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Local Variation in Cannabis Use Patterns among Young Adults in the San Francisco Bay Area

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Abstract

This study evaluated whether neighborhood-level disorder, social cohesion, and perceived safety, were associated with days of cannabis use in the prior month in a representative sample of young adults in Alameda and San Francisco Counties in California (N=1272). We used multiscale geographically weighted regression, modeled by county, to measure associations between cannabis use days and neighborhood attributes, adjusting for sociodemographic characteristics and self-rated health. Positive associations were found between number of cannabis use days and neighborhood disorder, and greater perceived safety. Higher levels of social cohesion predicted fewer cannabis use days. Racial/ethnic, sex and, socioeconomic compositions of participants residing in areas with significant neighborhood-level associations varied substantially, suggesting that risk factors for young adult cannabis use may be highly localized. Public health efforts in cannabis education and intervention should be tailored to fit the culture and composition of local neighborhoods.

Keywords

neighborhood; marijuana; urban planning; substance use; health disparities; geospatial; health geography

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INTRODUCTION

Laws concerning the legalization of cannabis have changed rapidly over the past few years while cannabis research has lagged behind. Between 2012 and 2019, eleven states, including California, and Washington D.C., have legalized the recreational use of cannabis, and 31 more states have either decriminalized cannabis or legalized its use for medical reasons, or both.[1,2] These laws are likely to disproportionately affect young adults as this group has the highest cannabis use rate among all age groups, with cannabis use prevalence more than doubling among 18–25 year old adults from 10.5% in 2001–2002 to 23% in 2019.[3,4] As cannabis regulatory policy continues to evolve in California, it is important to track young adult cannabis use behavior as a harbinger of regulatory impacts on use and potential associated health outcomes.

While evidence remains sparse with respect to the long-term physical health effects of cannabis use,[5] there are demonstrated risks for cognitive impairment, impaired lung function in young adults,[6] and cannabis use disorder, with higher rates of cannabis use disorder among individuals who began using cannabis in adolescence.[7] Furthermore, cannabis use among young adults frequently accompanies or precedes tobacco use, and thus may indirectly lead to greater potential for tobacco-related harm.[8] One longitudinal study of young adult males found that those who were nicotine dependent were more likely to initiate cannabis use.[9] Similarly, other young adult studies found that 21.3% of 18–24 year old respondents had used both tobacco and cannabis in the prior month,[8] and that young adults who currently used cannabis had greater odds of current tobacco use and later nicotine dependence.[10,11]

Cannabis use is differentially distributed within the young adult population. Groups with higher cannabis use prevalence also use cannabis on more days in the prior month.[12] Latino, non-Hispanic Black and Multiracial young adults have been found to have higher cannabis use rates than White and Asian adolescents.[11,13,14] Males have historically been more likely to use cannabis than females, but this gap has decreased over the years so that there is no longer a substantial difference.[11,13] One further trend that distinguishes cannabis from other substances, and has not been well explored in the existing literature, is a higher prevalence among higher income and more well-educated populations than among those of lower socioeconomic status (SES), both at individual and neighborhood levels.[11,15,16] Additionally, compared to tobacco, young adults perceive cannabis to be less harmful to health, less addictive and more socially acceptable,[17] and lesser perceptions of harm have been associated with greater likelihood of using cannabis among young adults.[11]

With considerable variability in sociodemographic characteristics of young adults who use cannabis, there is a strong potential for neighborhood contexts to be influential in predicting young adult cannabis use, especially as it may pertain to issues of disparity. Specific contexts may impact certain populations differentially with respect to cannabis use patterns. Among young adults, several studies have shown that those living in more disadvantaged and more disordered neighborhoods are more likely to use cannabis.[18–25] In contrast to these findings, Galea et al.[15,16] reported that neighborhoods characterized by higher SES demonstrated higher cannabis use rates, but further found that greater neighborhood-level

inequalities in educational attainment and income predicted greater likelihood of cannabis use as well.

Few of these studies, however, have investigated the role of neighborhood context employing representative samples with sufficient fine scale data, and even fewer among young adults, as opposed to adolescents. Previous research found that among young adults (18–26) in the San Francisco Bay Area, non-Hispanic multiracial (46.6%), Latino (33.5%) and non-Hispanic African American (32.1%) young adults had higher rates of cannabis use than their non-Hispanic White (31.1%) and Asian (9.8%) counterparts.[11] What is yet unknown is how neighborhood factors may play a role in predicting these use rates.

The existing literature presents us with a complex picture of the potential relationships between cannabis use and neighborhood characteristics, especially among young adults who have the highest cannabis use rates, and with whom little representative research has been conducted. In this study we address these gaps by evaluating associations between neighborhood characteristics and current cannabis use among a representative sample of young adults in the San Francisco Bay Area. Specifically, we hypothesize that (1) neighborhood disorder (e.g. noise, litter, public disturbance) will be associated with more days of cannabis use among young adults; and (2) more neighborhood-level social cohesion; and (3) greater perceived neighborhood safety will be associated with fewer days of cannabis use in the previous month.

