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Tobacco outlet density near home and school: Associations with smoking and norms among US teens

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ABSTRACT

This study examined whether living or going to school in neighborhoods with higher tobacco outlet density is associated with higher odds of cigarette smoking among teens, and with perceptions of greater smoking prevalence and peer approval. Using an Internet panel that is representative of US households, we matched data from teen-parent pairs (n = 2771, surveyed June 2011–December 2012) with environmental data about home and school neighborhoods. Density was measured as the number of tobacco outlets per square mile for a ½-mile roadway service area around each participant's home and school. Logistic regressions tested relationships between tobacco outlet density near home and schools with ever smoking. Linear regressions tested relationships between density, perceived prevalence and peer approval. Models were adjusted for teen, parent/household and neighborhood characteristics. In total, 41.0% of US teens (ages 13–16) lived within ½ mile of a tobacco outlet, and 44.4% attended school within 1000 ft of a tobacco outlet. Higher tobacco outlet density near home was associated with higher odds of ever smoking, although the relationship was small, OR = 1.01, 95% CI (1.00, 1.02). Higher tobacco outlet density near home was also associated with perceptions that more adults smoked, coef. = 0.09, 95% CI (0.01, 0.17). Higher tobacco outlet density near schools was not associated with any outcomes. Living in neighborhoods with higher tobacco outlet density may contribute to teen smoking by increasing access to tobacco products and by cultivating perceptions that smoking is more prevalent. Policy interventions to restrict tobacco outlet density should not be limited to school environments.

1. Introduction

There are approximately 375,000 tobacco outlets in the contiguous U.S., nearly seven for every 1000 school-age youth (Center for Public Health Systems Science, 2014). Many of these outlets are convenience stores or small markets, which are popular destinations for teens: 47.5% reported visiting these stores at least weekly (Sanders-Jackson et al., 2015). Tobacco outlets are concentrated in school neighborhoods with higher proportions of Hispanic and low-income students (Henriksen et al., 2008). In neighborhoods with a higher concentration of tobacco outlets, youth are more likely to report purchasing their own cigarettes (Leatherdale and Strath, 2007; Loomis et al., 2012) and underage sales are more prevalent (Lipton et al., 2008; Pokorny et al., 2003).

Concern about disparities in retail access to tobacco products has inspired a growing body of literature that examines whether teens who live or attend school in neighborhoods with higher tobacco outlet density are more likely to smoke. Several studies document that higher tobacco outlet density in school neighborhoods is associated with higher odds of teens' ever smoking (Adams et al., 2013; McCarthy et al., 2009), current smoking (Marashi-Pour et al., 2015; Mistry et al., 2015), susceptibility to future smoking (Chan and Leatherdale, 2011), and with greater school-level smoking prevalence (Henriksen et al., 2008). However, other studies report null findings (Kaai et al., 2014; Lovato et al., 2007). Higher tobacco outlet density where teens live, defined as tract, city or county, is also associated with higher odds of current smoking (Novak et al., 2006) and ever smoking (Lipperman-Kreda, et al., 2012; West et al., 2010). Again, other studies report null findings (Adachi-Mejia et al., 2012; Pokorny et al., 2003).

Two studies have compared tobacco outlet density in both home and school neighborhoods. In California, higher density within 0.75 and 1-mile buffers of teens' home was associated with more frequent smoking, but density near schools was not (Lipperman-Kreda et al., 2014). In Scotland, youth who lived in areas with the highest outlet density had 53% higher odds of being a current smoker; conversely, youth who attended schools in areas of highest outlet density had significantly lower odds of ever smoking and being a current smoker (Shortt et al., 2016). The authors suggested that mandatory school uniforms and higher levels of surveillance among outlets located in close proximity to schools may deter both purchase attempts and underage sales

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(Shortt et al., 2016). Two studies examined distance to nearest tobacco outlet from either school or home as a predictor of teen smoking behavior but neither detected any relationship (Adachi-Mejia et al., 2012; Lipperman-Kreda et al., 2014).

Higher tobacco outlet density reduces search costs for cigarettes and increases environmental cues to smoke (Kirchner et al., 2013; Paynter and Edwards, 2009; Wakefield et al., 2008). In addition, living or going to school in areas that are more saturated with tobacco outlets may serve to normalize tobacco use (McDaniel and Malone, 2014; Wakefield et al., 2006). In New York state, higher tobacco outlet density was associated with an increased likelihood that youth think smoking makes them look cool and fit in (Loomis et al., 2012). However, the association of outlet density with other normative perceptions about tobacco use has received little attention.

The current study contributes to the literature on tobacco outlet density and youth smoking in three ways: (1) it estimates tobacco outlet density and proximity near home and school for a representative sample of US households with teens; (2) it examines whether higher tobacco outlet density near homes, near schools, or both, are associated with higher odds of ever smoking cigarettes, after adjusting for both individual and neighborhood characteristics; (3) it examines a previously unexplored hypothesis about tobacco outlet density and normalization of smoking, by investigating whether youth who live or attend school in areas with higher tobacco outlet density perceive that smoking is more prevalent or perceive greater approval for smoking among peers.

