries are located.

When comparing all of the LA County cities represented in the data, dispensary bans had little effect on outcomes in high school students’ marijuana use. Although the observed effects for city dispensary bans in the multivariate regression models were in the expected direction, the influence of dispensary bans on students’ marijuana behaviors was qualitatively small and was not statistically significant when accounting for individual characteristics and school type. It is possible that because people under the age of 18 are not able to access
marijuana directly from dispensaries, attending school in a city that allows dispensaries has little effect on their ability to obtain marijuana, which state and national-level studies have documented as already being quite easy (Austin et al., 2018; Miech et al., 2018).

It is possible that city dispensary policies are too distal to what is important to high school students to have a qualitatively important impact on their attitudes and behaviors pertaining to marijuana use. Alternatively, there may be other, more influential distal factors at work, like societal attitudes toward marijuana and social norms surrounding substance use that have been changing statewide and even nationally. One possible explanation for the lack of impact of city dispensary bans on high school students’ marijuana use behavior and attitudes is that storefront medical marijuana dispensaries are not the only type of medical marijuana business in operation in LA County.

Interestingly, however, analyses conducted for earlier survey years (the 2014/2015 school year) that were subject to similar data limitations (missing data for about a third of the cities in LA County) did identify a statistically significant negative association between a city having a dispensary ban and lifetime marijuana use (Branson, 2017). It appears that by the next year, the 2015/2016 school year, dispensary bans were no longer associated with lower rates of even lifetime use among high school students. What could explain this change? One difference between the 2014/2015 school year and the 2015/2016 school year was that only four LA County cities allowed medical marijuana dispensaries in 2014, compared to six in 2016 and of the two new cities included in this group one (Santa Monica) did not have any active dispensaries before the end of the study period, while the other, Huntington Park, allowed four dispensaries but only in industrial zones. As this dissertation has demonstrated, the distance to the nearest dispensary was among the most powerful influences on student marijuana use behavior. By allowing dispensaries to locate only in industrial zones, the City of Huntington Park may have prevented their city ordinance allowing MMDs from having an impact on marijuana use behaviors among the young people attending their schools.
Another possible explanation for the association between dispensary bans and lifetime marijuana use noted during the 2014/2015 school year disappearing for the 2015/2016 and 2016/2017 school years may be an almost exponential growth in medical marijuana delivery services in LA County. For example, even after the number of storefront MMDs has been curbed in some areas of LA County, growth in medical marijuana delivery services seems to have continued unabated, regardless of the city policy where they are located. Only 25 percent of the cannabis consumed in the state is purchased from government-approved brick-and-mortar retailers, according to a report released in February 2019 by the Cannabis Growers Association. Much of the rest is sold door-to-door by hundreds of unlicensed, small and independent couriers (Cannabis Growers Association, 2019). I was not able to test or control for this factor in my analysis. Empirical data measuring the growth in marijuana delivery services in LA County is available only via the same commercial services by which I obtained addresses for LA County storefront dispensaries, but I do not have access to any data archives from these sources for the years between 2015 and 2017 and did not track the numbers of delivery services other than when I recorded the number and location of unduplicated dispensaries listed by Weedmaps and other dispensary listing websites in September 2016.

California is one of the few states that allows marijuana delivery. Colorado, Washington state, Alaska and Washington, D.C., don’t allow home delivery of marijuana. Oregon, California and Nevada do, but services are not universal. Colorado, Washington state, Alaska and Washington, D.C., don’t allow home delivery of marijuana. Oregon, California and Nevada do, but services are not universal. Colorado Governor John Hickenlooper stated one of chief concerns surrounding marijuana delivery services; that “delivery service offers more opportunity for that marijuana to get into the hands of kids.” (“California one of few states that allow cannabis delivery, but it’s not as simple as ordering pizza,” 2018). Another key concern for delivery services is enforcement. Many are based in cities where marijuana businesses are not permitted and it is impossible to monitor how often they deliver to cities in which MMDs are
banned; even though some delivery business have put protocols in place that allow them to identify areas where delivery is prohibited and refuse to deliver to those jurisdictions (“California one of few states that allow cannabis delivery, but it’s not as simple as ordering pizza,” 2018), they represent only a handful of the hundreds of the businesses available to choose from for marijuana delivery. For example, neither medical or recreational marijuana business are currently legal in the cities shown in the screenshot below, but dozens of marijuana delivery businesses are based there and ready to service those regions.

Figure 8.1. Screenshot from Weedmaps.com with listings of marijuana delivery services for the South Bay region of LA County, as of 11/10/2018.

The finding that low family income was inversely associated with recent marijuana use supports previous studies and reviews indicating that youth are sensitive to prices for products like cigarettes and alcohol (Cerdá et al., 2018; Wagenaar, Tobler, & Komro, 2010) but adolescents’ sensitivity to marijuana prices has not been studied directly to date. The increase
in the odds of both lifetime and recent use between ninth and eleventh grade is consistent with the body of evidence that age is associated with a greater likelihood of recent as well as lifetime use (Gruber et al., 2014; Lynne-Landsman, Livingston, & Wagenaar, 2013; Mayberry, Espelage, & Koenig, 2009). The magnitude of the difference between grades also suggests that initiation of marijuana use occurs for many youth in this study sample between these two grades, or around age 15, which is consistent with other research on adolescent marijuana use (Perez, Ariza, Sanchez-Martinez, & Nebot, 2010; Schmits, Mathys, & Quertemont, 2015). Finally, the very high likelihood of students attending non-traditional schools to report recent and lifetime marijuana use indicates that non-traditional schools would be an ideal target for school-based substance abuse prevention interventions.

Research Questions 2-5: Mediation Analyses

The results presented in Chapter 6 refuted Hypothesis 1.2, and established that dispensary bans do not have a direct effect on high school students’ marijuana use when controlling for student and school characteristics known to be associated with adolescent marijuana use. This diverged from findings from the trend analysis which found that over time a more restrictive dispensary policy in Los Angeles was followed by decline in lifetime marijuana use among the City’s 9th and 11th grade students. Before concluding that dispensary bans had no relevance to adolescent marijuana use, however, I investigated if a more complex relationship was masking an association.

By investigating indirect effects, I hoped to learn identify indirect mediators of a relationship between dispensary bans have an impact on adolescent marijuana use, for example if their effect is dependent on them having a significant effect on another variable that has a significant influence on student marijuana use. This kind of hypothetical relationship is called indirect mediation (Zhou et al., 2010). Often, the researcher’s interest switches to the variable with the direct effect once it is identified, but in the case of civic policies regulating
dispensaries, learning more about these dependent relationships could also elucidate the mechanisms by which restrictive city regulations on legal, adult-use products might be effective in preventing substance use among adolescents. For example, if these analyses had demonstrated that the density of dispensaries was significantly correlated with adolescent marijuana use by city, policies that strictly limit the number of dispensary bans could pursued in lieu of dispensary bans.

Research Question 2: Dispensary Density Analysis

Recent studies have demonstrated that dispensary density is positively associated with higher prevalence of use and more frequent use among adults (Freisthler & Gruenwald, 2014) but their influence has not been studied among youth. Prevention research supports the idea that more convenient access to substances that are legal for adults, such as tobacco or alcohol, often has the end result of creating easier access for youth (Ahmad & Billimek, 2007; Flewelling et al., 2013; Harrison, Fulkerson, & Park, 2000). This finding implies that youth living in or attending school in a city that allows dispensaries might obtain cannabis more easily or more often from adults in their social network. Considering that adolescents report older relatives and the illicit market as their primary sources of cannabis (King, Merianos, & Vidourek, 2016; Reed et al., 2019), a dispensary ban making access less convenient for adults could have the additional effect of making it less conveniently obtained by teens.

The number of dispensaries in a community makes sense as a measure of convenience of access but could also be a marker for ineffective enforcement if it is larger than the number a city allows. Dispensary bans were significantly negatively associated with lower density of dispensaries, among the cities of LA County (b = -0.60261, p<.0001), which supported H2.2. This means that the average city with a dispensary ban had less dispensaries operating there the average city that allowed dispensaries. I expected the number of dispensaries in a city to be positively correlated with the prevalence of marijuana use among students but instead found
that there was not a statistically significant association ($b = 0.000605$, $p = 0.8659$). This finding refuted H2.2 and ruled out the rate of dispensaries per 10,000 residents as an indirect mediator that carries the effect of dispensary bans on students’ rates of lifetime and recent marijuana use.

Included as a measure of the actual exposure to dispensaries in communities, the number of dispensaries per 10,000 had surprisingly little influence on the outcomes of interest for this study. As youth are not able to access these storefront outlets directly, the presence of dispensaries in their city may have little impact on the availability of marijuana within their social circles. That the number of dispensaries in a community normalized by population had no effect on high school students’ marijuana use was in line with research indicating that adolescents generally do not get marijuana directly from dispensaries, but rather from social sources like relatives or friends. I hypothesized that a greater number of dispensaries located within a city would create more convenient access for the adults that act as a conduit of marijuana to adolescents. However, creating easy access for adults through legitimate sources like dispensaries may have also shrunk the illicit market as a source for adolescents. One possibility is that the adults and adolescents that formerly supplied marijuana through the illegal market pursued other activities after losing a large proportion of their adult customers when access to dispensaries became legal.