METHODS

Study Design & Sample

This study utilized data from the 2014 San Francisco Bay Area Young Adult Health Survey (BAYAHS), a probabilistic multi-mode household survey of 18–26-year-old young adults, stratified by race/ethnicity. The survey was conducted in Alameda and San Francisco Counties in California (Figure 1). The sample frame consisted of 16,136 households. We conducted the survey in three phases and employed four modes of delivery (mail/web, telephone, face-to-face). Our procedure has been published in more detail elsewhere.[11,26,27] In brief, questionnaires were mailed to an address-based sample of households where young adults were more likely to reside, stratified by race/ethnicity. If more than one eligible young adult resided in a selected household, we randomly selected a young adult to complete the questionnaire, which could be done on paper or online. Non-responders to the mail survey were contacted by telephone; non-responders to telephone contacts were visited and invited to complete face-to-face interviews. For the face-to-face interviews we also used 2009–2013 American Community Survey and 2010 decennial census data in a multistage sampling design to supplement the address-based sample in order to oversample Latino and Black young adults. The final sample consisted of 1,363 participants with race, sex and age distributions closely reflecting those of the young adult population overall in the two counties surveyed. Individual sample and post-stratification adjustment weights were constructed after data collection. For purposes of spatial analysis, we also used Census Bureau TIGER/Line boundary shapefiles for the two counties.

Measures

Current cannabis use.—Our dependent variable was measured as a count of days of cannabis use based on the question: “during the past 30 days, on how many days (0–30) did you use cannabis or hash?”

Explanatory Factors

Neighborhood Characteristics.: Neighborhood factors were measured by asking respondents to consider “your neighborhood” when reporting their perceptions.

Length of neighborhood residence was measured as how many months and years participants had resided in their current neighborhoods. Neighborhood physical disorder was measured using a scale indicating the extent to which respondents indicated seven items – drinking in public, fighting in public, graffiti, vacant housing/buildings, noise, litter or trash, and young people causing a disturbance – to be “not a problem (0);” “somewhat of a problem (1);” or “a big problem (2).[28] These items were added together to create a continuous scale from 0–14. Neighborhood social cohesion was measured with four items: “people in your neighborhood generally do not get along with each other;” “people in your neighborhood are willing to help each other;” “people in your neighborhood do not share the same values;” and “many people in your neighborhood know and interact with each other.”[28] Participants indicated their response to each of these items from strongly disagree (0) to strongly agree (4) and responses were added to generate a scale from 0 (no social cohesion) to 16 (complete social cohesion). Perceived safety was measured using two items asking to what extent participants agreed that their neighborhood was “safe to walk around during the day” and “safe to walk around at night.” The categorical responses for both items were added together to create a scale from “strongly disagree (0)” for both items to “strongly agree (8).”

Covariates

Sociodemographic Characteristics.: We assessed respondent age, sex, race/ethnicity and maternal educational attainment. Age was calculated using respondent birthdate and year. Sex was coded as ‘1’ if the respondent was male, and ‘0’ for female. Race/ethnicity categories were measured dichotomously, ‘1’ if the respondent identified with a certain race/ethnic group (Latino, non-Hispanic Black, non-Hispanic Asian, non-Hispanic Multiracial), ‘0’ otherwise, and are mutually exclusive. Non-Hispanic White was the reference category. Educational attainment of the participant’s mother was measured categorically, from “no education (1)” to “doctorate degree (16).” As our population is between the ages of 18–26, they may not have reached their terminal educational degree at the time the study was conducted, and maternal education has been shown to predict long-term health outcomes.[29–31]

Very good or excellent self-rated health was based on a question asking, “would you say your health in general is…excellent, very good, good, fair, poor.” This measure was dichotomized with responses of “excellent” or “very good” set equal to ‘1’ and ‘0’ if the response was good, fair or poor.

Analysis

Spatial analyses were performed at the household level, represented as point data in ArcGIS 10.7.[32] We performed a Global Moran's I (spatial autocorrelation) analysis in ArcGIS 10.7 with our outcome variable, number of cannabis use days in the past 30, to determine whether multiscale geographically weighted regression (MGWR) was appropriate for our analysis. If the dependent variable demonstrates significant spatial autocorrelation, there are likely significant local associations between dependent and independent variables that would be lost in typical ordinary least squares (OLS) regression, which aggregates results over space. Classical GWR modifies the OLS regression model by generating parameter estimates specific to each geographic unit of analysis, in this case the addresses of survey participants, in order to specify more accurate parameters.[33] A standard GWR equation is shown below wherein (u_i,v_i) represents the geographic coordinates of location i:

$$Y_i = X_i\beta(u_i, v_i) + \varepsilon_i$$

MGWR adjusts the assumptions of this classical GWR model, which assumes stationarity of scale, by allowing for variation in the geographic scales at which processes modeled in the regression operate.[34]

The Z-score generated by the Moran's I analysis was 3.18 with a p-value of 0.009, indicating significant spatial autocorrelation for cannabis use days, and thereby warranting a MGWR analysis to uncover local associations. We retained observations that had complete spatial and attribute data for our final models, resulting in an analysis sample of 1272 observations out of 1363, or 95% of the total sample. We conducted a Little's test to evaluate whether the excluded data were missing completely at random or not and found the data to be missing at random instead (p-value=.025). We performed the regression models with and without the missing data and found no substantial changes in the results. We performed separate MGWR analyses by county after considering the difference in numbers of observations by county (N=411 in SF; N=861 in Alameda), the substantial difference in geographic scale, and the variable density of sociodemographic factors by county.

We used MGWR 1.2[35] software to perform Gaussian regressions modeled on the geographic coordinates for participant households in each county, then visualized the results in ArcGIS 10.7.1. We selected the Corrected Akaike Information Criterion (AICc) as our optimization metric and an adaptive spatial kernel. Below we present the summary results of the MGWR models by county. Local results (Figures 1–3) are portrayed as point density surfaces in order to illustrate patterns of significance while also safeguarding participant confidentiality. The density patterns represent the range of parameter coefficients for each area where an explanatory variable was significantly associated with daily cannabis use. Only those neighborhoods where a significant association ($p<.05$) was found between the selected indicator and the outcome of cannabis use days are included in the density surfaces.

