Editors' Choice

# The economic geography of medical cannabis dispensaries in California

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## ARTICLE INFO

## ABSTRACT

*Background:* The introduction of laws that permit the use of cannabis for medical purposes has led to the emergence of a medical cannabis industry in some US states. This study assessed the spatial distribution of medical cannabis dispensaries according to estimated cannabis demand, socioeconomic indicators, alcohol outlets and other socio-demographic factors.

*Methods:* Telephone survey data from 5940 residents of 39 California cities were used to estimate social and demographic correlates of cannabis consumption. These individual-level estimates were then used to calculate aggregate cannabis demand (i.e. market potential) for 7538 census block groups. Locations of actively operating cannabis dispensaries were then related to the measure of demand and the socio-demographic characteristics of census block groups using multilevel Bayesian conditional autoregressive logit models.

*Results:* Cannabis dispensaries were located in block groups with greater cannabis demand, higher rates of poverty, alcohol outlets, and in areas just outside city boundaries. For the sampled block groups, a 10% increase in demand within a block group was associated with 2.4% greater likelihood of having a dispensary, and a 10% increase in the city-wide demand was associated with a 6.7% greater likelihood of having a dispensary.

*Conclusion:* High demand for cannabis within individual block groups and within cities is related to the location of cannabis dispensaries at a block-group level. The relationship to low income, alcohol outlets and unincorporated areas indicates that dispensaries may open in areas that lack the resources to resist their establishment.

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Medical cannabis use has been permitted in California since 1996 (California Police Chiefs' Association [CPCA], 2009), however medical cannabis dispensaries continue to attract substantial opposition. The US Department of Justice lists cannabis as a prohibited Schedule 1 substance (Drug Enforcement Agency, 2011), and its Drug Enforcement Agency periodically raids dispensaries and prosecutes operators (Linthicum & Blankstein, 2012). Besides the moral and ethical debate about the drug itself, much of the public discourse centers around unresolved questions on the relationships between cannabis dispensaries, cannabis laws, crime (Kepple & Freisthler, 2012), and patterns of cannabis use (Harper, Strumpf, &

Kaufman, 2012; Wall et al., 2011, 2012). In this study, we examine the location of dispensaries in communities, with reference to predictions from economic geography and prior observations of other legal drug markets.

Medical cannabis dispensaries are a new point of supply for a potentially addictive substance. Their location within communities is important because the presence of a dispensary exposes the local population to increased access to cannabis, and possibly to problems related to outlet operations (CPCA, 2009). Availability theory suggests that increased access will lead to increased use among the local population (Stockwell & Gruenewald, 2004), and such an effect has been demonstrated in alcohol markets (Gruenewald, 2011). Wall et al. (2011, 2012) found higher proportions of cannabis users in states with medical cannabis laws compared to states without such laws; whereas Harper et al. (2012) found no such relationship in a replication study. A recent study found a cross sectional association where cities with greater density of cannabis dispensaries had more individuals who used cannabis

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and more frequent use of cannabis by those individuals (Fresithler & Gruenewald, 2013), though causation is unknown.

Regarding problems related to outlet operations, the small body of existing literature contains mixed findings. Crime rates in the immediate vicinity of dispensaries differ according to the security measures implemented by operators (Freisthler, Kepple, Sims, & Martin, 2012). However, there is no association between the density of dispensaries and violent or property crime in Sacramento, California (Kepple & Freisthler, 2012). Opponents of medical cannabis often assume that dispensaries have a detrimental impact on communities in a similar manner to alcohol markets (CPCA, 2009). Longitudinal studies have shown that increased alcohol outlet density is associated with increased assaults (Gruenewald & Remer, 2006; Livingston, 2008), motor vehicle crashes (McMillan, Hanson, & Lapham, 2007; Ponicki, Gruenewald, & Remer, 2013), intimate partner violence (Cunradi, Mair, Ponicki, & Remer, 2012; Livingston, 2011), and child abuse and neglect (Freisthler, Gruenewald, Remer, Lery, & Needell, 2007; Freisthler & Weiss, 2008). To date, no such studies of the neighborhood effects of cannabis dispensaries have been published. It is unclear if dispensaries have a similar negative impact on communities to alcohol outlets.

Despite these concerns, no studies have attempted to describe the location of dispensaries within communities. Theoretical models from economic geography make clear predictions which fill that void (Aoyama, Murphy, & Hanson, 2011; Hanson, 2005; Harris, 1954). The 2007 National Survey on Drug Use and Health estimated that 40.4% of US residents aged 12 and over had ever used cannabis, and 10.2% had used the drug in the previous 12 months (United States Department of Health and Human Services, 2007). In order to maximize market share and reduce convenience costs for these potential customers, outlets will open in response to demand. Competition will encourage agglomeration (Hotelling, 1929), as will zoning restrictions, local ordinances, and wholesale transportation costs. Therefore, dispensaries should be found concentrated in and near areas of high cannabis demand.