The finding that the rate of dispensaries per 10,000 population had no effect on high school students’ marijuana lifetime or recent use or perceptions of how easy it was to get marijuana was in line with research indicating that adolescents generally do not get marijuana directly from dispensaries, but rather from social sources like relatives or friends (King, Merianos, & Vidourek, 2016). It’s also possible that the predictions of marijuana legalization advocates are correct; that allowing easier access to marijuana through legitimate sources like dispensaries (or semi-legitimate in the case of unlicensed dispensaries) has starved the illicit market as a source. Although this could be a factor, local research indicates that it could not be
completely responsible for the results seen here. Two recent local studies have indicated that although use of dispensaries as a source for marijuana is preferred by the adult marijuana users in LA County, most of this population continues to access marijuana from illicit sources in addition to dispensaries (Grella, Rodriguez, & Kim, 2014; LA County Dept. of Public Health, 2018). For example, a September 2018 community assessment published by the LA County Department of Public Health Substance Abuse and Prevention Program (SAPC) titled “Marijuana Use and Public Perceptions in Los Angeles County” indicates that dispensaries are still not the most common marijuana source for adult users. Instead, 58% of the LA County marijuana users surveyed cited friends as the primary source for their marijuana (which implies illegal trading of marijuana, even if it was legally obtained), whereas only 21% of respondents reported dispensaries as their primary source. However, only approximately 6% of the respondents in the 2018 study reported a “dealer” as their primary source, i.e., the illicit market. This is less than half of the proportion of marijuana users surveyed for a qualitative study of dispensary users conducted by SAPC and UCLA in 2014, which found that although dispensary customers unanimously preferred to get marijuana from dispensaries as compared to the illicit market, 13% also continued to get marijuana from the illicit market (Grella, Rodriguez, & Kim, 2014).

Research Question 3: Perceived Risk Mediation Analysis

Even if city ordinances do not have an effect on the supply of marijuana available to youth or ultimately impact their marijuana use behaviors, could they have an effect on their perceptions of risk and on youth social norms surrounding marijuana use? Attitudes toward drugs and alcohol are known to be powerful predictors of adolescent substance use (Schmidt et al., 2016), and changing attitudes to perceive cannabis use as more acceptable and less risky have been noted among youth populations (Miech et al, 2018). For example, qualitative research with at-risk youth in LA County indicates that many view marijuana use as having
fewer negative consequences than drinking (D’Amico, et al., 2015). A community assessment conducted in LA County also found that the risks of cannabis use were rated much lower among cannabis users than among non-users, indicating a potentially important relationship between perceptions of the risk of marijuana use and the willingness to use it.

The results of the perceived mediation analysis indicate that while perceived risk has a strong association with the prevalence of students’ lifetime and recent marijuana use (H3.2), it is not determined by their city’s dispensary policy (H3.1). Perceiving great risk from frequent (1-2 days a week) marijuana perceived risk could not therefore mediate the relationship between dispensary bans and student marijuana use (H3.3). Perceived risk having a strong association with student marijuana use is consistent with well-known theoretical models like the Health Belief Model (Janz & Becker, 1984) but it is outside of the scope of this analysis to determine what is determining students’ perception of the risks of marijuana use other than to note that it is not the dispensary ordinance in the city where they attend school and likely live.

Research Question 4: Proximity from Schools to the Nearest Dispensary Mediation Analysis

For Research Question 4 I tested the mediating effect of the continuous distance from the study participants’ schools to the nearest dispensary in LA County. I hypothesized that dispensary bans would be associated with a greater average distance compared to cities that allowed dispensaries. I used the distance to the nearest unlicensed dispensary as the mediating variable based on a sub-analysis finding that unlicensed dispensaries had a stronger association with student marijuana use and because there were more unlicensed dispensaries located near schools. I found that dispensary bans were indeed associated with a significantly longer average distance between schools and the nearest unlicensed dispensary (H4.1), and that a greater distance was in turn associated with lower rates of lifetime and recent marijuana use among students. Including the distance between schools and the nearest dispensaries in the regression equation greatly improved the model fit and the strength of the association
between dispensary bans and student use, although it fell just short of statistical significance (b = -0.3531, p = 0.0754). This result indicated that to the extent that dispensary bans are effective, their effectiveness is partially determined by being associated with unlicensed dispensaries being located further from schools.

The distance between schools and the nearest unlicensed dispensary has a powerful association with students’ marijuana use as well as the relationship between dispensaries and student use, suggesting that the usefulness of dispensaries in keeping unlicensed outlets further away from schools. It’s important to note that a dispensary ban is not required to do this, but different approaches among cities that allow dispensaries may be required.

A sensitivity analysis using progressively smaller distances within a mile and testing for significant associations with rates of lifetime and recent marijuana use among students found that there was a statistically significant relationship between both lifetime and recent marijuana and having the nearest dispensary located within a mile. A mile is equivalent to 5,280 feet, which is more than 8 times the minimum distance the State of California requires dispensaries to be located away from schools. Interestingly, the presence of licensed dispensaries within a mile was not associated with greater likelihood of marijuana use among the study participants, but was instead significantly associated with lesser likelihood of both lifetime and recent marijuana use. The disparate effects of licensed and unlicensed dispensaries at distances within a mile of schools merits much more detailed study. How do licensed dispensaries prevent diversion to youth so much more effectively than unlicensed dispensaries, if indeed that is the cause of the opposite effect on youth use? Could licensed dispensaries shrink the illicit market on such a localized level? Recent premise surveys conducted by the LA County Department of Public Health indicate that ID checks were nearly universal among both unlicensed and licensed dispensaries (Los Angeles County Cannabis Dispensary Premise Survey, 2018/2019), so it’s unlikely that youth are buying it directly from unlicensed dispensaries themselves. Perhaps less easily observable differences occur with unlicensed dispensaries.
circumventing other regulations intended to prevent diversion to youth and the illicit market, like quantity limits on the amount customers can buy in a single transaction. Research on dispensaries business practices and compliance with state and city regulations to date is sparse but supports this possibility. For example, recent observational research among dispensaries in LA County indicates that unlicensed outlets were more likely to have violated several regulations designed to prevent youth harm, such as displaying products designed to be attractive to youth, displaying products outside of their original child resistant packaging (Los Angeles County Cannabis Dispensary Premise Survey, 2018/2019). Premise surveys in LA County also indicated that unlicensed dispensaries were more likely to be found located near sensitive areas where dispensary regulations prohibit them (Los Angeles County Cannabis Dispensary Premise Survey, 2018/2019). Thus, although there is a smaller number of unlicensed dispensaries operating in a city compared to the total number of dispensaries, unlicensed outlets may have greater impact of the likelihood of lifetime marijuana use among the city’s high school students.

In contrast, licensed storefront dispensaries have considerable incentive to comply with State and city regulations to maintain their licensure. Many have received their licenses through a lottery process where dozens of prospective business owners have applied for the handful of licenses that are ultimately granted (Long Beach Press Telegram, 2018). Others have endured long waits before obtaining licenses as cities and states process a backlog of applicants. Finally, licensed dispensaries stand to lose out on immense profits if they lose their license. For example, in an interview with Forbes Magazine, one California dispensary owner reported that on a busy day her shop could serve as many as 1,000 customers, while on a slow day they could serve closer to 500-600. Since the dispensary’s customers spent on average $50 per person, a busy sales day could bring in $50,000 (Debra Borchardt, Forbes, 2015).

Research Question 5: Dispensary Density Near Schools Mediation Analysis
With Research Question 5, I hypothesized that the number of dispensaries located within 2,000 feet of a school would be an important mediator of the effect of dispensary bans on student marijuana use (H5.3) if dispensary bans were more effective than city policies that allow dispensaries at limiting the number of unlicensed outlets near schools (H5.1). H5.1 was supported, as significantly less dispensaries were found within 2,000 feet of the study participants' schools \((b = -0.39309, p = <.0001)\). However, the number of dispensaries within 2,000 feet only had a significant positive association for lifetime marijuana use \((b = 0.1430, p = 0.0028)\), and not for recent use \((b = 0.06235, p = 0.2981)\). Adding the number of dispensaries within 2,000 feet to the regression equation did not substantially strengthen the association between dispensaries and student marijuana use and the association remained non-significant for both lifetime and recent use. However, investigating the number of dispensaries within 2,000 feet has identified that unlicensed dispensaries have significant effects on students' lifetime marijuana use behaviors at more than triple the distance the State of California requires dispensaries to be located away from schools. This finding indicates a need to rethink how dispensaries are zoned and regulated. Their number did not have an effect on a city level, but their distance did and having them near schools does impact some measures of marijuana use. Perhaps instead of siting dispensaries in mainstream business districts that are close to residential areas, they should be located in industrial zones, as in the City of Huntington Park. Current regulations limit how close they can be to each other, but perhaps a better approach may be to cluster dispensaries in the areas of a city where they are the furthest away from sensitive areas like schools. Given the economic potential of the marijuana market, this could even present a revitalizing presence for industrial zones where manufacturing presence has been declining. This could also keep different functions of the marijuana industry in close proximity, where labs and growing operations could be near storefront outlets.

Limitations of the Dissertation
There are certain limitations to this dissertation that must be acknowledged. A key limitation of this study is that it could not directly measure constructs that were not measured in the CHKS or city policy data, such as the resources and approaches different cities used to enforce dispensary regulations. Enforcement in particular may be important. It is one reason why I included analyses using the actual number of dispensaries in a city or near the schools, because so many cities had dispensaries located within their borders despite dispensary bans, which could be expected to confound results. Enforcement is a factor that should be studied much more extensively in the future using qualitative as well as quantitative approaches to determine why there was so much variation in the effectiveness of dispensary bans between cities.