Finally, in order to better describe the subsamples of participants residing in the neighborhoods where significant local associations were identified between daily cannabis use and neighborhood indicators, and to aid interpretation, we summarized those

participants' weighted characteristics, further classified as "no cannabis use" and "used cannabis." The former were participants who had not used any cannabis in the prior 30 days, compared to those participants who had used cannabis on one or more days.

RESULTS

Sample Characteristics

Table 1 shows weighted sample characteristics by county. Bivariate regression analyses were performed in Stata 16 to evaluate initial associations between days of cannabis use and each explanatory variable and covariate. In Alameda County, days of cannabis use was associated with higher levels of neighborhood disorder, while Non-Hispanic Asian residents had statistically fewer cannabis use days. In San Francisco County, Latinos reported more days of cannabis use, and Non-Hispanic Asians reported fewer. More cannabis use days were also associated with lower likelihood of reporting very good or excellent self-rated health in San Francisco. In both counties, young adults who used cannabis had lived in their neighborhoods for less time than those who had not, were more likely to be male, and had mothers with higher educational attainment. Reports of neighborhood social cohesion and perceived safety were similar between groups.

Summary Multiscale Geographically Weighted Regression (MGWR) Results

Table 2 shows summary regression results from our MGWR models by county. These are an aggregate of the local regression model results. Local MGWR results are illustrated in maps, starting with Figure 2. In Model 1, for Alameda County, days of cannabis use increased in association with neighborhood disorder. Male and non-Hispanic Black participants also used cannabis on more days in the past month than non-Hispanic White participants. Alternatively, non-Hispanic Asians had fewer cannabis use days, as did those young adults who reported being in very good or excellent health. In San Francisco County, there was no significant association with neighborhood disorder, however, greater social cohesion was associated with significantly fewer days of cannabis use. Non-Hispanic Multiracial young adults in San Francisco also used cannabis on more days. Additionally, as in Alameda County, non-Hispanic Asian residents and those in very good or excellent health had fewer cannabis use days.

Local MGWR Results and Subsample Characteristics

We calculated subsample characteristics for participants residing in each area where significant associations were found between neighborhood features and days of cannabis use, shown as point density surfaces in Figures 1–3, in order to gain a better picture of sub-county dynamics that may help explain the MGWR results. Tables 3–5 report these characteristics by cannabis use status, including the number of observations included in each area.

Alameda County—The association between days of cannabis use and greater reported neighborhood disorder was strong enough throughout Alameda County that it is reflected in the summary results (Table 2). However, by evaluating the results locally, we can see that certain areas of the county drove that association (Figure 2). Specifically, days of cannabis

use were higher in certain parts of the county, including Berkeley, Oakland, San Leandro, Dublin, Pleasanton and Livermore, where reports of neighborhood disorder were also higher. This pattern did not hold for the Southwestern part of the county in areas such as Newark, Fremont and Union City.

Participants in this area reported using cannabis on 11.1 out of the prior 30 days. Those who had used cannabis reported a score of 3.1/14 on the disorder scale compared to 2.2/14 among those who had not used cannabis. Reports of social cohesion and perceived safety were similar, if not identical, between the two groups. Participants who reported using cannabis were more likely to be any racial/ethnic group other than non-Hispanic Asian, had slightly higher maternal educational attainment, and slightly worse self-rated health.

San Francisco County—There was no relationship between neighborhood disorder and days of cannabis use in San Francisco County. There was a significant association between higher levels of neighborhood social cohesion and fewer cannabis use days in the summary regression results (Table 2); however, the local results indicate that this relationship was primarily defined by residents in the Mission and Bernal Heights neighborhoods (Figure 3). These neighborhoods have traditionally been home to Latino families and have had lower socioeconomic status than other parts of the city; however, they have experienced substantial transition, and conflict, in recent years with housing prices increasing dramatically and more young residents employed in the technology industry moving in and infusing cash into the area.[36,37]

Despite social cohesion being significantly associated with fewer cannabis use days in this area, participants nevertheless reported using cannabis on 15.6 days during the prior month. Reports of neighborhood disorder and perceived safety were lower among young adults who had used cannabis in these neighborhoods, as were reports of social cohesion, on average. Those who used cannabis in this area were less likely to be male (32.5% vs. 50.0% in the overall sample) and much more likely to identify as non-Hispanic Black (23.7% vs. 10.1% of the sample). They also reported being in worse self-rated health compared to participants who had not used cannabis (54.9% vs. 57.8%).

The MGWR results also demonstrated a relationship between greater perceived neighborhood safety and more days of cannabis use in Western San Francisco County (Figure 4). This association was strongest in the Richmond and Sunset neighborhoods, and the Southwestern neighborhoods, such as Ocean View and Crocker Amazon. Although San Francisco is a small county geographically, these neighborhoods tend to feel distant from the city center, are more residential than those east of Golden Gate Park and have traditionally been more affordable than other parts of the county.

In the area of San Francisco County where perceived safety was positively related to days of cannabis use, participants reported 8.9 days of use in the prior 30. Those who had used cannabis reported similar levels of neighborhood disorder and social cohesion to those who had not, but participants who used cannabis had lived in the area for an average of 4.3 fewer years than their counterparts. Young adults in this area who used cannabis were more likely

to be Latino, or non-Hispanic White or Multiracial, than non-Hispanic Black or Asian, and had higher maternal educational attainment and better self-rated health.

