Clustering of Black Adolescent Marijuana Use in Low-Income, Urban Neighborhoods

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INTRODUCTION

The prevalence of adolescent marijuana use has historically been higher in Whites than Blacks. This changed in the mid-2000s when past 30-day marijuana use leveled off among White adolescents and increased among Blacks. Now, Black 8th, 10th, and 12th graders have higher prevalence of past 30-day marijuana use than Whites.[1] Few studies, however, have focused on factors that might explain this trend, in particular neighborhood factors that may be especially salient for this at-risk population.[2] Black youth disproportionately reside in urban neighborhoods with high levels of crime, poverty, and violence wherein a wide array of illegal behavior, including marijuana use, may be reinforced.[3–5]

This study examines the geographic clustering of Black adolescent marijuana use in urban neighborhoods. For the purposes of this paper, *clustering* refers to the tendency of behaviors of individuals living in the same neighborhood to be more alike than that of individuals from different neighborhoods. In most studies, clustering of outcomes is treated as a *design effect* that must be accounted for in order to estimate variances correctly. However, clustering is an important aspect of the epidemiology of marijuana use that may shed light on aspects of the shared neighborhood environment driving higher or lower prevalence of use in certain neighborhoods and thus may inform community-wide prevention programs. Whereas our prior studies have examined whether geographically defined contexts (e.g., neighborhood disadvantage) were associated with an individual's risk of using marijuana,[6,7] in this study, we examine whether neighborhood-level characteristics are related to the geographic clustering of marijuana use in neighborhoods, e.g., does marijuana use cluster in more disadvantaged neighborhoods? Because we know that individuals from the same socioeconomic status tend to cluster their residences in self-selected neighborhoods,[8,9] it will be important to examine whether any clustering can be explained by the characteristics of the individuals who live in the neighborhood. In particular, we will examine whether neighborhood crime, violence, and poverty impacts clustering of marijuana use in neighborhoods over and above the impact of personal

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socioeconomic characteristics that may limit residential options. This will provide evidence as to whether neighborhood-level factors add collective or environmental disadvantage to the individual disadvantage of residents.[10] We focus on adolescence because initiation during this developmental period is associated with an increased risk of both addiction and use of other illicit drugs.[11,12]

METHODS

Participants and Procedures
In 1993, 799 first graders were recruited from nine Baltimore City public elementary schools. Three classrooms in each school were randomly assigned to one of two interventions or a control condition. Interventions targeted early learning and aggression and were provided over the first-grade year. Of this 799, 371 youths still resided in Baltimore City during 8th grade and had data available for this analysis. Data used for the current study was restricted to Black adolescents ($n = 341$) to more accurately reflect the nature of Black adolescent marijuana use in the context of the neighborhoods where they live. The number of non-Black adolescents ($n = 30$) was too small to make meaningful comparisons between Blacks and non-Blacks. Fifty-two percent of the analytic sample is male and 67 % were receiving free or reduced-price meals in 8th grade (a proxy for low socioeconomic status (SES)). The mean age was 13.7 years (range 12.4 to 15.3). This research was reviewed and approved by the Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health. Written parental consent and youth verbal assent were obtained for youths to participate in middle school assessments. Black adolescents in the analytic sample were more likely to be receiving free or reduced-price meals than Black adolescents not included, possibly due to the fact that lower-income families do not have the resources to move to more affluent areas outside of Baltimore City.[13] The groups did not differ in terms of sex, intervention status, or behavioral problems in first grade (i.e., aggression, oppositional defiant behaviors, and concentration problems).

