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Exploration of the Link between Tobacco Retailers in School Neighborhoods and Student Smoking

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Abstract

BACKGROUND—School smoking bans give officials the authority to provide a smoke-free environment, but enacting policies within the school walls is just one step in comprehensive tobacco prevention among students. It is necessary to investigate factors beyond the school campus and into the neighborhoods that surround schools. The purpose of this study was to explore the relationship between the density of tobacco retailers and the illegal tobacco sales rate within school neighborhoods and smoking behaviors among students.

METHODS—This study utilized secondary data from the baseline of the Youth Tobacco Access Project. Data were collected from 10,662 students attending 21 middle schools and 19 high schools, in addition to 512 tobacco retailers, all within 24 towns in Illinois during 2002. A random-effects regression analysis was performed to assess the relationship between the density of tobacco retailers and illegal tobacco sales rates on current smoking and lifetime smoking prevalence.

RESULTS—Schools had a range of between zero and 9 tobacco retailers within their neighborhood with a mean of 2.76 retailers (*SD*= 2.45). The illegal sales rate varied from zero to 100%, with a mean of thirteen percent. The density of tobacco retailers was significantly related to the prevalence of ever smoking among students (*b*= 0.09, *t*(29) = 2.03, p = .051, *OR* = 1.10), but not to current smoking (p >.05); the illegal tobacco sales rate was not related to current smoking or lifetime smoking prevalence (p >.05).

CONCLUSION—Results indicate that tobacco retailer density may impact smoking experimentation/initiation

There is a growing appreciation among social scientists that neighborhoods and geographical context are important predictors of health behaviors.[1] Geographical mapping has shown the disparities in the availability of fresh fruits and vegetables between minority and non-minority communities,[2] access to safe neighborhood recreation,[3] as well as a disproportionate concentration of fast-food[4] and alcohol retailers[5] in lower socio-economic

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communities. Moreover, research has shown linkages between the availability of alcohol in neighborhoods (eg, density of liquor stores) and a host of negative outcomes such as violent crime,[6] binge drinking and driving among adolescents,[5](p266) and injurious automobile crashes.[7] This research linking environmental characteristics to health behaviors extends to school environments and youth tobacco use.

A study of tobacco sales revealed that 62% of all of the illegal sales were within one mile of a school; these authors argued that close proximity to schools of tobacco retailers and tobacco advertising increases youth access to tobacco.[8] Another investigation found that stores located near schools with a higher smoking prevalence had significantly lower cigarettes prices, fewer government-sponsored health warnings, and more in-store tobacco promotions, when compared to schools with lower smoking prevalence.[9] A study of billboard advertising found that 74% of the billboards were within just 2,000 feet of public school property and nearly 20% of billboards contained tobacco advertising.[10]

Interestingly, one study documented that youth who lived in areas with the greatest tobacco retailer density were more likely to be current smokers than were youth who lived in the areas with the lowest density.[11] However, studies on the density of tobacco retailers within school neighborhoods have shown mixed results. Henrikson and colleagues found that the prevalence of smoking was 3.2 percentage points higher among students in schools with the highest density of tobacco retailers, compared to students in schools without any tobacco retailers.[12] Another study found no significant link between the number of tobacco retailers and school smoking prevalence among a sample of high schools.[9](p268)

More applied research with policy implications that are relevant to both school professionals and to public health and community planners is needed to engender healthy school environments. For example, research is needed to clarify the impact that the tobacco retailer density within a school neighborhood has on youth smoking, to elucidate potential policy intervention levers. Additionally, information is needed on the impact on students of illegal tobacco sales within school neighborhoods. The present study hypothesized that the density of tobacco retailers and the illegal tobacco sales rate within school neighborhoods would relate to current smoking and lifetime smoking prevalence among students.