In summary, evaluations of neighborhood characteristics, racial/ethnic and gender compositions, length of residence, self-rated health, and maternal education vary substantially across these different subsamples of participants who reside in different neighborhoods across the two counties, which nonetheless each demonstrated significant associations between days of cannabis use and some aspect of neighborhood environment. Additionally, number of cannabis use days themselves differ substantially from one area to the other, ranging from 8.9/30 days in the western part of San Francisco County (Figure 4) to 15.6/30 days in the Mission/Bernal Heights neighborhoods (Figure 3). These results suggest that broad characterizations of cannabis use among young adults may not be instructive for public health messaging or intervention, and that individually-targeted interventions may not be the most effective means of reaching young adults at risk for cannabis use. Drawing the focus from individuals to their environments as targets of intervention may have greater impact on cannabis use.

DISCUSSION

The goal of the current study was to evaluate associations between neighborhood characteristics and days of cannabis use among a representative sample of young adults in the San Francisco Bay Area. We found evidence to support two of our three hypotheses to varying degrees across Alameda and San Francisco counties. First, we hypothesized a positive relationship between neighborhood disorder and days of cannabis use in the prior month. We found evidence of this relationship in Alameda County in both the summary and multiscale geographically weighted regression results, but not in San Francisco County. Furthermore, this relationship was significant in much of Alameda County, for example in Berkeley, Oakland, San Leandro and the eastern part of the county, but there was no association between disorder and cannabis use days in the Southwestern part of Alameda County (Fremont, Newark).

When investigating characteristics of participants in the areas of significant association more closely, we found increased reports of neighborhood disorder among young adults who had used cannabis, as well as a relatively diverse racial/ethnic and sex composition, except for non-Hispanic Asians who had much lower daily rates of cannabis use overall. The primary distinguishing characteristics among these participants were therefore their assessments of neighborhood disorder, their tendency to be non-Asian, and their specific geographical locations in Alameda County.

This suggests that there was agreement among young adult residents of these areas, regardless of race/ethnicity or sex, that their neighborhoods were more disordered, i.e. had more incidences of litter, graffiti, vacancy, noise, and general public disturbance, and that this disorder may have contributed to the number of days that they used cannabis. This finding is important for research on neighborhood disorder as it pertains to health, as the concept of “disorder” has increasingly been criticized, and with valid reason, for potentially confounding race and class with physical signs of disorder.[38,39] While that critique has

substantial validity, and “disorder” may not be the appropriate frame in many instances, in this case there appears to be a substantial level of concordance across Alameda County and along sociodemographic characteristics, pointing to its relevance as something that distinguishes neighborhoods in this county for cannabis use, at least. For future consideration, geographically explicit momentary assessment studies may be a particularly useful approach for eliciting the types of daily environmental stressors young adults encounter in their neighborhood activity spaces that may contribute to higher rates of cannabis use.[40,41]

We further hypothesized that neighborhood-level social cohesion would be inversely associated with number of cannabis use days. We found support for this in San Francisco County in both the summary and local MGWR results. This association was localized to the Mission and Bernal Heights neighborhoods (Figure 3), which accounted for only 35 participants. Young adults who reported cannabis use in this area reported 15.6 days of use during the previous month, compared to 11.2 days among all San Francisco young adults who had used cannabis, and these participants assessed social cohesion to be lower than those who had not used cannabis (9.6/16 vs. 10.5). This suggests that the locality and its composition may be particularly important for evaluating the significant association between daily cannabis use and social cohesion in this area.

As these neighborhoods have traditionally been populated with Latino families, but are increasingly populated by, mostly non-Hispanic White and wealthier young adults, this transition may have an important role to play.[37] In separate analyses (not shown), we found a significant interaction between greater social cohesion and fewer cannabis use days for Latino young adults compared to other groups, thus indicating that social cohesion was especially important for this group of young adults living in an area that was traditionally Latino. This is punctuated by the relatively low proportion of Latino young adults in this area who used cannabis in the prior month, compared to Latino young adults in the sample overall, who have the highest cannabis use rates.[11] It may therefore be instructive to evaluate how neighborhood environment impacts risk behavior by race/ethnicity, and in relationship to neighborhood population dynamics. There is some support for this idea in the literature, although most of the existing studies use national data sets, which limit the level of geographic and individual detail that can be assessed for different racial/ethnic groups, and few have investigated these ideas with respect to health behavior (as opposed to psychological health).[42–44]

Finally, our third hypothesis, that greater perceived neighborhood safety would be inversely associated with days of cannabis use, was not supported by our data. Instead, we found that greater perceptions of neighborhood safety were positively associated with daily cannabis use rates in much of San Francisco County, particularly in the Richmond, Sunset, Ocean View, Crocker Amazon, and Excelsior neighborhoods (Figure 4). There was no significant relationship between perceived neighborhood safety and cannabis use days in Alameda County. In the San Francisco neighborhoods where perceived safety was significant, young adults reporting using cannabis 8.9 days out of the past 30. Those who reported cannabis use had lived in their neighborhoods for 4.3 fewer years than those who had not, and they assessed social cohesion (9.8/16 vs. 9.4) as higher and neighborhood safety as greater (6.6/8

vs. 6.1). These participants were also much less likely to be non-Hispanic Black or Asian than other groups, had higher maternal educational attainment and better self-rated health than nonusers.

The neighborhoods where this association between greater perceived safety and cannabis use was most pronounced tend to be further from downtown, and generally older and more established residential neighborhoods. The Richmond, Sunset and Parkside neighborhoods (Figure 4) border Golden Gate Park and the Pacific Ocean, and harbor a mix of single family homes and small multiunit buildings; Ocean View, Crocker Amazon and Excelsior are composed largely of single family homes, are bordered by large parks, and have a much higher homeownership rate than in the areas surrounding downtown San Francisco.[45] However, longer duration of residence seems to be linked to lesser perceived safety, so it may be fruitful to determine where young adults in this area who reported cannabis use moved into the area from, at what age, and what their comparative perceptions may have been. While we cannot examine these questions with our data, it is an area ripe for research – how do perceptions of neighborhood environments change from one space to another, how do changing perceptions relate to risk behavior, and does age of relocation matter for associated health outcomes?