Measures
Questions regarding marijuana use were asked via audio computer-assisted self-interviews in the spring of 8th grade. Adolescent reports of marijuana use were based on asking "Have you ever used marijuana?" Because past-year marijuana use occurred too rarely for stable parameter estimation, we relied on lifetime reports of marijuana use. Data on neighborhood factors including crime and poverty by census tract were provided by the Baltimore City Data Collaborative; a joint venture of the Family League of Baltimore City; Baltimore Safe and Sound Campaign; and the Johns Hopkins Bloomberg School of Public Health. Census tract level data used in the present study were as follows: adult arrest rates for non-violent (arson, larceny, burglary, stolen vehicles) and violent offenses (homicide, rape, aggravated assault, and robbery), calculated as the number of arrests per 1000 population; juvenile arrest rates for non-violent, violent, and drug-related offenses, each calculated as the number of arrests per 1000 youth aged 10 to 17; child abuse and neglect rate, calculated as the number of substantiated cases per 1000 youth aged 0 to 17; and percentage of families in poverty and percentage of single-parent families. Census tract level data

were from the 2000 decennial census, the year prior to when the youth survey was collected. Youth addresses in 8th grade were geocoded to the census tract level.

Data Analysis Plan

The clustering of marijuana use was estimated within-census tracts (herein called neighborhoods) using alternating logistic regression (ALR) models.[14] This method has been used by several researchers to examine the clustering of drug use in neighborhoods.[15–20] ALR is a statistical method that uses pairwise odds ratios (PWORs) to estimate the association between binary responses (e.g., yes/no) from individuals residing in the same geographical area. The PWOR can be calculated from a 2×2 table containing all possible pairs of youth (each with a binary 0/1 outcome) from the same neighborhood.[21] The number of discordant pairs (0, 1) and (1, 0) is evenly divided in the table. The PWOR is calculated like an ordinary odds ratio, $PWOR = a \times c / (b/2)^2$ where a is the number of (1, 1) pairs (e.g., both youths report marijuana use), c is the number of (0, 0) pairs (e.g., both youths report no marijuana use), and b is the number of discordant pairs (e.g., only one youth in the pair reports marijuana use). This PWOR is sometimes referred to as the *crude* or unadjusted PWOR. Consistent with odds ratios from logistic regression analysis, the PWOR takes a value of 1.0 when there is no clustering of the outcome of interest. A PWOR greater than 1.0 indicates that the marijuana use of one youth is statistically dependent upon the marijuana use of another randomly chosen youth residing in the same neighborhood, over and above the expectation based upon randomly paired selections of youth without respect to neighborhoods.

To address the question of whether marijuana use clusters within neighborhoods as a function of neighborhood-level characteristics, ALR can also model the PWOR using a log odds ratio regression model given by

$$\text{Log PWOR}\left(Y_{ijk}, Y_{ilm}\right) = \alpha_0 + \Sigma \alpha_k Z_{ijklm}, \ j \neq l \tag{1}$$

where $Y_{ijk} = 1$ if the jth youth in the ith neighborhood of type k reports marijuana use and Y_{ilm} is the corresponding response for the lth youth in the ith neighborhood of type m and $Z_{ijklm} = 1$ if $k = m$ (that is, youth j and l reside in the same neighborhood of type k). It follows that $\exp(\alpha_0)$ is the PWOR for the reference-type neighborhood and $\exp(\alpha_0 + \alpha_k)$ is the PWOR within-neighborhood of type k. In this analysis, we define a neighborhood type by membership above or below the median representing adult arrest rates for non-violent and violent offenses; juvenile arrest rates for non-violent, violent, and drug-related offenses; rates of child abuse and neglect; and the percentage of families in poverty and the percentage of single-parent families. Each neighborhood-level characteristic is considered in a separate PWOR model.

ALR models can also estimate the association between individual-level covariates and marijuana use by alternating iteratively between the log odds ratio regression model for the clustering given in Eq. (1) and a logistic regression model for marijuana use. Fitting these models jointly can be interpreted as adjusting the clustering for the composition of neighborhoods with respect to individual-level factors.[17] In this analysis, we will adjust for an individual's gender, age, and intervention group and whether they received free or reduced-price meals (a proxy for SES) in 8th grade. All models were fit using SAS PROC GENMOD with the LOGOR option on the REPEATED statement.

RESULTS

Respondents were spread across 91 census tracts. There was an average of 4 youths per tract with a range from 1 to 22. Table 1 contains the descriptive data for the 91 census tracts obtained from the Baltimore City Data Collaborative for the year 2000. The median percentage of families living in poverty and single-parent families were 17.6 and 40.2 %, respectively. The median arrest rates for adult non-violent and violent offenses per 1000 population were 55.3 and 22.2, respectively. The corresponding rates for juveniles per 1000 10–17-year-old youth were 18.5 and 9.1, respectively. In comparison, the juvenile arrest rate for drug-related crimes was 29.6 per 1000 youth aged 10–17.

