Short communication

Location, location, location: Assessing the spatial patterning between marijuana licenses, alcohol outlets and neighborhood characteristics within Washington state

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ARTICLE INFO

ABSTRACT

Background: The availability of marijuana products is becoming increasingly prevalent across the United States (US), many states are allowing for the production, processing, and retailing of these products for medical and/or recreational use. The purpose of this study is to: (1) examine the spatial patterning of marijuana licenses, and (2) examine the impact of alcohol outlets in addition to other neighborhood characteristics on marijuana licenses within the state of Washington.
Methods: This cross-sectional observational study examined 1458 census tracts in Washington state from 2017, using marijuana and alcohol data from the Washington State Liquor and Cannabis Board as well as neighborhood characteristics data from the American Community Survey 2011–2015 5-year estimates. We used exploratory and formal spatial regression methods, including integrated nested Laplace approximation within a Bayesian statistical framework, to address the study aims.
Results: Our results indicate there is significant spatial patterning of marijuana producers and processors across the state. We also found that all marijuana licenses are located in poorer census tracts, and marijuana retailers are co-located in census tracts with off-premises alcohol outlets.
Conclusions: Our study provides empirical evidence of the relationship between marijuana licenses, alcohol outlets, and neighborhood characteristics, and has important implications for policymakers in other states currently considering legalizing marijuana-products for medical and/or recreational use.

1. Introduction

Marijuana use is the most commonly used illicit drug, where, in 2015, 22.2 million people reported using this drug in the past month (Center for Behavioral Health Statistics and Quality, 2016). The availability of marijuana products is becoming increasingly prevalent across the United States, where many states are allowing for the production, processing, and retailing of these products for medical and/or recreational use. States like Washington (WA) have recently enacted legislation related to marijuana reform, and Initiative 502 (I-502) legalized small amounts (i.e., purchase up to one ounce) of marijuana products for adults aged 21 years and older within the state for recreational use. Although Washington, along with a growing list of other states (i.e., Alaska, California, Colorado, Massachusetts, Nevada, Oregon) and Washington, D.C. have legalized marijuana for recreational use, cannabis remains classified as a schedule I controlled substance under federal law. Since I-502 was passed in 2012, little work has been done

to examine the location of establishments licensed to produce, process, and retail marijuana. WA also went through measures of alcohol reform, where, in 2011, Initiative 1183 (I-1183) was passed, and allowed for the privatization of liquor sales and distribution. The impact of I-1183 has been shown to significantly increase the availability of alcohol between 2010 and 2013, with increased availability having an association with violence within the city of Seattle (Tabb et al., 2016). WA provides a unique setting in that significant marijuana and alcohol policies were implemented simultaneously in the past few years, which increased access to both marijuana and alcohol. The negative public health implications vary with respect to increased access to marijuana (Hall, 2015; Hartman and Huestis, 2013) and alcohol (Grubesic et al., 2013); therefore, it's necessary to look at this state and the implications of these policies to help improve future marijuana-related policies in other states.

Few studies have focused on the relationship between neighborhood characteristics and the location of marijuana licenses. An ecological,

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cross-sectional analysis of census tracts in Los Angeles explored the relationship between neighborhood sociodemographics, structural features of neighborhoods, and density of medical marijuana dispensaries (Thomas and Freisthler, 2016), and found a significant relationship such that dispensaries were located in primarily commercially zoned areas (i.e., shopping malls, service stations, restaurants) with greater road access, as well as greater alcohol outlets and a higher percentage of Hispanic residents. Another California-based study found that marijuana dispensaries were primarily located in neighborhoods with more poverty and co-located next to alcohol outlets (Morrison et al., 2014). However, a separate California found there was no cross-sectional association between the density of medical marijuana dispensaries and either violent or property crime in Sacramento neighborhoods (Kepple and Freisthler, 2012). While there are some inconsistencies in the literature involving the relationship between marijuana dispensaries and neighborhood characteristics, some studies are worth highlighting that underscore the importance of this relationship. A recent analysis of marijuana dispensaries in Colorado found that these dispensaries were more likely to be in neighborhoods with higher crime rates, minorities, poverty, and alcohol outlets (Shi et al., 2016). Another recent case study of Denver, Colorado has shown that four popular regulatory models tend to concentrate suitable land for marijuana dispensaries in severely socioeconomically disadvantaged census tracts and areas with high proportions of minorities (Németh and Ross, 2014). And, while this case study does not imply that marijuana dispensaries will necessarily locate in these specific areas, it is worth noting that marijuana-related policies should consider the implications of distributing licenses in these neighborhoods. These findings are echoed in similar studies when focusing on alcohol outlets, in that substantial evidence exists that show inequitable distributions of alcohol outlets in African American neighborhoods (LaVeist and Wallace, 2000) as well as in low-income neighborhoods (Romley et al., 2007).

