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# The availability of medical marijuana dispensary and adolescent marijuana use

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ABSTRACT

*Purpose.* To examine the association between medical marijuana dispensary (MMD) availability and adolescent marijuana use.

*Methods.* The study sample was comprised of 8th, 10th, and 12th graders (N = 14,953) from 141 schools in the 2014 Monitoring the Future study, who resided in the 18 states that had legalized medical marijuana as of January 1, 2014. Multilevel logistic regressions with random effects were conducted to quantify the cross-sectional associations of the availability of MMD within 5- and 25-mile buffers from the centroid of school zip codes with self-reported recent use (past-year) and current use (past-month) of marijuana, controlling for individual characteristics and school, zip code, and state contextual factors.

*Results.* In the combined sample, the availability of MMD was not associated with recent or current use of marijuana. Subsample analyses suggested that the availability within a 5-mile buffer was associated with a higher likelihood of recent use in 8th graders (OR = 1.93, 95% CI = 1.11–3.33) and the availability within a 5- to 25-mile buffer was associated with a higher likelihood of recent use in 10th graders (OR = 1.33, 95% CI = 1.00–1.77). The availability of MMD was not associated with recent use in 12th graders or current use in any grades.

*Conclusions.* The availability of MMD was not associated with current use of marijuana among adolescents. There was some evidence suggesting that the availability of MMD within short to medium traveling distance may be associated with a higher level of recent use in middle schoolers who are also at a high risk of experimenting with marijuana.



## 1. Introduction

The prevalence of marijuana use among adolescents is high in the U.S. In 2013, an estimated 7.1% or 1.7 million adolescents aged 12 to 17 used marijuana in the past month (SAMHSA, 2014). Adolescents' marijuana use, particularly regular use, is associated with a wide range of adverse health effects (Hall and Degenhardt, 2009; Meier et al., 2012; O'Shea et al., 2006) and socioeconomic outcomes (Chatterji, 2006; Green et al., 2010; Yamada et al., 1996). Since 1996, 25 states and Washington D.C. have legalized marijuana for medical use. There have been concerns that the dramatic changes in policy, physical, economic, and social environments pertinent to the legalization may generate unintended consequences such as an increase in the prevalence of marijuana use. Empirical evidence is much needed to enhance our understanding about the relationship between contextual factors and marijuana use especially in adolescents.

The protection of medical marijuana dispensary is the most common provision of medical marijuana laws. Almost all states with medical marijuana legalization have operating dispensaries (Pacula et al., 2015; Wen et al., 2015). Although people under age 18 are typically not allowed to purchase marijuana in these dispensaries, dispensary could have spillover effects on them. The availability of dispensaries may increase adolescents' access to marijuana and increase their marijuana use (Friese and Grube, 2013; Joffe et al., 2004). The presence of dispensary in the neighborhood may reflect and/or promote an overall normative environment that tolerates marijuana use, which will in turn influence the perceptions and behaviors of adolescents (Friese and Grube, 2013; Pacula et al., 2015). A strong relationship between retail outlets and prevalence and/or frequency of use in adolescents has been well documented in the literature on tobacco and alcohol (Campbell et al., 2009; Henriksen et al., 2008; McCarthy et al., 2009; West et al., 2010), two drugs that are arguably comparable to marijuana because of the similarities in addictiveness, use prevalence, health consequences, and regulation strategies (Pacula et al., 2014).

Despite the potential impacts of medical marijuana dispensaries on adolescents' marijuana use, very few studies provided empirical evidence. Focusing on state-wide policies, two studies suggested that a higher level of marijuana use for those under age 21 was associated with the state-protection of dispensaries (Pacula et al., 2015; Wen

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et al., 2015). The binary indicator at state level, however, provided little information about dispensary availability at local level. The total number of operating dispensaries in a state could be as few as two or three or as many as several thousands. A closer examination is needed to understand the differential availability of dispensaries in neighborhood and associated level of marijuana use. The existing evidence was based on data in California, a state that has the longest history of legalization and the largest density of dispensaries. For example, the studies by Freisthler and Mair et al. suggested that the availability and density of dispensaries in California was associated with a higher prevalence of marijuana use and abuse among adults (Freisthler and Gruenewald, 2014; Mair et al., 2015). Such findings, however, may not represent states that have much lower density of dispensaries or represent adolescents who have limited access to the dispensaries.

This exploratory study aimed to examine whether the availability of medical marijuana dispensary in school neighborhood is associated with a higher level of marijuana use in adolescents. This study provides first empirical evidence on adolescent population, and it is the first study representing all the states that had legalized medical marijuana as of 2014. By considering a rich set of physical, demographic, socioeconomic, and policy factors at neighborhood level, this study allowed a better understanding about the potential impacts of contextual environments on marijuana use and informed policymakers regarding the regulatory measures on medical marijuana dispensaries.