By 8th grade, 25 % of the sample had used marijuana. Both gender and age were associated with lifetime marijuana use based on the mean model (not shown). Males were almost twice as likely as females to have ever used marijuana (odds ratio (OR) = 1.83; 95 % confidence interval (CI) = 1.10, 3.03). The strongest association was with age with the likelihood of marijuana use increasing with age (OR = 2.30; 95 % CI = 1.21, 4.40). There was no association with intervention group or receiving free or reduced-price meals. Lifetime marijuana use did not significantly cluster within neighborhoods either before (PWOR = 1.12; 95 % CI = 0.86, 1.45) or after (PWOR = 1.20; 95 % CI = 0.89, 1.61) adjustment for these individual-level covariates. However, after stratifying by census-level characteristics using the model in Eq. (1), marijuana use clustered significantly in neighborhoods with higher rates of adult non-violent (PWOR = 2.10; 95 % CI = 1.12, 3.95) and violent (PWOR = 1.29; 95 % CI = 1.01, 1.66) crimes and juvenile non-violent crimes (PWOR = 1.54; 95 % CI = 1.00, 2.41). Marijuana use also clustered significantly in neighborhoods with higher rates of child abuse and neglect (PWOR = 1.34; 95 % CI = 1.06, 1.70) and higher percentages of single-parent families (PWOR = 1.29; 95 % CI = 1.01, 1.65) (Table 2).

DISCUSSION

Using data from a study of primarily low-income, Black adolescents living in urban neighborhoods, we found that marijuana use clustered in neighborhoods with higher rates of crime, child abuse and neglect, and percentage of families living in poverty. The largest effects on clustering were for adult and juvenile non-violent crime. Marijuana use co-occurred twice as often in neighborhoods with higher rates

TABLE 1   Census tract level data, 2000 (data from the Baltimore City Data Collaborative)

Rate or percent	Mean (SD)	Range	Median
Adult non-violent crime arrest rate[a]	63.6 (34.1)	18.9–224.7	55.3
Adult violent crime arrest rate[a]	24.9 (14.2)	2.1–59.2	22.2
Juvenile non-violent crime arrest rate[b]	23.3 (18.0)	0.0–97.6	18.5
Juvenile violent crime arrest rate[b]	10.6 (8.9)	0–50.7	9.1
Juvenile drug-related crime arrest rate[b]	36.1 (28.2)	0–110.1	29.6
Rate of child abuse and neglect[c]	13.4 (8.9)	0–62.1	12.3
% families below poverty level	20.5 (12.8)	1.5–62.1	17.6
% single-parent families	39.7 (13.4)	7.2–69.7	40.2

[a]Per 1000 population
[b]Per 1000 population aged 10–17
[c]Per 1000 families

TABLE 2 Adjusted pairwise odds ratio (PWOR) of within-neighborhood marijuana use stratified by neighborhood factors

Rate	Below median PWOR (95 % CI)	Above median PWOR (95 % CI)
Adult non-violent crime	1.02 (0.73, 1.42)	2.10 (1.12, 3.95)
Adult violent crime	1.12 (0.72, 1.73)	1.29 (1.01, 1.66)
Juvenile non-violent crime	1.11 (0.76, 1.62)	1.54 (1.00, 2.41)
Juvenile violent crime	1.20 (0.86, 1.67)	1.22 (0.67, 2.22)
Juvenile drug-related crime	1.19 (0.84, 1.68)	1.27 (0.74, 2.15)
Child abuse and neglect	1.05 (0.64, 1.72)	1.34 (1.06, 1.70)
Families below poverty level	1.10 (0.74, 1.62)	1.33 (0.99, 1.78)
Single-parent families	1.09 (0.66, 1.79)	1.29 (1.01, 1.65)