The location of marijuana dispensaries and alcohol outlets pose a public health challenge for high-risk neighborhoods. Disadvantaged neighborhoods have been shown to be associated with an elevated risk for young adult marijuana use (Furr-Holden et al., 2011); therefore, if marijuana dispensaries are more likely to be located in neighborhoods with more poverty, this could increase access to marijuana products and subsequently increase usage of those residents in these high-risk neighborhoods. In addition, while increasing access to alcohol has been associated with various public health issues ranging from violence (Grubesic et al., 2013) to alcohol-related hospital admissions (Tatlow et al., 2000), initial evidence also suggests associations between the availability of medical marijuana dispensaries and higher rates of marijuana use and abuse (Mair et al., 2015; Morrison et al., 2014).

To our knowledge, no studies currently exist that focuses on assessing the relationship between the location of marijuana licenses, alcohol outlets and other neighborhood characteristics within WA. The purpose of this study is to examine the spatial patterning of marijuana in Washington and to examine the impact of alcohol outlets and other neighborhood characteristics on these licenses. Our hypotheses are what types of licenses will significantly cluster across parts of the state and exhibit unique patterning, and that alcohol outlets and other neighborhood characteristics will have a significant impact on marijuana licenses.

2. Materials and methods

Our study focused on assessing the relationship between marijuana and alcohol outlet licenses and other neighborhood characteristics in 1458 census tracts within the state of Washington. Marijuana license information was obtained from the Washington State Liquor and Cannabis Board (WSLCB), which has a mission of promoting public safety and trust through fair administration and enforcement of liquor, cannabis, tobacco, and vapor laws (Washington State Liquor and Cannabis Board). The WSLCB provided marijuana license information as of September 2017 for the state, and the street address of each type of license was provided and then ultimately geocoded. There were three unique types of marijuana licenses considered: producer, processor, and retailer. Because vertical integration across production/processing and retail is prohibited in WA, establishments with a producer/processor license are not allowed also to hold a license for retailing, and vice versa. Additionally, the WSLCB does not issue a license for any premises within one thousand feet of the perimeter of the grounds of any elementary or secondary school, playground, recreation center or facility, child care center, public park, public transit center, or library, or any game arcade admission to which is not restricted to persons aged twenty-one years or older, where a retail licensee may only sell products between the hours of 8 am and 12 am. Lastly, the WSLCB provided the address for both off-premises (i.e., supermarkets) and on-premises (i.e., restaurants) alcohol outlets, and these outlets were also geocoded successfully.

Similar to previous studies (Freisthler and Gruenewald, 2014; Mair et al., 2015; Shi et al., 2016), additional neighborhood characteristics for the state were obtained from the American Community Survey 2011–2015 5-year estimates (US Census Bureau, 2015) including the following sociodemographic measures: percentage of the population under 21 years of age (i.e., people who have no legal access to marijuana dispensaries and alcohol outlets), percentage of the population with at least a high school education, and population density. We also considered a diversity index, which ranged from 0 (least) to 100 (most diverse), and this index measures the likelihood that two persons chosen at random from the same census tract belong to different race or ethnic groups (Brewer and Suchan, 2001), using race and ethnicity as defined by the US Census Bureau (US Census Bureau (2017)). Lastly, we considered crime using the total crime risk index for each census tract, where this index provides an assessment of the relative risk of many major crimes (i.e., murder, rape, robbery, assault) (ESRI Community Analyst, 2016).

Our statistical analyses included exploratory and formal spatial data analysis methods. We explored the spatial patterning of marijuana licenses using choropleth maps with point locations to visually assess the patterning of these licenses. We then assessed the Moran's I statistic and spatial correlograms for the number of marijuana licenses in each census tract to objectively measure whether spatial clustering is present and to evaluate if spatial patterning is more local or broad across the state, respectively. Next, we formally estimated the relationship between each type of marijuana license and the various neighborhood characteristics using conditionally autoregressive models (Besag et al., 1991). This model formally adjusts for the spatial correlation present in marijuana licenses across the state and is advantageous in small area estimation. All models were fit in R (R Development Core Team, 2011) using the integrated nested Laplace approximation method (Rue et al., 2009) under a Bayesian statistical framework.

3. Results

Fig. 1 shows choropleth maps of marijuana license by type, with the Seattle region enlarged for improved viewing. Each type of marijuana license displays a unique pattern, where there is significant spatial autocorrelation for marijuana producers (Moran's I = 0.289, $p = 0.01$) and processors (Moran's I = 0.228, $p = 0.01$). There was no significant clustering of marijuana retailers. The spatial correlograms further confirm these findings (Supplementary Material, Fig. S1); such that, there is significant autocorrelation among the first up to six order neighbors for marijuana processors and producers, which means there is local clustering of these types of licenses in up to six neighboring census tracts.

Table 1 shows the results of the fully adjusted models for marijuana licenses. Census tracts with more poverty have more marijuana