Another important limitation of this study is that I was only tangentially able to account for dispensaries being located nearby a city but outside of its’ borders by using the continuous measure of distance between the school and the nearest dispensary. Many of the unlicensed dispensaries in LA County in this study were found in the unincorporated areas bordering incorporated cities that did not allow dispensaries. This could partially explain the lack of a significant effect for dispensary bans and for the number of dispensaries in city, as residents of those cities can easily cross city borders to buy marijuana from adjacent areas. Similarly, the City of Los Angeles’ is colossal size and irregular borders mean that many of the incorporated cities in LA County share a border with it, and resident of bordering cities could easily obtain marijuana from Los Angeles dispensaries. Additionally, the ubiquity of marijuana delivery services operating in Los Angeles County may confound these analyses of the spatial influence of marijuana dispensaries and would be expected to weaken spatial associations by representing a source for marijuana that may circumvent city bans on dispensaries to the extent that delivery-only dispensaries can deliver marijuana to cities that ban storefront MMDs. Furthermore, enforcement of dispensary regulations among the cities of LA County has been uneven at best, resulting in considerable variation of the effectiveness of dispensary bans by
city. Medical marijuana delivery and mail order services may also hamper the effectiveness of dispensary bans in limiting the availability of marijuana in a city.

Additional limitations are based in the data I used. The CHKS survey is a well-validated behavioral survey, but it is not a population-based random sample and was not designed to compare student substance use behavior between cities, but rather over time within districts. It does not use a complex sampling strategy and therefore there are not weights than can be used to approximate populations. The CHKS sample is therefore more of a convenience sample when used at the city level and results from these analyses can’t be construed to be representative of all the students in a city, even if due to the large sample size most of the city’s students participated in the survey. I also needed to pool two school years of data to include more of the schools in LA County because the survey is administered by schools every other year and on a staggered basis, so on any given year some schools will be between surveys. This meant that although the data collection for the dispensary locations and city policies fell in the middle of the range used, the time of data collection and the measurement of student marijuana use did not coincide as perfectly as if I had used data only from the 2016/2017 school year.

The data for dispensary locations does not come from an official source but rather a commercial listing of dispensaries. I did what I could to verify that outlets were in active operation and excluded those I could not verify, but I suspect I may have excluded some unlicensed dispensaries that were in operation but that screened phone calls. Recent studies should like the Los Angeles County Cannabis Dispensary Premise Survey (2018/2019) were able to use a more rigorous method of verification by driving out to each dispensary and reported similar numbers of licensed and unlicensed dispensaries in the County in 2019 and 2019, although they also found that the number of unlicensed outlets is declining in cities that allowed dispensaries (Los Angeles County Cannabis Dispensary Premise Survey, 2018/2019) so the 3:1 ratio of unlicensed to licensed outlets that I observed in 2016 is likely to change.
**Strengths of the Dissertation**

There are a number of strengths to this dissertation that should be highlighted. It is the first to investigate the influences of city dispensary policies, the actual number of dispensaries in a city on high school students’ marijuana use at a city level, and the proximity of dispensaries on high school students’ marijuana use. It also integrates data of different types and for different sources: administrative data like the city policy database I collected from municipal codes and school addresses and attributes from the California Schools Directory, location data from online dispensary listings, and school-based survey data from the California Healthy Kids Survey. The CHKS study provides detailed information not only about students’ substance behaviors, but also their attitudes about the risks of harm from substance use and how easy they perceived it for their peers to access substances, which allowed for investigation not only of marijuana use but attitudes that research has shown is correlated with marijuana use (Piontek et al., 2013; Wambeam et al., 2014). Including these variables resulted in important findings about not only students who already use marijuana, but variables associated with use, such as perceived risk. This information is key from a prevention perspective and it is hoped that the data presented in this dissertation can be applied to improve substance abuse prevention among high school students in LA County.

The multilevel methodology used in this dissertation is also a novel contribution to the field. To date, much of the research on adolescent substance use has been confined to individual-level variables when studying influences on substance use behaviors. These proximal influences on substance use behavior are undoubtedly powerful, but are less amenable to change using cost-effective primary prevention approaches like policies and regulations that discourage use. While there have been studies that have looked at neighborhood and community-level measures and their influence on marijuana use (e.g. Freisthler & Gruenwald, 2014), they have not focused on the individual-environment interaction that can be studied using
hierarchical generalized linear modeling. Local leaders want to know the best use for their limited resources when it comes to preventing marijuana-related harms like youth use.

Accounting for the influence of city dispensary policies on an individual level was essential to capturing the differences in dispensary regulations among the cities of LA County and determining whether these different approaches had an effect on youth use in the population at greatest risk of harm from marijuana use: adolescents.

The focus on adolescents presents an additional strength. This study represents the first comparative analysis of the effects of city dispensary policies on youth use. As demonstrated from the results of this dissertation, the influence of dispensaries is very localized and further study on a neighborhood level is needed. Hopefully the findings from this study will justify the need the need for population-based research at a more local level going forward.

Finally, by using a continuous measure of distance between schools and dispensaries this study has demonstrated that their influence extends much further than expected. I had expected to compare the associations of the distance participants’ schools and marijuana use starting with the longest distance, the distance to the nearest unlicensed dispensary within the County, then to the nearest dispensary within a mile, and then within a mile, getting progressively closer to the school before finding a significant effect. Instead, the effect of the distance to the nearest dispensary in LA County was statistically significant, as it also was at a mile and for lifetime use, within 2,000 feet.

**Implications for Public Health Research**

Some of the findings in this dissertation were rather unexpected and merit further investigation. The most important unanswered question is how LA County youth are obtaining marijuana and from who. The results presented here suggest that they are obtaining it one way or another from unlicensed dispensaries, but recent research indicating that compliance with ID checks is high even at unlicensed dispensaries suggests that youth are not obtaining it from
dispensaries directly. More study is needed about compliance with other regulations that might be associated with diversion to the illicit market and updated, local research about where or who adolescents obtain marijuana from.

That the number of MMDS located in a city was not influential on high school students’ marijuana use was truly surprising and merits further study. I also tested the raw number (not normalized by population) and normalizing the number of dispensaries by the area in square miles of the city, with similar results. That this variable was not statistically significant in the multivariate regression models is important but should not be taken as meaningless. For example, although the number of dispensaries did not seem to influence the students’ behavior unless they were located near an area they frequented, in this analysis the number of dispensaries in a community was linked to the number that were found near schools. Furthermore, the number of dispensaries the cities in LA County have so far allowed may not have reached the threshold where their number has had an effect on the marijuana use behaviors of the adolescents who live/attend school there, but as licensing for recreational outlets proceeds the number of dispensaries in many LA County cities is increasing or is planned to increase. For example, the City of Los Angeles Department of Cannabis Regulation (DCR) estimates that an additional 200 licenses for retail storefronts will be able to be given out under current regulations. When added to the 170 existing medical marijuana dispensaries currently permitted by the City there will be close to 400 licensed dispensaries operating in the City of Los Angeles. Continued research on the impact to youth and other vulnerable populations as increasing numbers of recreational marijuana use outlets are licensed in LA County cities is crucial to determine their effects compared to medical marijuana outlets. It will also be important to monitor cities’ progress in reducing the number of unlicensed dispensaries and how this may impact adolescent marijuana use and other health and safety outcomes.

**Implications for Policy and Practice**
This study was intended to inform local policy and practice in regulating marijuana to prevent youth. Although it may have raised as many questions as it has answered, it has also hopefully resulted in some useful findings about the impact of local policy implementation on adolescent marijuana use. The most important implication for policy and practice identified here is the importance of local enforcement. The example of the City of Los Angeles was first to tolerate dispensaries under state law, but the lack of enforcement from the state combined with what was a very underdeveloped regulatory structure instead resulted in the presence of dispensaries having unwanted impacts on youth and public health. In Los Angeles it took many attempts and a voter mandate from a ballot measure to develop and implement an adequate regulatory approach with Proposition D. Then it took time and the dedication of staff and financial resources in enforcement to make it successful. The decline in rates of marijuana use after Proposition D was enacted show that it is possible to take an out of control marijuana market in hand and that doing so can have a preventative impact on youth use. However, the experience of the City of Los Angeles also indicates that a complete ban on dispensaries is not necessary to curb undesirable outcomes. Instead it suggests that a robust local regulatory structure may allow for adult access to marijuana while reversing trends of marijuana use among adolescents and, by extension, health harms.

Cities that allow dispensaries are forced to balance the tax and potentially other economic gains that can come from hosting marijuana businesses with the potential costs of enforcing marijuana regulations and the potential harms that dispensaries could cause. Many cities may have not been willing to take on the challenge, which could be one reason why most of the cities in LA County have enacted bans on dispensaries. However, preventing youth use is also a frequently mentioned reason for banning dispensaries, if not always the primary reason (LA County DPH, 2019). The results of this study suggest that allowing dispensaries to operate in a city may not bring about significant harm to youth as long as dispensaries are located far enough away from schools. This information should guide the cities of LA County in choosing an
approach to dispensary regulation. If a city feels it has the resources to vigorously enforce a dispensary ordinance and the capacity to host dispensaries far from sensitive areas, it may make economic sense to allow a small number of marijuana outlets serve their adult residents. Furthermore, continuing to ban dispensaries does not obviate the need for enforcement, which means that cities with dispensary bans must spend resources on marijuana control without the benefit of marijuana taxes. Finally, an important finding from a forthcoming impact evaluation on medical and recreational marijuana outlets in LA County found that the numbers of unlicensed outlets has been decreasing in cities where dispensaries are allowed, while they have held steady in cities and unincorporated areas where they are banned (Los Angeles County Cannabis Dispensary Premise Survey, 2018/2019). Licensing a small number of dispensaries may offer cities more local control over marijuana if allowing a few marijuana outlets cuts down on the number of unlicensed outlets a city must identify and close down.