## 2. Methods

### 2.1. Data source and study sample

The Monitoring the Future study is a repeated cross-sectional survey of nationally representative adolescents in 8th, 10th, and 12th grades in the 48 U.S. contiguous states. It is conducted annually to collect information on adolescents' substance abuse behaviors and related problems. The survey utilizes a multistage random stratified sampling design (the first stage selects geographic areas based on population density, the second stage selects schools within geographic areas, and the third stage selects classes within schools). The school's probability of being selected is proportionate to its size, and up to 350 students may be included in each school. The survey is self-administered in classroom setting or administered in larger groups. The detailed information about the survey design can be found elsewhere (Miech et al., 2015).

The most recent 2014 Monitoring the Future was used in this study. Our study sample was restricted to students in the 18 states that had legalized medical marijuana as of January 1st, 2014.[1] Out of 41,551 adolescents in the 2014 study, 16,458 (39.61%) met the inclusion criteria on state of residence. We further excluded those who had incomplete information on marijuana use behaviors and sociodemographic characteristics. A total of 14,953 adolescents entered the final analysis, representing the 8th, 10th, and 12th graders in public and private schools in states with medical marijuana legalization.

### 2.2. Measures

#### 2.2.1. Marijuana use

The individual-level self-reported outcome variables included two dichotomized indicators assessing whether an adolescent was a recent user and a current user of marijuana, respectively. In this study, the recent use of marijuana was defined as using marijuana or hashish in the past 12 months, and the current use of marijuana was defined as using marijuana or hashish in the past 30 days.

[1] Including Arizona, California, Colorado, Connecticut, Delaware, District of Columbia, Illinois, Maine, Massachusetts, Michigan, Montana, Nevada, New Jersey, New Mexico, Oregon, Rhode Island, Vermont, and Washington. Alaska and Hawaii legalized medical marijuana by 2014 but were not sampled in Monitoring the Future study.

#### 2.2.2. Availability of medical marijuana dispensary

The key independent measures were two binary indicators representing the availability of medical marijuana dispensary within 5-mile and 25-mile buffers from the centroid of school zip code. We obtained exact physical addresses of all medical marijuana dispensaries with storefronts in the 18 states from a previously used, cross-validated crowdsourced website (weedmaps.com), which provides voluntarily submitted information on dispensaries from marijuana users and dispensary owners (Freisthler and Gruenewald, 2014; Freisthler et al., 2015; Lipperman-Kreda et al., 2014a; Mair et al., 2015; Thomas et al., 2015). Previous literature has suggested that the directories and locations of dispensaries on crowdsourced websites were more up-to-date relative to state or city official lists (Freisthler and Gruenewald, 2014). The dispensary data were collected in October–December, 2014. All point locations of the dispensaries were successfully geocoded using ArcGIS (ArcMap, version 10.2; ESRI Inc., Redlands, CA, USA).

We created 5-mile and 25-mile Euclidean (straight-line) buffers from the centroid of school zip code. Euclidean distance and network distance are strongly correlated, and Euclidean distance is a reasonably good proxy for network distance when the latter one, although a preferred measure of geographical access, is often not available (Boscoe et al., 2012). The buffers were chosen based on the tertile cutoff points of the distance between the centroid of school zip code and its nearest medical marijuana dispensary in our study. The 5-mile buffer is a short traveling distance of approximately 7–12 min of driving and 25-mile buffer is a medium traveling distance of approximately 38–60 min of driving at 25–40 miles/h. The centroid of school zip code was used to approximate the actual location of a school, as Monitoring the Future study does not release exact school addresses in order to protect data confidentiality. Literature has suggested that the Euclidean distance calculated from point address was not significantly different from the distance calculated from the corresponding zip code centroid (Jones et al., 2010). The zip code centroid has been frequently used as an alternative to finer measure of locations when the latter was not available (Burgoine et al., 2013; McElroy et al., 2003; Rahman et al., 2013). We performed a spatial join to assess whether any medical marijuana dispensary was located within the buffers from each school zip code centroid. Three dichotomized indicators were generated to represent the availability of dispensary within a short traveling distance (<5 miles), within a medium traveling distance (5–25 miles), and within a long traveling distance (>25 miles), respectively.

#### 2.2.3. Contextual factors

We included contextual variables that were suggested as correlates of marijuana use (Hasin et al., 2015; Mair et al., 2015). School-level contextual variables included number of students per grade, school type, and urbanicity (Hasin et al., 2015). Zip-code-level variables were derived from U.S. Census and American Community Survey, including proportion of population under age 21, whether the population were predominantly racial and ethnic minority (over 60% of the residents in the zip code were not non-Hispanic White) (Moore and Diez Roux, 2006), and proportion of population age 25+ without a high school diploma. We also utilized crime index developed by ESRI based on FBI Uniform Crime Report database. The index was a standardized number of crime cases in each zip code (ESRI, 2014). The continuous crime index was converted into three tertiles to represent low, medium, and high crime rates. State-level variables included two policy variables pertinent to medical marijuana legalization. As home cultivation could be an alternative source of marijuana and home cultivation culture may influence adolescents' attitudes and behaviors, (Pacula et al., 2015) we included an indicator of whether the state allowing for home cultivation of marijuana in 2014. Another dichotomized variable was created to indicate the duration of state medical marijuana legalization as of 2014 (0–5 years versus 5+ years).