Adjusted for gender, age, intervention group, and free and reduced-price meal status in 8th grade

of adult non-violent crime and 1.5 times more often in neighborhoods with higher rates of juvenile non-violent crime than one would expect if marijuana use was randomly distributed across neighborhoods. Both of these PWORs lie outside of the 95 % CI bound for the crude PWOR (1.12; 95 % CI = 0.86, 1.45). In comparison, marijuana use occurred approximately 1.3 times more often in neighborhoods with higher rates of adult violent crime, child abuse and neglect, and percentage of single-parent families, still one standard error greater than the crude PWOR point estimate. Although the adjusted PWOR across all neighborhoods was not statistically significant (PWOR = 1.20; 95 % CI = 0.89, 1.61), it was comparable in magnitude to that observed in a study of clustering of lifetime marijuana use within neighborhoods in the USA[19] (PWOR = 1.3; 95 % CI = 1.2, 1.4) and past-year marijuana use at the meshblock level in New Zealand[20] (PWOR = 1.3; 95 % CI = 1.2, 1.5).

The stronger magnitude of the effects of adult and juvenile non-violent crime on the clustering of adolescent marijuana use might be explained by prior research that has shown that the absence of male role models participating in legitimate labor market activity in a neighborhood is associated with higher rates of juvenile crime.[22] This in turn may support the formation of delinquent peer groups that normalize, support, and encourage a wide range of deviant behaviors including drug use.[23,24] Clustering of marijuana use in neighborhoods with higher rates of crime may therefore be occurring through deviant peer networks. Additionally, urban neighborhoods characterized by the highest rates of crime may be faced with a scenario where the *law of the streets* outweighs the residents' capacity to maintain safety and control. Neighborhood crime often brings with it social disorder that can hinder the residents' effectiveness to improve their neighborhood and their willingness to sustain their activism.[25] Residents may be unable to maintain informal social controls over activities in their neighborhood (e.g., monitoring street corner activity, intervene when a crime is committed) out of fear for their own safety as well as a feeling of powerlessness. As a result, drug activity may flourish, thereby promoting ease of availability to youth as well as reinforcement of positive drug-using norms.

Higher rates of substantiated cases of child abuse and neglect may be a marker for higher concentrations of substance-abusing caregivers; 40–80 % of all child maltreatment is reported to involve parental substance abuse problems.[26] Marijuana use may be co-occurring among youth living in neighborhoods with

higher rates of abuse and neglect because of their exposure to positive drug-using norms by not only their own caregivers but also other adults in the neighborhood.

Neighborhoods with more single-parent families may signal two things that support a clustering of marijuana use in these neighborhoods. First, single-parent family is a proxy for low socioeconomic status. Concentrated disadvantage can isolate residents from key resources supporting a collective social control leading to perceived powerlessness to intervene on behalf of the community as stated earlier, thereby supporting an illegal behavior such as drug use.[27,28] Secondly, neighborhoods with more single-parent families, most of which are likely to be female-headed households, may lack parental monitoring and supervision as well as collective parental monitoring over youth activities in the neighborhood.[29]

Limitations of this research merit discussion. First, the data are based solely on self-reports of marijuana use and may be under-reported, although as noted by Anthony and colleagues,[30] this is much less likely for reports of substance use than other behavioral health problems. Second, we relied on a lifetime history of marijuana use which means that marijuana use may have occurred in a neighborhood other than the 8th grade neighborhood. We note, however, that most of the lifetime users in 8th grade are recent initiators; only 5 % of the sample had used marijuana by spring of 6th grade. Finally, our models include salient neighborhood characteristics theoretically linked to adolescent marijuana use but there are other potentially important characteristics of the neighborhood environment that might account for geographic clustering of marijuana use not included here (e.g., drug markets).

Despite these limitations, this research provides preliminary support for clustering of marijuana use among young Black, low-income, urban adolescents in neighborhoods with higher rates of crime, child abuse and neglect, and single-parent households. One of the strengths of the study was the use of independent and objective measures (e.g., violent crime, census measures) to characterize the neighborhood environment. These neighborhood factors are worth exploring in future efforts as a criterion to select geographic communities for targeted marijuana prevention activities. Future research will examine clustering in this population in later adolescence and young adulthood to see if these relationships persist over time.

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