Conclusion

It is my hope that by using evidence-based policy we can create an environment where the young people of LA County will use marijuana less and later. With this research my aim was to determine the effectiveness of a common approach to dispensary regulation, dispensary bans, on preventing adolescent marijuana use. It also aimed to build on our understanding of how city policies like dispensary bans can be effective, whether it is by their association with a lower number of dispensaries in a city, with increasing perceptions of the risk of marijuana use among young people, with a greater distance between schools and dispensaries, or with a lower number of dispensaries located near schools.

Although this analysis shows that enacting and enforcing strict controls on marijuana outlets can have a preventative impact on a city’s students, dispensary bans were not found to have an independent association with lower rates of marijuana use in cross sectional analyses. Given that minors ostensibly cannot access marijuana directly from storefront dispensaries, it
may not be surprising that city ordinances that allow storefront dispensaries should have little substantive effect on adolescents’ marijuana use. I hypothesized that dispensary bans would make access to marijuana less convenient for adults on a city level, which in turn could impact availability for youth, but there are many alternate sources for marijuana available to adults other than a dispensary in their city. There was also substantial variation in enforcement among the cities in LA County that have enacted dispensary bans, where some do not seem to have the resources or political will to enforce them. In the absence of rigorous enforcement to prevent unlicensed outlets, city bans on storefront marijuana outlets are evidently more symbolic than effective.

Although the number of dispensaries in a city was not significantly associated with student marijuana use, future research should monitor adolescent marijuana use rates as the number of dispensaries in cities increases with additional adult use/non-medical outlets. There may be a threshold effect for the ratio of dispensaries per resident that a city can host without a concomitant increase in adolescent marijuana use, but this threshold is unknown to date. Furthermore, increased density of outlets can have other undesirable effects such as marijuana abuse and dependence among adults (Mair, Freisthler, Ponicki, & Gaidus, 2015). The multivariate analyses presented here also found little evidence for an effect of dispensary bans on young people’s attitudes toward the risk of marijuana use. Instead these attitudes seem to be driven by other factors that were not measured in this study. Therefore, it appears that cities may be better served worrying about their capacity to enact tight regulations on dispensaries and to enforce them than being concerned whether enacting an ordinance allowing dispensaries will send a message to young people that marijuana use is safe and acceptable and thus encourage use.

The most potent effects on student marijuana use were related to the proximity of unlicensed outlets. The negative association between dispensary bans and student marijuana use, was significantly dependent on dispensary bans being associated with a greater distance
to the nearest dispensary in the County compared to city dispensary policies that allowed
dispensaries. The continuous distance to the nearest dispensary had a powerful association
with students’ marijuana use within LA County, at one mile, and at short distances such as
2,000 feet. These local effects prove the primary importance of keeping unlicensed outlets much
farther away from schools than current regulations in any city in LA County require. Future
policy efforts should place greater importance on preventing the localized effects of unlicensed
outlets and explore different approaches, such as clustering dispensaries in industrial zones or
other areas far from the business and residential neighborhoods where schools are found.

Together these findings support a rigorous but nuanced approach to regulating
marijuana outlets. It is evident that enforcement was key in preventing marijuana use among the
youth in this study. Whether a city allowed dispensaries or not, the presence of unlicensed
dispensaries seemed to drive associations with youth marijuana use, indicating that the quality
of enforcement is more important than the kind a policy a city chooses. Future research should
focus on minimizing the localized effects of unlicensed dispensaries and undertake to better
understand why unlicensed outlets have such a disparate impact on youth marijuana compared
to licensed outlets.
## Appendix A: Medical Marijuana Dispensary Ordinances in LA County

<table>
<thead>
<tr>
<th>City</th>
<th>Ordinance #</th>
<th>Municipal Code</th>
<th>Description</th>
<th>Date Enacted</th>
<th>Link to Municipal Code Section</th>
<th>Section 1</th>
<th>Section 2</th>
<th>Section 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agoura Hills</td>
<td>N/A listed</td>
<td>9660</td>
<td>Explicit ban</td>
<td>9/10/08</td>
<td>Agoura Hills Municipal Code Section 9660</td>
<td>2</td>
<td>3</td>
<td>Y</td>
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<tr>
<td>Alhambra</td>
<td>4531A</td>
<td>23.85.010</td>
<td>Explicit ban</td>
<td>9/25/08</td>
<td>Alhambra Municipal Code Section 23.85.010</td>
<td>3</td>
<td>5</td>
<td>Y</td>
</tr>
<tr>
<td>Arcadia</td>
<td>2262</td>
<td>9.220.45.1.3</td>
<td>Explicit ban</td>
<td>9/1/69</td>
<td>Arcadia Municipal Code Section 1.9213</td>
<td>3</td>
<td>5</td>
<td>Y</td>
</tr>
<tr>
<td>Artesia</td>
<td>159</td>
<td>8.2-2.2601</td>
<td>Explicit ban</td>
<td>N/A listed</td>
<td>Artesia Municipal Code Section 8.2-2.2601</td>
<td>7</td>
<td>4</td>
<td>Y</td>
</tr>
<tr>
<td>Avalon</td>
<td>1123-13</td>
<td>5-20.01</td>
<td>Explicit ban; Specifically includes delivery services</td>
<td>8/20/2013</td>
<td>N/A Available Online</td>
<td>8</td>
<td>4</td>
<td>Y</td>
</tr>
<tr>
<td>Azusa</td>
<td>07-01</td>
<td>15-31</td>
<td>De facto ban; Businesses illegal under any state or federal law</td>
<td>1/2/07</td>
<td>Azusa Municipal Code Section 15-31</td>
<td>3</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>Baldwin Park</td>
<td>1366</td>
<td>153.120.330</td>
<td>Explicit ban</td>
<td>5/1/12</td>
<td>Baldwin Park Municipal Code Section 153.120.330</td>
<td>3</td>
<td>1</td>
<td>Y</td>
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<tr>
<td>Bell</td>
<td>1205</td>
<td>17.58.030</td>
<td>Explicit ban</td>
<td>2/1/14</td>
<td>Bell Municipal Code 17.58.030</td>
<td>7</td>
<td>1</td>
<td>Y</td>
</tr>
<tr>
<td>Bell Gardens</td>
<td>840</td>
<td>9.2.10.010</td>
<td>Explicit ban</td>
<td>3/11/11</td>
<td>Bell Gardens Municipal Code Section 9.2.10.010</td>
<td>7</td>
<td>1</td>
<td>Y</td>
</tr>
<tr>
<td>Beloower</td>
<td>1123</td>
<td>N/A</td>
<td>Explicit ban</td>
<td>N/A listed</td>
<td>Beloower Ordinance List - Ordinance 1123</td>
<td>7</td>
<td>4</td>
<td>N</td>
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<tr>
<td>Beverly Hills</td>
<td>11-0-2606</td>
<td>10-3-2761</td>
<td>De facto ban; Includes co-ops and residential zoning only; N business zones</td>
<td>4/1/11</td>
<td>Beverly Hills Municipal Code Section 10-3-2761</td>
<td>5</td>
<td>8</td>
<td>N</td>
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<tr>
<td>Bradbury</td>
<td>N/A</td>
<td>N/A</td>
<td>Residential zoning only; N business zones</td>
<td>N/A</td>
<td>Per City Clerk's office on 10/14/2014</td>
<td>3</td>
<td>5</td>
<td>N/A</td>
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<tr>
<td>Burbank</td>
<td>N/A</td>
<td>10-1-502</td>
<td>De facto ban; N/A Listed as a permitted land</td>
<td>N/A</td>
<td>Burbank Municipal Zoning Code 10-1-502</td>
<td>2</td>
<td>5</td>
<td>N</td>
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<tr>
<td>Calabasas</td>
<td>2010-265</td>
<td>17-12-125</td>
<td>Explicit ban</td>
<td>1/27/10</td>
<td>Calabasas Municipal Code Section 17-12-125</td>
<td>2</td>
<td>3</td>
<td>N</td>
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<tr>
<td>Carson</td>
<td>08-1410</td>
<td>9191.381.5</td>
<td>Explicit ban</td>
<td>7/20/08</td>
<td>Carson Municipal Code Section 9191.381.5</td>
<td>8</td>
<td>2</td>
<td>Y</td>
</tr>
<tr>
<td>Compton</td>
<td>985</td>
<td>5.100.010</td>
<td>Explicit ban</td>
<td>4/1/11</td>
<td>Compton Municipal Code Section 9.100.010</td>
<td>7</td>
<td>4</td>
<td>Y</td>
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<tr>
<td>City</td>
<td>Ordinance #</td>
<td>Municipal Code</td>
<td>Description</td>
<td>Date Enacted</td>
<td>Link to Municipal Code Section</td>
<td>spA</td>
<td>spB</td>
<td>spC</td>
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<tr>
<td>Claremont</td>
<td>2008-09</td>
<td>9.72.010</td>
<td>Exploit ban</td>
<td>9/1/08</td>
<td>Claremont Municipal Code Section 9.72.010</td>
<td>3</td>
<td>1</td>
<td>N</td>
</tr>
<tr>
<td>Commerce</td>
<td>520</td>
<td>5.61.030</td>
<td>Exploit ban</td>
<td>9/29/09</td>
<td>Commerce Municipal Code Section 5.61.030</td>
<td>7</td>
<td>1</td>
<td>N</td>
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<tr>
<td>Compton</td>
<td>2167</td>
<td>9-24.3</td>
<td>Exploit ban</td>
<td>N/A</td>
<td>Compton Municipal Code Section 9-24.3</td>
<td>6</td>
<td>2</td>
<td>Y</td>
</tr>
<tr>
<td>Covina</td>
<td>13-2025</td>
<td>17.60.025</td>
<td>Exploit ban: specifically includes delivery services</td>
<td>3/1/13</td>
<td>Covina Municipal Code Section 17.60.025</td>
<td>3</td>
<td>5</td>
<td>Y</td>
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<tr>
<td>Custody</td>
<td>N/A</td>
<td>N/A</td>
<td>De facto ban</td>
<td>N/A</td>
<td>Per City Clerk's Office 10/5/2014</td>
<td>7</td>
<td>1</td>
<td>N</td>
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<tr>
<td>Culver City</td>
<td>N/A</td>
<td>N/A</td>
<td>De facto ban</td>
<td>N/A</td>
<td>Per City Clerk's Office 10/10/2014</td>
<td>5</td>
<td>2</td>
<td>N</td>
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<tr>
<td>Diamond Bar</td>
<td>04(2014)</td>
<td>8.28</td>
<td>Exploit ban</td>
<td>2/18/14</td>
<td>Diamond Bar Municipal Code Section 8.28</td>
<td>3</td>
<td>4</td>
<td>N</td>
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<tr>
<td>Downey</td>
<td>1286</td>
<td>9428.04</td>
<td>Exploit ban</td>
<td>8/8/11</td>
<td>Downey Municipal Code Section 9428.04</td>
<td>7</td>
<td>4</td>
<td>Y</td>
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<td>Duarte</td>
<td>788 &amp; 789</td>
<td>1.04 and 5.04</td>
<td>De facto ban: Businesses illegal under any state or federal law</td>
<td>2/1/17</td>
<td>Per City Clerk's Office 10/7/2014</td>
<td>3</td>
<td>5</td>
<td>Y</td>
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<tr>
<td>El Monte</td>
<td>2657</td>
<td>5-17-010</td>
<td>Exploit ban</td>
<td>6/29/05</td>
<td>El Monte Municipal Code Section 5-17-010</td>
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<td>N</td>
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<td>El Segundo</td>
<td>N/A</td>
<td>N/A</td>
<td>De facto ban: Not listed as a permitted land</td>
<td>N/A</td>
<td>Per City Clerk's Office 5/16/2014</td>
<td>8</td>
<td>4</td>
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<tr>
<td>Gardena</td>
<td>1738</td>
<td>18.42.040C</td>
<td>Exploit ban</td>
<td>7/6/05</td>
<td>Gardena Municipal Code Section 18.42.040C</td>
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<td>N</td>
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<td>City</td>
<td>Ordinance #</td>
<td>Municipal Code</td>
<td>Description</td>
<td>Date Enacted</td>
<td>Link to Municipal Code Section</td>
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<td>Glendora</td>
<td>1903</td>
<td>5.23.030</td>
<td>Explicit ban</td>
<td>1/1/08</td>
<td>Glendora Municipal Code Section 5.23.030</td>
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<td>Hawaiian Gardens</td>
<td>823</td>
<td>5.25.030</td>
<td>Explicit ban</td>
<td>3/1/08</td>
<td>Hawaiian Gardens Municipal Code Section 5.25.030</td>
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<td>4</td>
<td>Y</td>
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<td>Hawthorne</td>
<td>N/A listed</td>
<td>17.04.010D</td>
<td>Explicit ban</td>
<td>N/A listed</td>
<td>Hawthorne Municipal Code Section 17.04.010D</td>
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<td>2</td>
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<td>Rancho Palos Verdes</td>
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<td>De facto ban; Businesses illegal under any state or federal law</td>
<td>10/9/06</td>
<td>Rancho Palos Verdes Municipal Code Section 5.10</td>
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¹ "SPA" is Service Planning Area
² "SP²" is Service Planning District
³ "Y" means existing legislation would not prevent dispensaries from operating if recreational marijuana was legalized.
APPENDIX B: CITY OF LOS ANGELES PROPOSITION D