METHODS

This study accessed data from the baseline of the Youth Tobacco Access Project (YTAP), a 5-year intervention study of youth tobacco use funded by the National Cancer Institute.[13] YTAP was conducted from 2000 through 2005 and sought to determine if enhancing police enforcement of Possession, Use, and Purchase (PUP) laws (such as providing youth with civil citations for possessing or using tobacco in public spaces) led to reduced tobacco usage among youth, and both conditions of the larger study focused on reducing minors' access to commercial sources of tobacco. This current study focused on procedures and data collected before intervention, during the baseline of the project.

Three data sources were used for this study: the *YTAP Student Survey data, Tobacco Purchase Attempts Assessments*, and *United States Census* data. Data were collected from 10,662 students attending 21 middle schools and 19 high schools. Data also were collected from Tobacco Purchase Attempts of 512 tobacco retailers, all within 24 towns in Illinois during 2002. The DePaul University Institutional Review Board approved YTAP study methods.

Participants

Of 19,837 eligible students in grades 7–10, parental consent was obtained for 12,859 students (65%). A total of 10,737 eligible participants went on to complete the survey (54%), and 75 (0.7%) were excluded from the analyses because of inconsistent or invalid responding across survey items. In addition, data from students in 6 high schools was eliminated from the current study, as Tobacco Purchase Attempts did not occur in these school neighborhoods during the baseline. This resulted in a sample of 21 middle schools, 13 high schools, and 9,704 student participants (see Table 1 for descriptive information on students).

Instruments

The *Student Survey* contained 79-items adopted from other established measures of students' attitudes and behavior toward tobacco, alcohol, and other drugs. Questions were modified from the *Youth Risk Behavior Survey*,[14] as well as surveys developed by Rigotti et al.,[15] and Altman et al.,[16] and the *Teenage Attitudes and Practices Survey*.[17]

Tobacco Retailer Inspection Data Collection Forms were used to document Tobacco Purchase Attempts to obtain the illegal sales rate in the study towns. After the attempt was complete, the youth field agent documented whether the sale occurred, along with other characteristics of the sale (eg, whether the youth was asked for identification; price of cigarettes), the retailer (eg, whether sales law or tobacco promotional signage was present), and the merchant (eg, demographics).

Procedures

Forty schools participated in data collection during baseline; of these, 34 schools were included in the analyses (again, 6 schools were excluded as Tobacco Purchase Attempts were not conducted at baseline in those areas). A population-based sampling strategy was employed at schools for data collection of the *Student Survey*. Based on the decision of the school administrator, either all students enrolled in the targeted grades or only students who lived in the participating community enrolled within the targeted grades were invited to participate. Members of the research team administered surveys to students in classrooms or small groups using a standardized protocol.

To identify the tobacco retailers for the Tobacco Purchase Attempts, identical lists to those used in the Illinois Liquor Control Commission's Kids Can't Buy 'Em Here merchant compliance program were obtained by YTAP personnel. The research team recruited youth to participate as field agents from Chicago high schools; in order to standardize the procedure across towns and minimize potential bias, only female youth aged 15 or 16 were recruited. Informed, active consent was necessary from both the youth and one of their parents/legal guardians in order for the youth to participate. Youth were paid $5.50 per hour for their participation, and were required to conform to the following dress code: (1) wear casual clothes (jeans and T-shirt/sweatshirt), (2) clothes could not indicate school affiliation or display any tobacco or alcohol images, and (3) wear little or no makeup and little or no jewelry. Finally, all of the field agents were rated as appearing to be 15 or 16 years of age by 2 independent judges.

A standard protocol was utilized for completing the tobacco purchase attempts. The attempt was conducted as follows: (1) field agents entered establishments that sell tobacco products to make the purchase attempts. Project staff remained outside in an unobtrusive location, (2) field agents canceled the attempt and left the establishment if they saw someone they knew (eg, a clerk or customer) and a second assessment was made later in the day, (3) field agents were courteous during the attempts and kept conversations to a minimum, (4) field agents

asked the clerk for a popular brand of cigarettes (eg, Marlboro Lights or Newport Lights) or selected them from a vending machine. If the retailer did not sell cigarettes, then the field agent asked for a popular brand of cigars, or asked for tobacco, (5) If the clerk asked the youth for their age, field agents gave the clerk the photo ID card and said, "Here is my ID." (6) If the clerk asked the youth for ID, field agents gave the clerk the photo ID card. Field agents were instructed to cancel the purchase attempt if they felt unsure about their safety. After the purchase attempt was complete they completed the *Tobacco Retailer Inspection Data Collection Form.*

After purchase attempts, all retailers were sent a letter informing them of the outcome of their inspection and a copy of their towns' tobacco ordinance. Outcomes of the inspection efforts were also shared with the towns' police department to aid them in their efforts to reduce illegal tobacco sales to minors. However, no legal enforcement occurred as a result of the YTAP purchase attempts.

