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Short Report

# Cigarette price variation around high schools: evidence from Washington DC

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ABSTRACT

This study examines lowest cigarette prices in all tobacco retail outlets in Washington D.C. ($n=750$) in relation to the type and number of high schools nearby, controlling for confounders. The lowest overall and Newport menthol prices were significantly lower at outlets near public non-charter and charter schools compared with outlets near private schools. Given higher smoking prevalence and more price-sensitive youth subgroups in U.S. public schools, exposure to low prices may contribute to tobacco-related health disparities in minority and low-income populations. Tobacco taxes combined with policies to minimize the increasing use of price as a marketing tool are critical.



## 1. Introduction

Extensive research links lower tobacco prices to higher youth smoking (Chaloupka et al., 2011; U.S. Department of Health and Human Services 2012; Kostova et al., 2011; Kim et al., 2013; Nikaj and Chaloupka 2014). The tobacco industry strategically utilizes price reductions to increase market share (Chaloupka et al., 2002; Tauras et al., 2006) offset the impact of tobacco taxes and policies (Keeler et al., 1996; Slater et al., 2001; Loomis et al., 2006), target cigarette marketing geographically and by user population. (Chaloupka et al., 2002; Miura 2010; Burton et al., 2013).

Price reductions are often implemented at the point-of-sale (POS) through price discounts and promotional allowances to retailers and wholesalers. In 2011, spending on price-related marketing in the U.S. comprised 90% of the tobacco industry's $8.4 billion advertising budget, a proportion that has increased by 20% since 2002 (Federal Trade Commission 2013). The broad reach of multinational tobacco companies and the ubiquity of POS advertising and price promotions make this issue relevant worldwide (Burton et al., 2013; World Health Organization 2013; Carter 2003).

Despite an increase in research examining the relationship between POS advertising and youth smoking, little research has looked at how cigarette prices are distributed in relation to schools. Low price advertising and availability near schools may encourage youth to purchase cigarettes, particularly among older students who are more likely than younger teens to obtain tobacco from commercial sources (Harrison et al., 2000; Gruber and Zinman 2000; Lipperman-Kreda et al., 2014). Henriksen et al. found lower Newport prices and a higher likelihood of prices being discounted in high school neighborhoods with more African America students (Henriksen et al., 2012). Further, low retail prices near schools have been associated with higher high school smoking prevalence (Lovato et al., 2007; Lovato et al., 2013) and an increased likelihood of youth initiation (Slater et al., 2007). Reduced pricing near schools may be an attractive marketing strategy for the industry, given the large concentration of price-sensitive youth nearby (Lovato et al., 2007; Lovato et al., Feb 2013; Adams et al., Feb 2013).

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Marketing of lower-priced cigarettes may also vary by the type of schools in the area. Level of disposable income is an important predictor of adolescent cigarette smoking (Chen et al., 2013; Wen et al., 2009; Wong et al., 2007) While all youth are found to be a price-sensitive population (Kostova et al., 2011; Chaloupka et al., 2002; Salti et al., 2013; Chaloupka and Warner 1999), private school students often come from more privileged backgrounds than public school students (U.S. Department of Education 2011–12a,b). Tobacco companies may be interested in reducing prices nearby public high schools to increase cigarette accessibility for students with less disposable income. The industry may also target by school demographics. With a greater proportion of minority students in U.S. public and public charter schools (U.S. Department of Education 2011–12a,b) and higher price-sensitivity among minority youth (Tauras et al., 2013; Nonnemaker and Farrelly 2011) pricing strategies may differ around these schools compared with private schools (Henriksen et al., 2012).

Given youths' responsiveness to lower prices and increased price sensitivity among certain youth subgroups, tobacco pricing in retail outlets may vary depending on the local school context which in turn may be a driver of health disparities. This study examines whether cigarette prices differ in relation to the number and type of high schools near retail outlets in Washington, D.C.

## 2. Methods

### 2.1. Sample

From September 2011 to March 2012, we surveyed all licensed tobacco retail outlets in Washington, D.C. ($n=1{,}060$), a midsized urban city of the U.S. with a large African American population (U.S. Census Bureau 2012). We excluded outlets that were no longer in business, not open to the public ($n=212$) or did not sell tobacco ($n=98$). Trained fieldworkers collected data on the final sample ($n=750$), examining store exteriors and interiors utilizing a mobile-phone based survey and photos. Store categorization, survey development and reliability assessment are detailed elsewhere (Author 2014; Author 2013; Author 2012; Author2 2014).