Further theory from urban economics (O'Sullivan, 2007) suggests that income is also likely to be associated with dispensary location. High housing value tends to exclude retail space (DiPasquale & Wheaton, 1992), and outlets with a demonstrable or perceived association with social, environmental or public health problems are excluded from stable neighborhoods that possess the resources to resist their establishment (Skogan, 1990). Thus, dispensaries will likely be located in areas of social disadvantage.

Also of note is the well-documented intersection between the location of drug markets, greater numbers of alcohol outlets, social disadvantage and the presence of other problems (Banerjee et al., 2008; Gruenewald, Millar, Ponicki, & Brinkley, 2000; LaVeist & Wallace, 2000; Livingston, 2012; Romley, Cohen, Ringel, & Sturm, 2007; Zhu, Gorman, & Horel, 2006). However, the potential spatial relationship between cannabis dispensaries and alcohol outlets is unclear. It is possible that dispensaries are excluded by the well-resourced alcohol industry which would seek to protect itself against potential associations with drug markets (Skogan, 1990). Conversely, zoning restrictions and reduced convenience costs for consumers may have the result that alcohol outlets and cannabis dispensaries are co-located within neighborhoods (Aoyama et al., 2011). In either scenario, it is necessary to include alcohol outlets in economic geography models.

The aim of this study was to determine predictors of cannabis dispensary location within communities. Based on the theory presented above, we hypothesized that dispensaries would be located in and near to areas of high cannabis demand and away from high income areas. Given the possible association with alcohol outlets and the influence they may exert on the social ecology of cannabis

dispensaries, we also examined the spatial relationship between these two types of businesses. Our results are interpreted in the context of medical cannabis as an emerging legal drug market.

## Methods

This study used two main data sources: (1) person-level data were used to generate estimates of cannabis demand for each Census block group, then (2) Census block-group level data were used to investigate the location of dispensaries according to market potential, socio-economic indicators, alcohol outlets and other covariates.

*Person-level data*

*Study sample*

This study used data from a cross-sectional computer assisted telephone (CATI) survey conducted in 50 moderately sized California cities in 2009. Of the 138 municipalities in the state with between 50,000 and 500,000 residents, a sample of non-contiguous cities was purposively selected based on geography and ecology in order to maximize generalizability to non-sampled cities (Paschall, Grube, Thomas, Cannon, & Treffers, 2012; Thompson, 1992). A response rate of 48.0% was calculated using standard definitions from American Association for Public Opinion Research (2002). There were 8553 respondents in the original sample, but for the current study, we excluded responses from 1986 (23.2%) who resided in the eleven study cities without cannabis dispensaries (see "Census-based data" section). Of the remaining 6567 surveys, a further 627 (9.5%) had incomplete responses for the variables of interest and were omitted from the analyses; of these, 600 (95.7%) were due to non-responses to a single household income item.

*Measures*

Cannabis use was collected in the telephone survey as self-reported days of use in the last 12 months (range: 0–365). Demographic variables were structured to correspond with US Census data, and were included in the model based on prior demonstrations of an association with cannabis use (Galea, Ahern, Tracy, & Vlahov, 2007; Kerr, Greenfield, Bond, Ye, & Rehm, 2007; Paddock et al., 2012; Tucker, Pollard, de la Haye, Kennedy, & Green, 2013). Variables included gender, race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, and Asian), annual household income ($20,000 or less, $20,001–60,000, $60,001–100,000, ≥$100,000), age (20–29, 30–39, 40–49, ≥50 years) and employment status (full time employed, unemployed or laid off). Highest level of education was coded as high school (or GED), college or technical school, and postgraduate or medical school. We were unable to include a geographic variable (i.e. city of residence) as the low number of cannabis users made the city level estimates imprecise. To avoid multi-colinearity, excluded categories were age 18–19, education less than high school or GED, income <$20,000 and other ethnicity.

*Census-based data*

*Study sample*

We used Census 2000 block group (BG) data for areas within and around the study cities. We preferred this spatial unit to other Census based geographies (e.g. blocks, tracts) because BGs are the smallest unit for which the demographic data we required are available, and larger units may not capture the hypothesized excluding effect of high local income. Forty-three of the 50 cities had an ordinance prohibiting medical cannabis dispensaries. In order to account for dispensaries located immediately outside these