Data Analysis

A random-effects regression analysis was performed using HLM 6.03;[18] this analytic approach was selected due to the nested design of sampling students within schools, and the multilevel data. Models were analyzed assuming over-dispersion.

Address data (for schools and merchants) were cleaned to ensure that addresses were systematically classified (eg, street address with correct municipal abbreviations, city, state, zip code). The addresses were then geocoded using the website batchgeocode.com. Locations were matched through the United States Census Bureau's TIGER/LINE®[19] files and ArcMap version 9.1[20] was used to conduct a buffer analysis around each school. This study used the area within a one half-mile radius of the school to define the school neighborhood. As Truong and Sturm point out, one half-mile is approximately a 10-minute walk from the school.[21] In addition, Henriksen, et al.[12](p211) noted that a half-mile radius from a central point is commonly used to characterize environmental contributions to health behaviors, including cigarette smoking,[22] alcohol use,[23] and exercise.[24]

Six hundred seventy eight tobacco retailers within the school neighborhoods were identified using these parameters. One hundred sixty-six retailers were excluded because they no longer sold tobacco at the time of the purchase attempt (eg, out of business; N = 30, 4.4%), were not appropriate (eg, adult-oriented business; N = 81, 11.9%), or were not able to be accessed during data collection (eg, seasonal retailers; N = 55, 8.1%). This left 512 retailers in the 24 towns.

The school neighborhood areas were matched to their representative census tracts to identify the population density and median household income of the areas. Census data were used to determine the population density of the neighborhood areas as well as the neighborhood median household income.[19] In neighborhoods with more than one census tract, data were averaged to create a mean population density and mean median household income. Tobacco retailer density represents the number of tobacco retailers within a half-mile radius of the school. The illegal tobacco sales rate represents the proportion of tobacco retailers within the half-mile school neighborhood who illegally sold tobacco to youth field agents during the tobacco purchase attempt.

Current smoking was coded as a dichotomous variable determined from the following question: *"During the past 30 days, on how many days did you smoke cigarettes?"* Given the skewed distribution of the data the variable was dichotomized; students who reported no cigarette use in the past 30 days were not considered current smokers, while all others were considered current smokers. Lifetime smoking was coded as a dichotomous variable in

response to the question *"About how many cigarettes have you smoked in your entire life?* Students who reported more than "none" were considered ever smokers.

Demographic information was collected and coded as follows. Sex was coded as a dichotomous variable determined from the response to the question *"What is your gender?"* Students were asked the question *"What grade are you in?"* Race/ethnicity was determined from responses to two questions; *"Are you of Latino or Hispanic origin?* (Yes or No)," and "*How do you describe yourself? Mark all that apply* (Asian, Black/African American, Middle Eastern, Native Hawaiian/Other Pacific Islander, Native American/Alaskan Native, White/Caucasian, Other)." The race/ethnicity variable was reduced to 4 categories to represent the largest reported race/ethnicity groups (ie, White/Caucasian, Black/African American, Latino/Hispanic origin, and Other). For the present analyses, the variable was indicator (ie, dummy) coded by creating dichotomous variables indicating African American, Latino, and Other in contrast to White/Caucasian. Therefore, in all analyses, Caucasian youth are the reference group for each of the 3 dummy coded race/ethnicity variables.