PROPOSITION D

An ordinance replacing Article 5.1 of Chapter IV and amending Section 21.50(b) of the Los Angeles Municipal Code. The ordinance: (a) prohibits medical marijuana businesses; (b) grants a limited immunity from enforcement to medical marijuana businesses that do not violate specified restrictions; and (c) increases the existing tax on such businesses from $50 to $60 per each $1,000 of gross receipts, until such time as the California Supreme Court rules regarding what cities can and cannot regulate and the City enacts new medical marijuana legislation consistent with that judicial guidance.

WHEREAS, the Compassionate Use Act (CUA), adopted by the voters in 1996, and the Medical Marijuana Program Act (MMPA), enacted by the State Legislature in 2003, provided California’s qualified patients and their primary caregivers with limited immunity to specified criminal prosecutions under state law for purposes including to ensure that qualified patients and their primary caregivers who obtain and use marijuana for medical purposes are not subject to state criminal prosecution;

WHEREAS, commencing in 2007, according to local media reports and neighborhood sightings and complaints, more than 850 medical marijuana businesses opened, closed, and reopened across the city, and commercial growing operations continued to proliferate without legal oversight, the City and its neighborhoods have experienced an increase in crime and the negative secondary harms associated with unregulated marijuana businesses, including but not limited to, murders, robberies, the distribution of tainted marijuana, and the diversion of marijuana for non-medical and recreational uses;

WHEREAS, in August 2007, the City enacted an interim control ordinance (the ICO) to prohibit medical marijuana businesses in the City and to exempt from that prohibition, until the City’s adoption of comprehensive medical marijuana regulations, certain existing medical marijuana facilities that timely registered with the City Clerk and 50 existing medical marijuana businesses registered with the City Clerk on November 13, 2007 in accordance with all applicable rules regarding the ICO;

WHEREAS, in January 2010, the City established a regulatory framework to balance the proliferation of medical marijuana businesses, access by seriously ill patients to medical marijuana, and public safety, by adopting Medical Marijuana Ordinance 101 090 (MMMO), adding Article 5.1, Chapter IV, of the LAMC, subsequently amended by ordinances including, in 2011, Temporary Urgency Ordinance 181520 (TUD); and 33 medical marijuana businesses notified the City Clerk by February 18, 2011 of their intention to register under the MMO as amended by the TUD;

WHEREAS, the City’s efforts to foster compassionate patient access to medical marijuana, which capped the number of dispensaries through priority registration opportunities for earlier existing collectives, a drawing, and mandatory geographic dispersal, resulted in an explosion of lawsuits by medical marijuana businesses challenging the validity of the MMO and TUC. These related actions were deemed complex and are assigned to Department 306 of the Los Angeles Superior Court. AU Collectives, LLC v. City of Los Angeles, et al.; City of Los Angeles v. ALIC, LLC; Los Angeles Superior Court, Lead Case No. BC433042 (and all related actions). These lawsuits have been accompanied by the continued opening and operation of unpermitted businesses, recurrent neighborhood complaints regarding crime and negative secondary effects, and an inappropriate and overly excessive drain upon civic legal and law enforcement resources;

WHEREAS, in the March 8, 2011 Municipal Election, the voters of the City of Los Angeles passed Measure M and enacted Los Angeles Municipal Code Section 31.50, which imposed a tax of $50 for every $1,000 of revenues generated by Medical Marijuana Collectives, a measure that has been subsequently challenged in court;

WHEREAS, 157 medical marijuana businesses that registered under the ICO also notified the City Clerk by February 18, 2011 of their intention to register under the MMO as amended by the TUD; and 155 of those 157 medical marijuana businesses also registered under Measure M in either 2011 or 2012;

WHEREAS, on October 4, 2011, the Second Appellate District of the California Court of Appeal, whose decision binds the City of Los Angeles, ruled in the case of Pack v. Superior Court, 199 Cal. App. 4th 1070 (2011) (Pack), that significant provisions of the medical marijuana ordinance of the City of Long Beach, which was modeled after Articles 5.1, Chapter IV of the LAMC, are preempted by the federal Controlled Substances Act (CSA) [21 U.S.C. Section 801, et seq.], which bans marijuana for all purposes;

WHEREAS, the Pack court held, as more particularly stated in the opinion, that while cities may enact prohibitions that restrict and limit medical marijuana businesses, cities are preempted under the CSA from enacting affirmative regulations that permit or authorize medical marijuana businesses and marijuana-related activities, and further raised the specter of violation of federal law through the actions of individual city officials, 199 Cal. App. 4th 1070, 91 L.2d 27;

WHEREAS, although the Los Angeles Superior Court issued a narrow preliminary injunction against pieces of the MMO in December 2010, on October 14, 2011, in (1) denied numerous motions to enjoin the MMO, as amended; (2) denied Pack’s motion to address the impact of federal preemption on the City’s medical marijuana regulations in light of Pack until that case becomes final or until “our Supreme Court decides to weigh in on the federal preemption issue” and because federal preemption had not been raised in those cases; and (3) observed that Pack could have a profound impact on the TUC which bears more than a passing resemblance to the Long Beach medical marijuana ordinance;

WHEREAS, given the similarities between the ordinance at issue in Pack and the City’s MMO and to avoid any possible violation of federal law, the City discontinued implementing the MMO, as amended;

WHEREAS, in December 2011, California Attorney General Kamala Harris abandoned her effort to revise the medical marijuana guidelines of the Attorney General and advised the State Legislature that in the opinion of the Attorney General, new legislation is required in order to resolve questions of law regarding medical marijuana that are not answered by
WHEREAS, in January 2012, the California Supreme Court granted review of People v. Cohen, deciding to adopt a ban of medical marijuana businesses proposed for the City of Long Beach, and subsequently dismissed its review in August 2012 as abandoned and moot, thereby not addressing the substantive question of federal preemption of local regulations; and has also granted review of City of Riverside v. Inland Empire Patient’s Health & Wellness Center, 200 Cal. App. 4th 885 (4th Dist., 2011) and People v. GL Holistic 2011 Cal. App. Unpub. LEXIS 18924, both recognizing that cities may properly ban medical marijuana businesses consistent with the CUA and MMBA, with oral argument in those cases set for February 5, 2013.