One final thing to note is the high percentage of non-Hispanic Multiracial young adults who used cannabis residing in this area − 21% versus 17.9% of those in San Francisco County reporting cannabis use, and of only 10.7% of young adult residents in the San Francisco sample overall. We have found in prior research that non-Hispanic Multiracial young adults were at higher risk for cannabis use,[11] but the reasons for this remain somewhat obscure. Multiracial young adults in the overall sample were a very mixed group and there was little common racial/ethnic thread among this group of participants. There have been a few studies pointing to increased risk of substance use, including cannabis, among Multiracial young people. As increasingly more young adults identify as Multiracial, and with the 2020 Census allowing for more specificity in racial identification, these young adults will be important to monitor, especially as it regards environmental perceptions and group identification dynamics.[11,46–48]

Collectively, these findings suggest that individually-focused behavioral interventions may not be the best approach for reducing days of cannabis use among young adults, at least as a standalone strategy. Instead, local, regional, and state policy approaches may be especially useful, as they have been with tobacco control.[27,49] Neighborhood disorder may be considered a tangible indicator of local (dis)investment as it has consistently been found to be reported more often in neighborhoods facing material disadvantage, at both individual and area levels. Further, it is consistently linked to substance use and poor health outcomes.[45,50–52] Social cohesion has also been shown to be lower in neighborhoods where perceived safety is also less, and reports of disorder are greater.[53–55] Therefore, translational research that includes strategic urban planning and investment strategies as preventive measures for cannabis, and other substance, use may have far greater impact than efforts focusing on particular individuals, or even groups of individuals.

This study has some limitations. First, these data were restricted to 18–26-year-old adults in the San Francisco Bay Area, and the results may not generalize to other age groups or geographic areas. Additionally, urban young adults are notoriously difficult to reach in population surveys and our response rate (30%) reflected this challenge. This rate is nevertheless comparable to other locally and nationally representative studies of this age group,[56–60] and the data themselves are representative of young adult population distributions and demographic characteristics in the two counties. Finally, the number of young adults residing in the Mission/Bernal Heights neighborhoods, where neighborhood social cohesion was associated with decreased cannabis use, was relatively small (n=35), so firm conclusions about the meanings of the relationships in that area may require additional investigation. Despite these limitations, our findings demonstrate the importance of neighborhood environments and in-depth analysis of local geographies for uncovering variations in cannabis use behavior.

CONCLUSION

Neighborhood disorder, social cohesion and perceived safety were all associated with days of cannabis use among young adults in the San Francisco Bay Area, although not in the direction expected for perceived neighborhood safety. These relationships varied substantially across sub-geographies within Alameda and San Francisco Counties, as did the individual and area-level sociodemographic compositions in neighborhoods that showed significant effects. These findings suggest that young adult cannabis use is a complicated behavior that does not necessarily follow the same patterns as use of other substances, for example with respect to socioeconomic status,[61] and one that is subject to local area dynamics. However, there is limited research examining use of cannabis or other substances, such as alcohol or tobacco, for which young adults are high risk, at such a fine geographic scale. From a research perspective, therefore, this study suggests a rich avenue for continued investigation into the ways in which risk factors and substance use behaviors cluster geographically. Additionally, public health efforts with respect to cannabis use, may benefit from a broad policy-focused approach that not only regulates consumption and sales, but incorporates local investment and planning strategies known to promote health overall.

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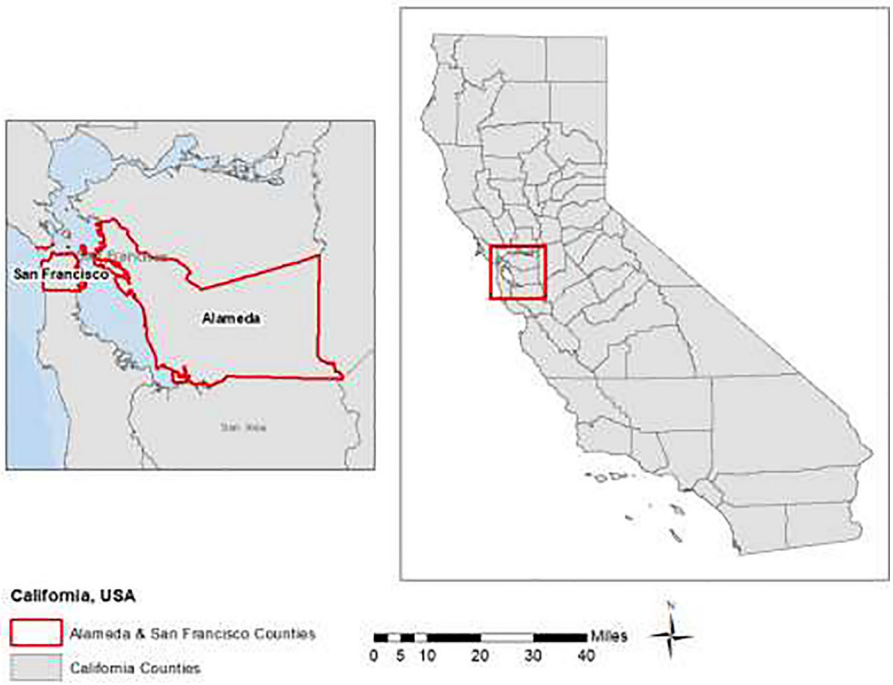

Figure 1.
Map of the state of California with inset showing study area: Alameda & San Francisco Counties.