Level 1 variables (person-level variables in this case) included grade, race/ethnicity, sex, and current smoking status. In all models, grade was centered around the group mean. Level 2 variables (school-level indicators in this case) included the density of tobacco retailers, the illegal tobacco sales rate, median neighborhood income and mean neighborhood density. All level 2 variables were centered around the grand mean and the outcomes were run using a Bernoulli model. Two models were included in the analyses.

Model 1 tested the hypotheses that students with a higher density of tobacco retailers or a higher illegal tobacco sales rate in their school neighborhoods were more likely to be current smokers. Level 1 (individual) included grade, race/ethnicity, sex, and the outcome variable-current tobacco use. Level 2 included the density of tobacco retailers, the illegal tobacco sales rate, median income, and mean population density.

Model 2 tested the hypotheses that students with a higher density of tobacco retailers or a higher illegal tobacco sales rate in their school neighborhoods were more likely to have ever smoked. Level 1 (individual) included grade, race/ethnicity, sex, and the outcome variable-lifetime smoking prevalence. Level 2 included the density of tobacco retailers, the illegal tobacco sales rate, median income, and mean population density.

RESULTS

The median income of the school neighborhoods (ie, within a half-mile radius) ranged between $21,817 and $128,696 (M= $59,968; SD=$18,899), and the mean population density ranged between 2,670 and 13,980 (M= 5,515; SD= 2,067). Schools had a range of between 0 and 9 tobacco retailers within their neighborhood with a mean of 2.76 retailers (SD= 2.45). The illegal sales rate varied from zero to 100%, with a mean of 13% (SD= 0.24).

Unconditional means models were employed to confirm significant between-school variation of the dependent variables. Results revealed significant between-school variation for current smoking (σ^2 =0.43, x^2 (33) = 281.59, p < .001), as well as for lifetime smoking prevalence (σ^2 =0.38, x^2 (33) = 607.29, p < .001). These results indicate clustering and confirm the need for a multilevel analytic strategy.

Model 1. Current Smoking

A 2-level hierarchical linear model assessed the effect of the density of tobacco retailers and the illegal tobacco sales rate within a half-mile neighborhood around the school on students' current smoking (see Table 2). None of the Level 2 variables were significant.

Model 2. Lifetime Smoking Prevalence

A 2-level hierarchical linear model assessed the effect of the density of tobacco retailers and the illegal tobacco sales rate on the lifetime prevalence of smoking by students (Table 3). The density of tobacco retailers was significantly related to the prevalence of ever smoking among students (b= 0.09, $t(29)$ = 2.03, p = .051, OR = 1.10). After controlling for other variables, schools with fewer tobacco retailers in the half-mile neighborhood around the school had lower lifetime smoking prevalence among students. For each additional tobacco retailer within the half mile of the school, the odds that the average students ever smoked increased by approximately 10%.

DISCUSSION

The current study sought to identify school neighborhood risk factors for student smoking. It was hypothesized that the density of tobacco retailers and the illegal sales rates in school neighborhoods would be associated with current smoking, and lifetime smoking prevalence. The association between the density of tobacco retailers and lifetime smoking prevalence was the only hypothesis supported in the current study.

The finding that the density of tobacco retailers was not associated with current smoking prevalence is consistent with results observed among high schools in Canada.[9](p268) Research conducted in California schools found that the density of tobacco retailers within a mile radius of schools was related to high school students' reports of experimental smoking, but not to established smoking.[25] A high density of tobacco retailers in areas frequented by youth may implicitly increase their perception of access. Students who perceive that tobacco is easy to obtain by youth may also believe that it is condoned or sanctioned by their community and peers. Additionally, advertising and tobacco promotions influence youth normative beliefs about the acceptability of tobacco. A high density of tobacco retailers in the school neighborhood likely exposes youth to more tobacco advertising (eg, while purchasing snacks during an open-campus lunch hour, while congregating with peers in front of corner markets or convenience stores after school), and may negatively shape their normative beliefs. More research is needed to understand the differential influences that the density of tobacco retailers around schools may play in smoking experimentation among students in middle school versus high school.