2. Methods

An online survey of teens and their parents provided data for smoking behaviors, normative perceptions, and demographic characteristics of teens, parents and their households. These survey data were matched with neighborhood-level data about participants' residence and school neighborhoods.

GfK (formerly Knowledge Networks) maintains a nationally representative Internet panel of US households, recruited using probability-based random-digit dialing and address-based sampling. We surveyed teen-parent pairs from GfK's existing panel of households with teens (ages 13–16 years) in order to capture smoking initiation among youth age 13 or older. GfK divides its panel into active and inactive components. The active group has responded to recent survey requests; the inactive group has not responded to recent surveys, or is known to be on vacation or ill, but can still be contacted for surveys. We included eligible households from both groups. All households were recruited similarly, and data were collected at the same time. In order to obtain adequate sample size (determined by a power calculation), participants were recruited in three cohorts. The first cohort was surveyed between April and June of 2011 (57.2% of sample), the second between September and October of 2011 (15.3% of sample) and the third from October through December 2012 (27.6% of sample). Parental consent and teen assent were obtained using a protocol approved by Stanford University's Institutional Review Board. Among eligible households, the response rate was 40%, which is consistent with other online surveys (Fowler, 2014). Of the parent-teen pair respondents with completed surveys, 44% were active panelists and 56% were from the inactive households. We tested whether being from an inactive household, alone or in combination with tobacco outlet density, explained the study outcomes. It did not, and was therefore not included in the analyses.

One eligible teen (age 13–16) and parent from each household were surveyed. The parent survey (42 items) assessed parental smoking, beliefs, and demographic information about the teen and the household; the teen survey (57 items) assessed teen smoking behaviors and beliefs. Both teens and parents were asked to report the name of the school that the teen attended.

2.1. Outcome measures

All primary outcome measures were self-reported by teens. Ever smoking was defined as a report of ever trying a cigarette (even a puff) and included current smokers who reported any cigarette smoking in the past 30 days. In addition, the study examined three normative perceptions about smoking. Using a sliding (thermometer) scale from 0 to 100%, participants estimated smoking prevalence for students in their grade at their school, adults in their community, and adults in their state. Responses for the two adult prevalence items were averaged ($r = 0.71$, $p < 0.01$). Using a 4-point scale (1 = definitely no, 4 = definitely yes), teens reported whether their friends "think it is OK to smoke cigarettes once in a while," and this item was repeated for most students in their school. The two items were averaged ($r = 0.57$, $p < 0.01$).

2.2. Teen/household covariates

Teens reported their age, gender, typical grades in school, and how many of their closest friends smoked cigarettes. A measure for self-reported grades was dichotomized at the median, and mostly B+ or higher was the referent category. Exposure to peer smoking compared youth with no friends who smoked and those with at least one friend who smokes cigarettes.

Parent-reported variables were teens' race/ethnicity and whether or not any adult in the household currently smoked. Race was collapsed into three categories: African American, White, and all other (including multiple races) because there was not a large enough number of Asian and Pacific Islander respondents to support a separate category for this group.

Household income was provided by the panel vendor using 19 response options of varying interval widths; these were recoded using the midpoint of each income interval and treated as a continuous variable in the analyses.

2.3. Home and school neighborhoods

The panel vendor provided latitude/longitude coordinates for home addresses with a 100-foot random shift to protect participant anonymity. We used the open-ended responses for school names reported by the teen, parent or both (90.2% of cases) to search street addresses, then used ArcGIS v10.1 to map every school to latitude/longitude (mapping rate = 94.8%).

For each teen, ego-centric neighborhoods were defined by ½-mile roadway network service area around the participant's home and school, following recommendations for studying environmental influences on health behaviors (Duncan et al., 2014). Home neighborhoods were centered on the address point provided by the panel vendor. School neighborhood boundaries were created from our estimate of the campus center point. For each school address, we calculated a 90-degree offset from the street and added a constant distance, using a larger offset for high schools (429 ft) than for middle schools (377 ft). These estimates were derived from school boundary shapefiles for California public schools.

Only 10.9% of participants lived within 1 mile of school, such that their individual home and school neighborhoods overlapped. In addition, 9.3% of teens were home schooled and therefore had identical home and school neighborhoods. Only 3.2% of participants' home neighborhoods overlapped with another participant's home neighborhood.

2.4. Tobacco outlet density and proximity

These measures were computed separately for home and school neighborhoods, using purchased address data for likely tobacco outlets in all zip codes that contained or were adjacent to each teen's residence and school (n = 33,144). A list of likely tobacco outlets was created by purchasing addresses from two independent sources, ReferenceUSA