### 2.2. Measures

We created two primary outcome variables: lowest overall displayed pack price and lowest Newport menthol pack price. We chose Newport, a premium brand in the U.S., because it is commonly used among U.S. youth and is the most popular brand among African Americans (Substance Abuse and Mental Health Services Administration 2007).

Lowest overall price was based on data collected on exterior and interior displayed prices. Fieldworkers collected data on lowest advertised exterior price and lowest interior price displayed, including both price advertisements and shelf tags with prices. The lower of the exterior and interior displayed prices was defined as the lowest overall displayed pack price. The brand of the lowest priced product was captured, and coded into premium, discount or both for the analysis. Fieldworkers also collected menthol and discounted price status of the lowest priced product. For Newport menthol prices, fieldworkers collected the lowest price if prices were displayed (including ads or shelf tags); if Newport menthols were available but no prices were displayed, fieldworkers asked retail staff for the lowest pack price. Interrater reliability (Shrout and Fleiss 1979; McGraw and Wong 1996) on price data ranged from 89% (clerk-reported price on Newports) to 100% (exterior low price).

Store addresses were geocoded in ArcGIS (ArcGIS Desktop: Advanced [Computer software] 2012) and linked to U.S. census demographic information, zoning data, and a comprehensive list of Washington D.C. high schools, which include public-non-charter, public charter and private schools (charter schools are considered public in D.C.). The final analytic sample of stores was located within 265 census block groups. Block group census variables were derived from the American Community Survey 2010 (U.S. Census Bureau 2006-2010), including median family income and percentages aged 15–17, 18-29, African American, and Hispanic. We also included a measure for outlet density linked to each store, created using a static bandwidth kernel density estimation (KDE) approach which extrapolates point data over a study area (i.e., the entire Washington D.C. district) (Kirchner et al., 2014) using a specific bandwidth (Carlos et al., 2010) resulting in a continuous density surface where every location in the assigned study area has a density value (Kirchner et al., 2014). To produce the final density surface in ArcGIS, a Gaussian kernel with an "optimized" fixed 5-mile bandwidth was used (Cromley and McLafferty 2002). The resulting density surface had a cell size of 30 m. We then extracted the density value for each high school utilizing the extraction toolset in ArcGIS.

We obtained zoning and school geographical data (District of Columbia, Office of the Chief Technology Officer 2012) and utilized ArcGIS to merge spatial data on the location of all public non-charter, public charter, and private schools to capture the school environment in 2011–2012. The current study used high schools only, resulting in 45 high schools across the District: 18 public, 13 charter and 14 private high schools. For each retail tobacco outlet, the proximity to the closest high school was calculated and the type of high school noted. We also calculated a count of the total number of schools within each outlet's 1.0 mile walkable network service area (Pollack et al., 2005; Lee et al., 2003) which ranged from 0 to 11.

### 2.3. Statistical analysis

Using Stata 13.1 (StataCorp, 2012), we ran linear multilevel regression models with full maximum likelihood estimation with a random intercept at the block group level. All models used robust standard errors, which are reasonably insensitive to the misspecification of variance and covariance at each level and to distributive assumptions (Snijders and Bosker 1999; Raudenbush and Bryk 2002). Outcomes included lowest overall pack price and lowest Newport menthol pack price as a function of closest school type and number of schools in a 1-mile area, census block group factors, zoning designation, store type, store size, and lowest-priced product characteristics. Number of schools in a 1-mile area (range 0–11) was included in the model as continuous (Tabachnick and Fidell 2007). In the overall lowest price model, we included Newport menthol price as a predictor to control for relative prices. Data were not available to control for relative prices in the Newport price model. Neighborhood predictors were centered at their mean, and those that represent percentages were scaled to equate a one-unit increase with an increase of 10 percentage points while population density was scaled to represent an increase of 1,000 residents per square mile. Collinearity diagnostics were conducted with findings indicating high collinearity with models that included both median family income and percentage African American. Since both are important for understanding price differences, we ran all models twice: one set of models included all predictors described above and percentage African American only (model results presented in tables) and another set included all predictors above and median family income (model results described in text). Missing data on individual outlet variables were minimal (1–4%) and listwise deleted.

We provide a visual analysis of findings from the lowest overall pack price model. We mapped the geographic distribution of schools and utilized the Geostatistical Analysts extension toolbar