The finding that retailer density was associated with lifetime smoking, but not current smoking indicates that neighborhood factors may have more influence on youth who are not already regular smokers. In contrast to current smoking, initial smoking experimentation may be more amenable to prevention efforts. More research is needed to validate this finding. If true, more exploration should be conducted to determine what other environmental factors may affect smoking experimentation, and environmental interventions should be targeted towards non-smoking youth to prevent or delay onset of experimentation with tobacco. Enactment of zoning ordinances within the school neighborhood, or licensing and limiting the number of retailers would reduce the density of tobacco outlets in the school community. As the public may be more likely to support policies aimed specifically at areas frequented by youth, public ordinances and zoning restrictions targeted in the half-mile neighborhood around schools might be more easily adopted and implemented than policies which try to span a larger area, without significant decay of their intended effects.

The illegal tobacco sales rate was also not related to student smoking, which may be due to the possible instability of the sales rate data. Additionally, given the reduction in illegal tobacco sales to minors in the past decade, there was a low base rate and restricted range of illegal tobacco sales within the sample school neighborhoods (eg, only 11 schools had at least one illegal sale) which resulted in low power to detect differences. Knowledge of the actual sales rates within school neighborhoods may be limited to current or past tobacco users, and a higher illegal tobacco sales rate within an area may be less likely to implicitly increase perceptions of access among youth who have not tried cigarettes.

Tobacco control advocates have largely ignored the possibility of using zoning tools (such as those used in alcohol control) to limit the location and number of tobacco retail outlets,[26] and researchers have called for investigations on tobacco outlet density and proximity to schools as a possible risk factor for youth smoking.[27] Results indicate that tobacco retailer density may impact smoking experimentation/initiation. More research is needed to understand how this mechanism works. It is possible that a higher density of retailers around schools increases youth exposure to smoking models (eg, those purchasing cigarettes, people smoking on their routes to school), and increases their perceptions of tobacco's acceptability in the school neighborhood. Qualitative methods, such as focus groups of students in different neighborhood contexts, may provide important information on how the school neighborhood, and specifically on the density of tobacco retailers, affects youth normative beliefs.

Limitations

Utilization of multi-level modeling, the large student sample size, and the usage of both student self-reports and retailer observational data lend support to these findings. However, several limitations of the present study should be discussed.

The Synar Amendment (Public Law 102–321)[28] has considerably decreased rates of illegal tobacco sales to minors in the past decade. This encouraging trend also restricted the amount of power for this study to detect differences in sales rates, as there was a low base rate of tobacco sales in school neighborhoods. Given that the data on illegal sales was collected in 2000, this limitation would likely be further pronounced using more recent data. However, the density of tobacco retailers, the variable linked to lifetime tobacco use in this study, is unlikely to have significantly systematically changed from this period, although additional geographic surveys would need to be conducted to validate this assumption. An additional limitation is that the sales rate data was collected at one point in time and may not reflect the true rate of illegal tobacco sales in each area.

Importantly, although the student survey included over nine thousand participants, as with many ecological studies, the unit of analysis was small, and was restricted to the number of schools in the study (ie, N = 34). This limited the number of variables that could be investigated at the school-level, and reduced the power of the analysis. However, the costs of conducting large community studies are often prohibitive, and these results can provide important insight into these contextual variables.

The use of a cross-sectional design limits the ability to understand the causal relationship between the density of tobacco outlets within the half-mile neighborhood of schools and students' experimenting with smoking. Whereas randomized community trials on the density of tobacco retailers would provide more insight into the causal pathways of these variables, the logistical considerations of a study like this make it unlikely.

An additional possible limitation of this research was the operational definition of "school neighborhood." A half-mile buffer zone was used to explore the impact of school

neighborhood characteristics on tobacco use behaviors. However, students may not conceptualize their school neighborhood according to these parameters; individual differences (eg, walking to school versus driving to school) and school differences (eg, urban versus rural, neighborhoods broken up by a major highway or thoroughfare) may impact the sense of the neighborhood. To maintain consistency across school and to be able to compare these outcomes to previous research, neighborhood buffers were chosen that were similar to those used by other researchers studying school context.