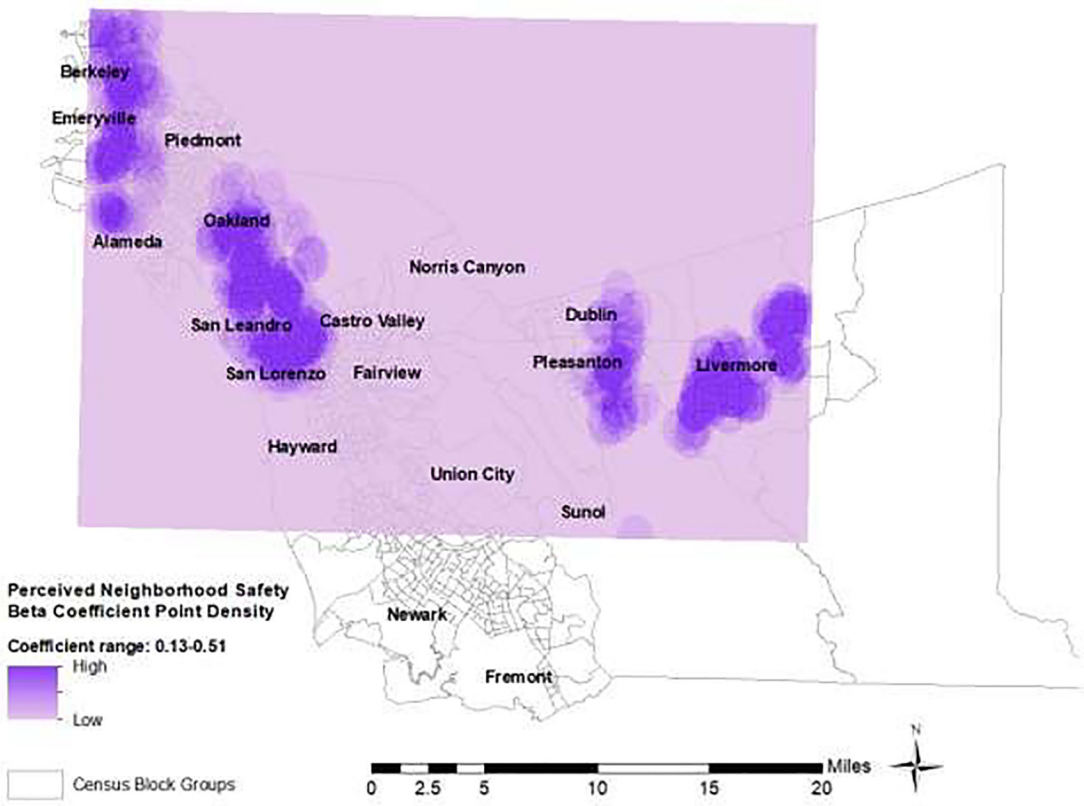

Figure 2.

Point density surface of β-coefficients in Alameda County where neighborhood disorder was positively associated with daily cannabis use

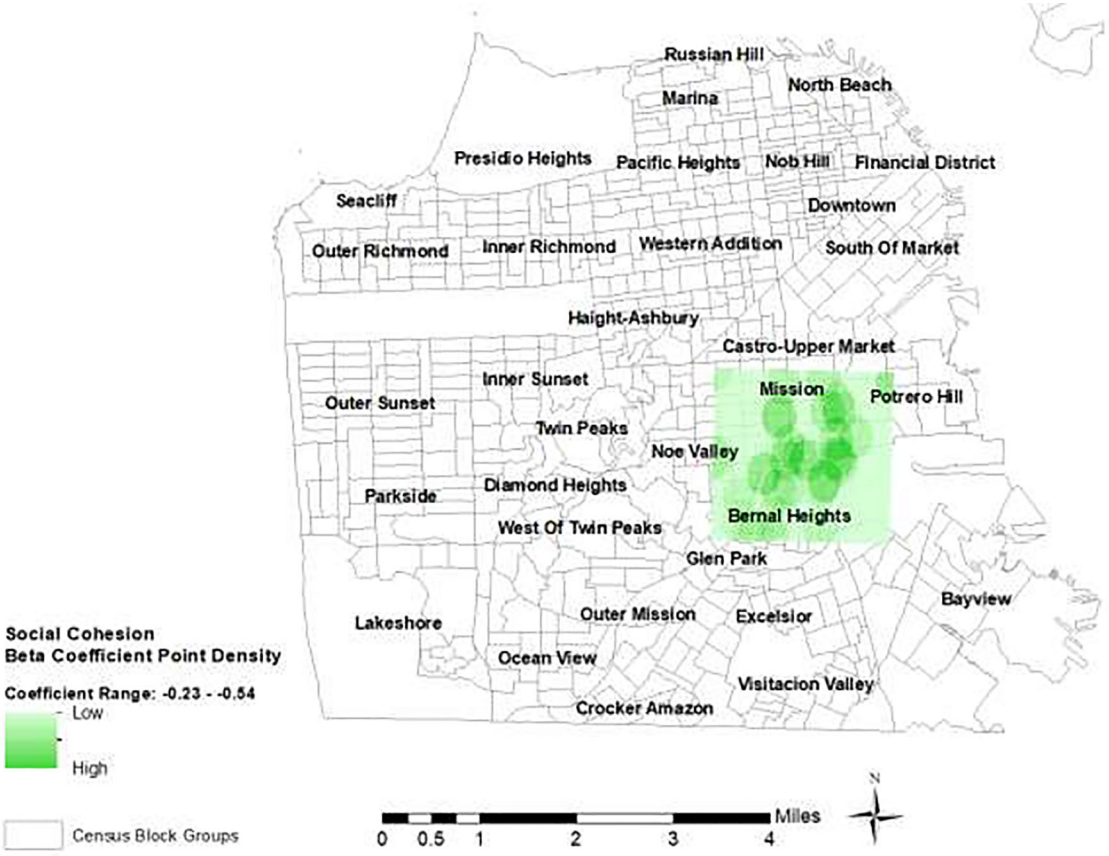

Figure 3.