WHEREAS, additional appellate rulings concerning medical marijuana were issued in February 2012, including by the Second Appellate District of the California Court of Appeal in the case of People v. Cohen, 203 Cal. App. 4th 1020 (2012), and by the Fourth Appellate District of the California Court of Appeal in the case of City of Lake Forest’s Evergreen Holistic Collective, 203 Cal. App. 4th 1413 (2012), and whereas the Evergreen Holistic case decision has been accepted for review by the California Supreme Court with further action deferred pending consideration and disposition of related issues in the Inland Empire case;

WHEREAS, an additional appellate ruling concerning medical marijuana was issued in March 2012, by the Second Appellate District of the California Court of Appeal in the case of People ex rel. Traxman v. Joseph, 204 Cal. App. 4th 1512 (2012) which held that that neither section 11852.775 nor section 11852.765 of the MMRA immunizes marijuana sales activity, “Section 11852.775 protects group activity ‘to cultivate marijuana for medical purposes’; it does not cover dispensing or selling marijuana. Section 11852.765 allows reasonable compensation for services provided to a qualified patient or person authorized to use marijuana, but such compensation may be given only to a ‘primary caregiver.’” Joseph 1520;

WHEREAS, in July 2012, the Second District Court of Appeal reversed the preliminary injunction order issued against the MCO in the case now renamed from its original filing to 420 Camphor, LLC v. City of Los Angeles, 287 Cal. App. 4th 703 (2nd Dist., 2012), which held, among other things, that (a) the provisions of the MCO were lawful that limited medical marijuana nonprofits in the City to only those approximately 180 that had timely registered with the City under the ICC, and (b) the MCO violated its own terms on June 8, 2012, and that as of that date only collective of three or fewer members are allowed to operate in the City, and whereas portions of this decision have been accepted for deferred review by the California Supreme Court;

WHEREAS, having made a confidential settlement proposal that was rejected by the dispensary litigants, the City thereafter sought in August 2012 to address the continued proliferation of unregulated and unauthorized medical marijuana businesses in the City by enacting Ordinance 18290 (Gentle Ban) to prohibit medical marijuana businesses, with limited exceptions that include dwelling units used by three or fewer qualified persons to process collectively and cooperatively cultivate medical marijuana, and hasipes and licensed clinics, care facilities and home health agencies entitled to the state law qualified immunities;

WHEREAS, the City Clerk presented a reaffirmatory petition to the City Council regarding the Gentle Ban Ordinance on September 17, 2012, and the City Charter authorizes the Council to respond to the reaffirmatory petition by repealing the Gentle Ban Ordinance within twenty days of its presentation;

WHEREAS, in connection with consideration by the City Council of the reaffirmatory petition, members and representatives of the medical marijuana community submitted comments and objections to the Gentle Ban and alternative proposed regulations to restrict medical marijuana businesses;

WHEREAS, the comments, objections and proposals include, among others, limitations upon the number of medical marijuana businesses rather than a ban; prohibitions that restrict rather than affirmative regulations that permit or authorize such businesses; prohibitions upon operating within certain distances of sensitive users; prohibitions upon hours of operation, uncompensated minors, marijuana usage from the exterior, lighting, and signage; criminal background checks; requiring transparent operations; requiring testing of marijuana for mold and contaminants; and restrictions related to security;

WHEREAS, in response to the comments, objections and proposals, the City Council adopted Ordinance 182286 on October 9, 2012 repealing the Gentle Ban Ordinance;

WHEREAS, an appellate ruling issued on October 24, 2012 by the Fourth Appellate District of the California Court of Appeal in the case of People v. Johnson, 2012 Cal. App. Lexis 1166, regarding the scope of immunities available under the MMRA regarding profits and sales by medical marijuana collective;

WHEREAS, on November 5, 2012, Department 311 of the Los Angeles Superior Court, in related actions filed by the People of the State of California and entitled People v. Calvera’s The Spot LLC, et al., Los Angeles Superior Court Case No. SC460794 (and all related cases), granted motions for preliminary injunction by the People against numerous medical marijuana dispensaries which opened in the City in violation of the City’s Zoning Code, which does not include medical marijuana as an enumerated use, and without following the required procedures to obtain a Zoning Administrator Interpretation (ZAI) under LAMC §13.22.1(A)(1) or Variance (Variance) under LAMC §13.23.07 for such a use, which orders have beenappealed; and

WHEREAS, the City wishes to address the continued proliferation of unregulated medical marijuana businesses in the City by granting a limited immunity from enforcement of its prohibition on medical marijuana businesses under Los Angeles Municipal Code Section 11.30 ([1] to those medical marijuana businesses that have abided by the City’s regulations to date and do not violate the restrictions set forth in this ordinance, until such time as the California Supreme Court rules regarding what cities can and cannot regulate and the City enacts new medical marijuana legislation consistent with that judicial guidance.
(d) Any vehicle during only that time reasonably required for its use by: (i) a qualified patient or person with an identification card to transport marijuana for his or her personal medical use, or (ii) a primary caregiver to transport, distribute, deliver, or give away marijuana to a qualified patient or person with an identification card who has designated the individual as a primary caregiver, for the personal medical use of the qualified patient or person with an identification card, in accordance with California Health and Safety Code Section 11362.765.

"Structure" means anything constructed or erected which is supported directly or indirectly on the earth, but not including any vehicle.

"Vehicle" means a device by which any person or property may be propelled, moved, or drawn upon a street, sidewalk or waterway, including but not limited to a device moved exclusively by human power.

"Youth Center" means any indoor, public, private or parochial facility, other than a private residence or a multiple dwelling unit, which contains programs which provide, on a regular basis, activities or services for persons who have not yet reached the age of 18 years, including, but not limited to, community-based programs, after-school programs, weekend programs, violence prevention programs, leadership development programs, vocational programs, substance abuse prevention programs, individual or group counseling, tutorial or other educational assistance or enrichment, music, art, dance and other recreational or cultural activities, physical fitness activities and sports programs.

B. The following words or phrases when used in this Section shall be construed as defined in California Health and Safety Code Sections 11746, 11825.3, 11962.7, and 11834.02:

"Alcoholism or drug abuse recovery or treatment facility";

"Hospital";

"Identification card";

"Person with an identification card";

"Primary caregiver"; and

"Qualified patient".

SEC. 45.198.2. PROHIBITED ACTIVITIES.

A. It is unlawful to own, cultivate, operate, use, or permit the establishment or operation of a medical marijuana business, or to participate as an employee, contractor, agent or volunteer, or in any other manner or capacity in any medical marijuana business.

B. The prohibition in Subsection A, above, includes renting, leasing, or otherwise permitting a medical marijuana business to occupy or use a location, vehicle, or other mode of transportation.

SEC. 45.198.3. LIMITED IMMUNITY.

Notwithstanding the activities prohibited by this Article, and notwithstanding that medical marijuana business is not and shall not become a permitted use in the City for so long as this Article remains in effect, a medical marijuana business shall not be subject to the remedies set forth in Los Angeles Municipal Code Sections 11.00 or 12.27.3 solely on the basis of:

(1) an activity prohibited by Section 45.198.2; and

(2) the fact that medical marijuana business is not a permitted use in the City, provided however that, as authorized by California Health and Safety Code Section 11962.83, this limited immunity is available and may be asserted as an affirmative defense only so long as subsections A through H of this Section 45.198.3 remain in effect in their entirety, only by a medical marijuana business at the one location identified in its original or any amended business tax registration certificate issued by the City, and only if that medical marijuana business does not violate any of the following medical marijuana business restrictions:

A. Every medical marijuana business is prohibited that was not operating in the City as a medical marijuana business by September 14, 2007, as evidenced by a business tax registration or tax exemption certificate issued by the City on or before November 13, 2007;

B. Every medical marijuana business is prohibited that did not register with the City Clerk by November 13, 2007 in accordance with all requirements of the City's Interim Control Ordinance 179627;

C. Every medical marijuana business is prohibited that did not notify the City Clerk by February 18, 2011 of its intention to register under the City's Medical Marijuana Ordinance 181009, as amended by the Temporary Urgency Ordinance 181030;

D. Every medical marijuana business is prohibited that ceased or ceased operation of the location set forth in its original or any amended business tax registration or tax exemption certificate issued by the City, as evidenced by:

(i) an enforcement determination, written settlement agreement, or court order, that has not been repealed, rescinded, or overturned by a government agency or court of competent jurisdiction, or