IMPLICATIONS FOR SCHOOL HEALTH

This study links school neighborhood factors to risk-taking behaviors of students. The findings underscore the importance of school professionals promoting healthy environments for students beyond the building walls. Given the findings of this study, education and health professionals should advocate for zoning and licensing restrictions that reduce, limit, or eliminate the number of tobacco retailers in school neighborhoods. Schools could partner with student groups, parents, or local health coalitions to raise awareness about the issue within the larger community. An example strategy would be to publicize geographic surveys conducted by students that map the concentration of tobacco retailers and tobacco promotion/advertising located in school neighborhoods or along school routes. These results would visually display to policy makers and opinion leaders the exposure to tobacco and tobacco marketing students encounter via their school attendance, and could leverage support for policy initiatives. School health professionals could further capitalize on student participation in the geographic surveys by asking them to think critically about the impact of tobacco marketing on smoking behavior, and by holding discussion groups with peers about the findings.

An explicit linkage between social science research, school health, and community planning will allow for bench science to more quickly influence social and school policy and public health outcomes. Researchers should both ensure that their questions have practical applications, as well as disseminate their findings through partnerships with schools and by utilizing accessible communication channels. Results of studies like this one provide more support for local efforts by school officials and community members to advocate for healthier settings for youth, such as through the enactment of policies and zoning restrictions that limit tobacco retailers in school neighborhoods.

Human Subjects Approval Statement

The DePaul University Institutional Review Board approved all study methods.

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Table 1

Demographic Characteristics of the Sample

	Total	
Variable	**N**	**%**
Total	9704	100
Grade		
7th	2998	30.9
8th	2722	28.1
9th	2175	22.4
10th	1799	18.5
Missing	10	0.1
Race/Ethnicity		
White/Caucasian	6887	71.0
Latino/Hispanic	1201	12.4
Black/African American	794	8.2
Other/Unknown	822	8.5
Gender		
Male	4607	48.2
Female	4946	51.0
Missing	151	1.6
Ever Smoked[1]		
Yes	2904	29.9
No	6752	69.6
Missing	48	0.5
Current Smoker[2]		
Yes	802	8.3
No	8843	91.1
Missing	59	0.6

Notes.

[1] even a puff.

[2] past 30 days.

Table 2

Relation of Predictor Variables to Current Smoking

		95% Confidence Interval				
Variable/Effect	**Odds Ratio**	**Lower**	**Upper**	***df***	***t***	***p***
Intercept	0.12	0.09	0.18	29	−12.15	.000
Retailer Density	1.04	0.95	1.14	29	0.96	.348
Illegal Sales Rate	1.08	0.41	2.84	29	0.15	.880
Mean Population	0.999955	1.00	1.00	29	−0.98	.335
Median Income	0.999996	1.00	1.00	29	−0.42	.680
Sex	0.82	0.69	0.98	9481	−2.18	.029
Grade	1.73	1.42	2.10	9481	5.54	.000
Latino	1.34	1.09	1.64	9481	2.82	.005
African American	0.48	0.31	0.73	9481	−3.41	.001
Other race	0.71	0.51	0.99	9481	−2.01	.044

Table 3

Relation of Predictor Variables to Lifetime Smoking Prevalence (ie, ever smoked)

		95% Confidence Interval				
Variable/Effect	**Odds Ratio**	**Lower**	**Upper**	***df***	***t***	***p***
Intercept	0.41	0.29	0.57	29	−5.52	.000
Retailer Density	1.10	0.999	1.20	29	2.03	.051
IllegalSales Rate	1.04	0.42	2.57	29	0.10	.924
Mean Population	0.999969	1.00	1.00	29	−0.81	.427
Median Income	0.999995	1.00	1.00	29	−0.67	.509
Gender	1.02	0.89	1.17	9491	0.33	.740
Grade	1.50	1.34	1.68	9491	7.08	.000
Latino	1.57	1.32	1.87	9491	5.17	.000
African American	1.06	0.84	1.33	9491	0.50	.618
Other race	0.86	0.69	1.07	9491	−1.39	.166