Point density surface of β-coefficients in San Francisco County where neighborhood social cohesion was inversely associated with daily cannabis use

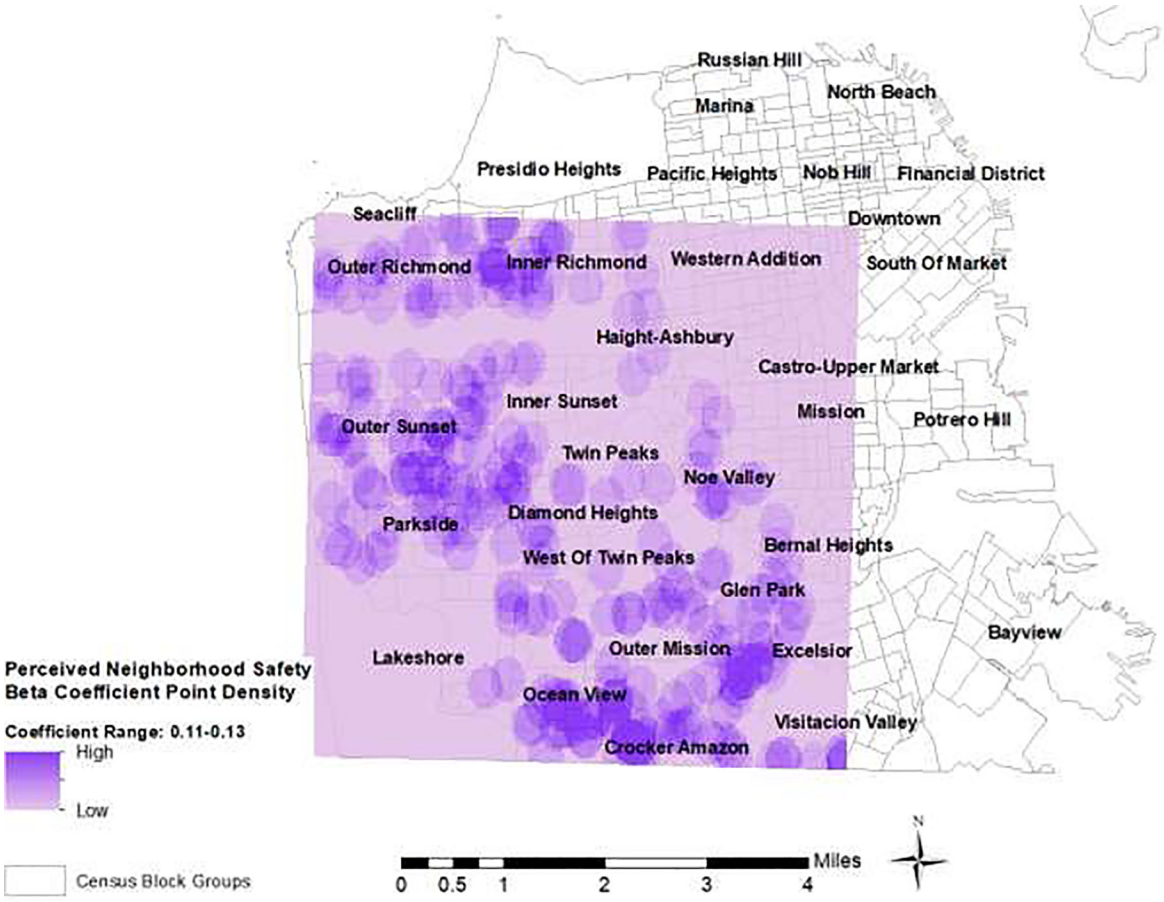

Figure 4.

Point density surface of β-coefficients in San Francisco County where perceived neighborhood safety was positively associated with daily cannabis use

Table 1.

Weighted sample characteristics, 2014 BAYAHS (N=1272)

	ALAMEDA COUNTY					SAN FRANCISCO COUNTY				
	μ or % / (S.D.)									
	No cannabis use		Used cannabis			No cannabis use		Used cannabis		
Characteristics	N = 654		N = 207			N = 339		N = 72		
Days of cannabis use in past 30	0.0	-	11.9	(10.9)		0.0	(0.0)	11.2	(12.6)	
Years of neighborhood residence (0–26)	13.2	(7.8)	11.9	(7.8)		15.1	(7.8)	11.8	(9.1)	
Neighborhood disorder (0–14)	2.10	(3.2)	2.8	3.4)	*	4.0	(3.7)	3.6	(3.7)	
Neighborhood social cohesion (0–16)	10.3	(2.9)	10.2	(2.6)		9.2	(2.4)	9.5	(2.1)	
Perceived neighborhood safety (0–8)	6.0	(1.8)	6.1	(1.9)		5.6	(1.6)	6.3	(1.5)	
Age (18–26)	22.6	(2.5)	22.2	(2.4)		23.1	(2.4)	23.1	(2.4)	
Male	46.1	-	55.3	-		48.0	-	58.5	-	
NH White	32.9	-	38.1	-		22.8	-	34.7	-	
Latino	25.5	-	31.0	-		11.1	-	24.0	-	*
NH Black	10.1	-	13.7	-		7.4	-	9.2	-	
NH Asian	26.2	-	8.2	-	†	55.2	-	14.3	-	†
NH Multiracial	5.4		9.0			3.5		17.9		
Mother’s educational attainment	10.9	(3.0)	11.6	(3.2)		10.2	(3.6)	11.8	(2.3)	
Very good/excellent self-rated health	59.5	-	60.4	-		58.4	-	57.7	-	†

Statistically positive (*) or negative (†) association with daily cannabis use in bivariate analysis; NH = Non-Hispanic

Table 2.