(ii) the absence of either a lease or deed and utility bills for the location, in the name of the medical marijuana business or in the name of any person or entity for the benefit of the medical marijuana business. Upon request from the City, a medical marijuana business that seeks immunity pursuant to this Article shall direct its landlord and utility providers to provide its lease and utility bills to the City Clerk. For purposes of provision (ii) of this subsection, a medical marijuana business shall not be deemed to have ceased operation during the time reasonably necessary to move to a new location pursuant to this Article, or if it temporarily ceased and resumed operation in response to an enforcement letter issued by a federal governmental entity or the City prior to the effective date of Temporary Urgency Ordinance 181030;

E. Every medical marijuana business is prohibited that failed or fails to:

(i) obtain a City business tax registration for taxation as a medical marijuana collective in 2011 or 2012, and

(ii) renew that business tax registration within 60 days of the effective date of this Article and before each annual renewal deadline thereafter;

F. Every medical marijuana business is prohibited that has an unpaid tax obligation to the City that is not paid in full, including any assessed fees, penalties, interest or other costs (collectively "unpaid tax obligations"), prior to the commencement of the following tax year. A taxpayer shall not be in breach of this subsection for tax years 2011 and 2012 if it pays the City by January 1, 2014 all unpaid tax obligations incurred for tax years 2011 and 2012. Further, a taxpayer shall not be in breach of this subsection if it enters into and fully performs the terms of an offer and compromise or other settlement agreement with the City that satisfies any unpaid obligations. This subsection shall not deprive any medical
NOW, THEREFORE,

THE PEOPLE OF THE CITY OF LOS ANGELES

DO ORDAIN AS FOLLOWS:

Section 1. Article 5.1 of Chapter IV of the Los Angeles Municipal Code is replaced in its entirety to read as follows:

ARTICLE 5.1
MEDICAL MARIJUANA

SEC. 45.19.6. PURPOSES AND INTENT.

The purpose of this Article is to enact a materially new ordinance that (a) prohibits medical marijuana businesses, but (b) grants a limited immunity from the enforcement of its prohibition to those medical marijuana businesses that do not violate the restrictions set forth in this ordinance, until such time as the California Supreme Court rules regarding what cities can and cannot regulate and the City enacts new medical marijuana legislation consistent with that judicial guidance.

It is also the purpose of this Article to stem the negative impacts and secondary effects associated with the ongoing medical marijuana businesses in the City, including but not limited to the extraordinary and unsustainable demands that have been placed upon scarce City policing, legal, policy, and administrative resources; neighborhood disruption; increased transient visitors; and intimidation; the exposure of schoolchildren and other sensitive residents to medical marijuana; drug sales to both minors and adults; fraud in issuing, obtaining or using medical marijuana recommendations; and murders, robberies, burglaries, assaults, drug trafficking and other violent crimes.

This Article is not intended to conflict with federal or state law, nor is this Article intended to answer or relate litigation over the unresolved legal questions posed by the California Attorney General or by case law regarding the scope and application of state law. It is the intention of the City Council that this Article be interpreted to be compatible with federal and state enactments and in furtherance of the public purposes that those enactments encompass.

SEC. 45.19.6.1. DEFINITIONS.

A. The following words or phrases, when used in this Article, shall be construed as defined below. Words and phrases not defined here shall be construed as defined in Section 11.01, 12.03 and 45.19.5 of this Code.

"Building" means any structure having a roof supported by columns or walls, for the housing, shelter or enclosure of persons, animals, chattels, or property of any kind.

"Location" means any parcel of land, whether vacant or occupied by a building, group of buildings, or accessory buildings, and includes the buildings, structures, yards, open spaces, lot width, and lot area.

"Manager" means any person to whom a medical marijuana business has delegated discretionary powers to organize, direct, carry on or control its operations. Authority to control one or more of the following functions shall be prima facie evidence that such a person is a manager of the business: (a) to hire, fire, or separate employees or staff including volunteers; (b) to acquire facilities, furniture, equipment or supplies other than the occasional replacement of stock; (c) to disburse funds of the business other than for the receipt of regularly-replaced items of stock; or (d) to make, or participate in making, policy decisions relative to operations of the business.

"Marijuana" shall be construed as defined in California Health and Safety Code Section 11352, and further shall specifically include any product that contains marijuana or a derivative of marijuana.

"Medical marijuana business" means either of the following:

(1) Any location where marijuana is cultivated, processed, distributed, delivered, or given away to a qualified patient, a person with an identification card, or a primary caregiver.

(2) Any vehicle or other mode of transportation, stationary or mobile, which is used to transport, distribute, deliver, or give away marijuana to a qualified patient, a person with an identification card, or a primary caregiver.

Notwithstanding Subparagraphs 1 and 2 above, "medical marijuana business" shall not include any of the following:

(a) Any dwelling unit where a maximum of three (3) or fewer qualified patients, persons with an identification card, and/or primary caregivers or an associate to collectively or cooperatively cultivate marijuana on-site, with respect to qualified patients and persons with an identification card for their own personal medical use, and with respect to the primary caregivers for the personal medical use of the qualified patients or persons with an identification card who have designated the individual as a primary caregiver, in accordance with California and Health and Safety Code Sections 11362.5 and 11362.7 et seq.;

(b) Any location during only that time reasonably required for a primary caregiver to distribute, deliver, or give away marijuana to a qualified patient or person with an identification card who has designated the individual as a primary caregiver, for the personal medical use of the qualified patient or person with an identification card, in accordance with California and Health and Safety Code Section 11362.3 and 11362.7 et seq.;

(c) The location of any clinic licensed pursuant to Chapter 1 (commencing with Section 1200), a health care facility licensed pursuant to Chapter 2 (commencing with Section 1250), a residential care facility for persons with chronic life-threatening illness licensed pursuant to Chapter 3.01 (commencing with Section 16580), a residential care facility for the elderly licensed pursuant to Chapter 3.2 (commencing with Section 15699), a hospice, or a home health agency licensed pursuant to Chapter 8 (commencing with Section 1750), all of Division 2 of the California Health and Safet Code where: (i) a qualified patient or person with an identification card receives medical care or supportive services, or both, from the clinic, facility, hospice, or home health agency, and (ii) the owner or operator, or one or not more than three employees designated by the owner or operator of the clinic, facility, hospice, or home health agency has been designated as a primary caregiver pursuant to California Health and Safety Code Section 11362.7(d) by that qualified patient or person with an identification card; or
marijuana business of rights, if any, to appeal or seek judicial determination of the propriety of any amounts alleged by the City as unpaid tax obligations, and a medical marijuana business shall not lose its claim of limited immunity due to the pendency of any such appeal or judicial determination;

G. Every medical marijuana business is prohibited that remains open and/or operating between the hours of 9 PM and 19 AM;

H. Every medical marijuana business is prohibited where marijuana and/or alcohol are consumed at the premises or in any area of the location used for parking any vehicle;

I. Every medical marijuana business is prohibited that allows a minor unaccompanied by a parent or legal guardian to enter its premises;

J. Every medical marijuana business is prohibited where marijuana is visible from the exterior of the premises;

K. Every medical marijuana business is prohibited that illuminates any portion of its premises during closure hours by lighting that is visible from the exterior of the premises, except such lighting as is reasonably utilized for the security of the premises;

L. Every medical marijuana business is prohibited that provides ingress or egress to its premises on any side of the location that (i) abuts, (ii) is across a street, alley or walkway, as measured at 90 degrees from the lot lines of the location, or (iii) has a common corner with any land zoned residential, except that an end door required by this Code may be maintained for emergency access only and must be locked from the exterior at all times.

The above notwithstanding, this subsection shall not prohibit a medical marijuana business from locating across a street from, or having a common corner with, any land zoned residential if the medical marijuana business is separated from that residential zone by a public thoroughfare with a minimum roadway width of 80 feet. This subsection shall not apply to defeat the limited immunity claim of a medical marijuana business that is otherwise entitled to assert the limited immunity provided by this Article if it moves within one hundred eighty (180) days after the effective date of this Article to a location that does not violate this subsection;

M. Every medical marijuana business is prohibited that fails to identify by name and residence address of each of its Managers to the City Clerk by October 31 of each year and whose Managers fail to successfully pass and publicly display at the location of the medical marijuana business the results of an annual LADP LiveScan background check to be completed by January 31 of each year. A failed LADP LiveScan is a LiveScan that includes any felony conviction within the past ten years and/or current parole or probation for the sale or distribution of a controlled substance;

N. Every medical marijuana business is prohibited that has one or more Managers who are also Managers at the same time of another medical marijuana business in the City; and

O. Every medical marijuana business is prohibited that is located within a 1,000-foot radius of a school, library,户型 or other facilities identified in California Health and Safety Code Section 11361.7(a)(1). It is the City’s intent to restrict these facilities from locating near medical marijuana businesses to prevent negative effects on the community and to ensure public health and safety.

The limited immunity provided by this Section shall not be available to and shall not be asserted as an affirmative defense to any violation of law except as expressly set forth in this Article. Further, nothing contained in this limited immunity is intended to provide or shall be asserted as a defense to a claim for violation of law brought by any county, state, or federal governmental authority. Finally, the limited immunity provided by this Section shall be available and may be asserted only so long as each and every provision and clause of subsections A through D and G through O of this Section 45.18.6.3 remain valid, effective and in operation.

SEC. 45.18.6.4. CONFIDENTIALITY OF TAX INFORMATION.