Multiscale Geographically Weighted Gaussian Regression Summary Results, 2014 BAYAHS (N=1272)

	Alameda Count (n=861)			San Francisco County (n=411)		
	β	SE		β	SE	
Perceived Neighborhood Characteristics						
Years of neighborhood residence	−0.01	0.03		0.05	0.05	
Neighborhood disorder	0.16	0.04	***	−0.01	0.05	
Neighborhood social cohesion	−0.01	0.04		−0.11	0.05	*
Perceived neighborhood safety	0.05	0.04		0.10	0.06	
Sociodemographic & Health Characteristics						
Age (18–26)	−0.01	0.03		−0.02	0.05	
Male	0.10	0.03	**	0.08	0.05	
NH White *(referent)*	-	-		-	-	
Latino	−0.06	0.05		0.11	0.07	
NH Black	0.13	0.04	**	0.02	0.06	
NH Asian	−0.18	0.04	***	−0.17	0.07	*
NH Multiracial	0.04	0.04		0.14	0.05	**
Mother's educational attainment	0.03	0.04		0.03	0.05	
Very good/excellent self-rated health	−0.08	0.03	*	−0.13	0.05	**
	Model fit					
R^2	0.17			0.45		
AICc	2361.05			1102.45		

* p < .05

** p<.01

*** p<.001

Table 3.

Weighted sample characteristics of participants in the study area with statistically significant local regression associations for neighborhood disorder

Alameda County	Neighborhood Disorder				
	μ or % / (S.D.)				
	No cannabis use		Used cannabis		
Characteristics	**N = 269**		**N = 107**		
Days of cannabis use in past 30	0.0	-	11.1	(10.7)	
Years of neighborhood residence (0–26)	12.4	(7.7)	12.0	(7.9)	
Neighborhood disorder (0–14)	2.2	(3.3)	3.1	(3.6)	*
Neighborhood social cohesion (0–16)	10.3	(3.2)	10.1	(2.6)	
Perceived neighborhood safety (0–8)	6.0	(1.9)	6.0	(1.9)	
Age (18–26)	22.7	(2.4)	22.2	(2.3)	
Male	50.0	-	52.5	-	
NH White	42.3	-	44.5	-	
Latino	228	-	28.6	-	
NH Black	14.0	-	16.8	-	
NH Asian	15.5	-	4.3	-	†
NH Multiracial	5.5	-	5.9	-	
Mother’s educational attainment	10.8	(3.3)	11.4	(2.9)	*
Very good/excellent self-rated health	57.2	-	55.5	-	

Statistically positive (*) or negative (†) association with daily cannabis use in bivariate analysis

Table 4.

Weighted sample characteristics of participants in the study area with statistically significant local regression associations for neighborhood social cohesion

San Francisco County	Neighborhood Social Cohesion				
	μ or % / (S.D.)				
	No cannabis use		Used cannabis		
Characteristics	N = 23		N = 12		
Days of cannabis use in past 30	0.0	-	15.6	(12.5)	
Years of neighborhood residence (0–26)	14.6	(8.3)	14.7	(7.4)	
Neighborhood disorder (0–14)	4.4	(3.9)	3.5	(4.0)	
Neighborhood social cohesion (0–16)	10.5	(2.3)	9.6	(2.7)	
Perceived neighborhood safety (0–8)	5.8	(1.2)	5.7	(1.9)	
Age (18–26)	22.9	(2.5)	22.3	(2.7)	
Male	58.4	-	32.5	-	
NH White	51.7	-	45.1	-	
Latino	30.8	-	26.4	-	
NH Black	0.0	-	23.7	-	*
NH Asian	4.5	-	4.8	-	
NH Multiracial	12.9	-	0.0	-	
Mother’s educational attainment	11.1	(3.5)	10.3	(3.4)	
Very good/excellent self-rated health	57.8	-	54.9	-	

Statistically positive (*) or negative (†) association with daily cannabis use in bivariate analysis

Table 5.

Weighted sample characteristics of participants in the study area with statistically significant local regression associations for perceived neighborhood safety

San Francisco County	Perceived Neighborhood Safety			
	μ or % / (S.D.)			
	No cannabis use		Used cannabis	
Characteristics	**N = 211**		**N = 48**	
Days of cannabis use in past 30	0.0	-	8.9	(11.4)
Years of neighborhood residence (0–26)	15.7	(7.8)	11.4	(9.2)
Neighborhood disorder (0–14)	3.5	(3.4)	3.6	(3.8)
Neighborhood social cohesion (0–16)	9.4	(2.2)	9.8	(2.0)
Perceived neighborhood safety (0–8)	6.1	(1.4)	6.6	(1.3)
Age (18–26)	23.2	(2.4)	22.9	(2.3)
Male	51.7	-	53.0	-
NH White	25.4	-	36.5	-
Latino	8.5	-	19.4	-
NH Black	17.3	-	4.5	-
NH Asian	63.5	-	18.7	-
NH Multiracial	0.84	-	21.0	-
Mother’s educational attainment	10.5	(3.6)	12.4	(2.0)
Very good/excellent self-rated health	60.6	-	69.0	-

Statistically positive (*) or negative (†) association with daily cannabis use in bivariate analysis