The City shall not disclose information and documents to the federal government, its officers, or agents regarding the gross receipts declared and taxes paid to the City by a medical marijuana business that is entitled to claim immunity pursuant to this Article about a grand jury subpoena, civil or administrative subpoena, warrant, discovery request, summons, court order or similar process authorized under law which seeks the involuntary disclosure of such information and documents. If the City receives a civil or administrative subpoena, warrant, discovery request, summons, court order or similar process authorized under law seeking its involuntary disclosure of such information and documents to the federal government, its officers, or agents, the City shall provide a copy of the civil or administrative subpoena, discovery request, or court order to the medical marijuana business whose information and documents are sought. The medical marijuana business shall have ten (10) days from the date of such notice and receipt of copy within which to obtain and serve on the City a protective order from a court of competent jurisdiction. This provision shall take precedence over any other provisions in the Los Angeles Municipal Code or the Los Angeles Administrative Code governing the disclosure of information.
SEC. 45.19.6.5. NO AUTHORITY TO PERMIT USE IN ANY ZONE.

The use of any building, structure, location, premises or land for a medical marijuana business is not currently enumerated in the Los Angeles Municipal Code as a permitted use in any zone, nor is the use set forth on the Official Use List of the City as determined and maintained by the Zoning Administrator. So long as this Article remains in effect, the Zoning Administrator shall not have the authority to determine that the use of any building, structure, location, premises or land as a medical marijuana business may be permitted in any zone; to add medical marijuana business to the Official Use List of the City; or to grant any variance authorizing any medical marijuana business.

SEC. 45.19.6.6. NO VESTED OR NONCONFORMING RIGHTS.

This Article prohibits medical marijuana businesses. Neither this Article, nor any other provision of this Code or action, failure to act, statement, representation, certificate, approval, or permit issued by the City or its departments, or their respective representatives, agents, employees, attorneys or assignees, shall vest, confer, or convey any vested or nonconforming right or benefit regarding any medical marijuana business. Any immunity or benefit conferred by this ordinance shall expire permanently and in full on the effective date of the City Council’s enactment of new medical marijuana legislation after the issuance of guidance by the California Supreme Court, or otherwise upon repeal of this ordinance.

SEC. 45.19.6.7. DUE PROCESS AND ENFORCEMENT.

All existing medical marijuana businesses must immediately cease operation; except that any medical marijuana business that does not violate any of the medical marijuana business restrictions described in Section 45.19.6.5. Limited immunity, may continue to operate but only so long as subsections A through G and H through O of Section 45.19.6.3 remain valid, effective and operative.

As has always been the law in the City, any enforcement action by the City for failure to comply with this Article shall be accompanied by due process. Every violation of this Article and each day that a violation of this Article occurs shall constitute a separate violation and shall be subject to all criminal and civil remedies and enforcement measures authorized by Sections 11.00 and 12.27.1 of this Code. In any enforcement proceeding pursuant to Section 12.27.1, the notice required by Subsection C.1 of Section 12.27.1 shall be provided to the owner and occupant of the medical marijuana business and shall not also be provided to other property owners within a 500-foot radius.

In the event a court of competent jurisdiction preliminarily or permanently enjoins, or holds to be unconstitutional or otherwise invalid by any court of competent jurisdiction, this Article shall not affect the validity of the remaining provisions of this ordinance and, to this end, the provisions of Section 2 of this ordinance are declared to be severable from the remaining provisions of this ordinance.

SEC. 45.19.6.8. LIMITED SEVERABILITY.

If any provision or clause of Section 45.19.6.3 of this Article is held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, such invalidity shall not affect any other provision, clause or application of Section 45.19.6.3 of this Article, and to this end the provisions and clauses of Section 45.19.6.3 of this Article are declared to be severable. The preceding sentence notwithstanding, if subsection E or F of Section 45.19.6.3 is held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, subsections E and F of Section 45.19.6.3 of this Article shall be severable from the remaining subsections of Section 45.19.6.3 of this Article.

Except for the inseparability of the provisions, clauses and applications of Section 45.19.6.3 on the terms set forth hereinabove, if any other provision or clause of this Article is held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, such invalidity shall not affect those provisions, clauses or applications of this Article which can be implemented without the invalid provision, clause or application, and to this end the provisions and clauses of this Article other than Section 45.19.6.3 are declared to be severable.

SEC. 45.19.6.9. EFFECTIVE DATE.

This Article shall be effective upon its passage.

Section 2. Taxation of Medical Marijuana Collectives.

A. Section 2.150(b) of the Los Angeles Municipal Code is amended to change the tax rate from $50 to $60, to read as follows:

(b) Every person engaged in operating or otherwise conducting a medical marijuana collective not otherwise specifically taxed by other business tax provisions of this Chapter, shall pay a business tax of $60.00 for each $1,000.00 of gross receipts or fractional part thereof.

B. Effective Date: This amendment to Section 2.150(b) of the Los Angeles Municipal Code to change the tax rate from $50 to $60 shall be effective upon the beginning of the first tax year following passage of this ordinance.

C. Severability: If this Section 2 of this ordinance is found to be unconstitutional or otherwise invalid by any court of competent jurisdiction, this invalidity shall not affect the validity of the remaining provisions of this ordinance and, to this end, the provisions of Section 2 of this ordinance are declared to be severable from the remaining provisions of this ordinance.

Section 3. Competing Measures. In the event that this measure and another measure or measures relating to the regulation of medical marijuana in the City of Los Angeles appear on the same ballot, the provisions of the other measure or measures shall be deemed to be in conflict with this measure. In the event that this measure shall receive a greater number of affirmative votes than the other measure or measures, the provisions of this measure shall prevail in their entirety over all provisions of the competing measure or measures, and the competing measure or measures shall be null and void.

Section 4. Amendment and Repeal. An ordinance submitted to the voters by the Los Angeles City Council, the provisions of this ordinance, other than the taxation provisions contained in Section 2, shall be subject to amendment or repeal as provided in Section 464(b) of the Los Angeles City Charter. The City shall amend or repeal this ordinance pursuant to Charter Section 464(b) as may be appropriate in order to implement judicial rulings or guidance from the California Supreme Court regarding what medical marijuana activities and conduct California cities can and cannot regulate.
Appendix C: 2016-17 CHKS Weighting Documentation

Weighting Procedures for 2016-17 LAUSD CHKS Data

During the 2016-17 school year, students participating in the secondary California Healthy Kids Survey (CHKS) at schools in Los Angeles Unified School District (LAUSD) provided data for four survey samples: CHKS, TUPE, Biennial Statewide CHKS, and BHC.

The CHKS sample is a random sample of schools and classrooms that is representative of students in LAUSD. The sample was drawn at both the school and classroom levels. First, 42 schools were randomly selected from 145 eligible schools in the district. Next, two classrooms per grade were randomly drawn from grades 7, 9, and 11 at each school in the school sample.

The same classroom sampling strategy was used for schools in LAUSD that participated in the CHKS survey but were not randomly sampled, except continuation schools and directly funded charter schools.²³⁴

Weights were calculated and included in the raw data file. The following procedures were used to compute weights.

A. Classroom Sampling Weight

Classroom Sampling Weight (CSW) was calculated by dividing the total number of students enrolled in each participating school by the total number of usable surveys in each school, by grade. Usable surveys are from grades 7, 9, and 11, and do not include those that are rejected due to mischievous responses. Grade level is defined based on student self-reported grade and grade-specific school enrollments. When a student selects a grade but grade-specific enrollment is 0, the computed grade is coded as missing.

Within grade:

\[
CSW = \frac{\text{# total students enrolled in each participating school}}{\text{# usable surveys in each participating school}}
\]

²The TUPE sample is comprised of LAUSD schools that participated in the CHKS survey because they had a TUPE grant. These schools may or may not have been included in the CHKS sample.
³The Biennial Statewide sample is comprised of LAUSD schools that were sampled as part of the statewide random sample.
⁴The BHC sample is comprised of schools participating in the Building Healthy Communities Initiative.

Weighting Procedures for 2016-17 LAUSD CHKS Data

Updated: 08/08/17
For continuation schools and directly funded charter schools in LAUSD that did not sample at classroom level, a value of “1” was assigned to the Classroom Sampling Weight for corresponding responses.

B. School Sampling Weight

School Sampling Weight (SSW) was computed by dividing the total number of students enrolled in all eligible schools by the weighted total number of usable surveys in all participating schools, for each applicable grade within district.

\[
SSW = \frac{\text{# total students enrolled in all eligible schools}}{\text{weighted total number of usable surveys in all participating schools}}
\]

or:

\[
SSW = \frac{\text{# total students enrolled in all eligible schools}}{CSW \times \text{total number of usable surveys in all participating schools}}
\]

Weights in Processed Data and Recommendations

In the raw data file, Classroom Sampling Weight was computed for each participating LAUSD school, regardless of what sample the school was in. The Classroom Sampling Weight is coded as missing for all non-LAUSD schools.

School Sampling Weight was calculated ONLY for the CHKS sample in LAUSD. The School Sampling Weight is coded as missing for LAUSD schools that did not sample at the school level (non-CHKS samples). Non-LAUSD schools receive a School Sampling Weight of “1” in the raw data file.

We recommend using Classroom Sampling Weight (A) for district-level and BHC-Place reports. School Sampling Weight (B) should be used for county-, regional-, and state-level reports (or any other level higher than district).
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California one of few states that allow cannabis delivery, but it’s not as simple as ordering pizza.


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