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The Impact of the Tobacco Retail Outlet Environment on Adult Cessation and Differences by Neighborhood Poverty

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Abstract

Aims—This study examined the impact of tobacco retail outlets on cessation outcomes over time among non-treatment-seeking smokers and assessed differences by neighborhood poverty and individual factors.

Design—Observational longitudinal cohort study using geospatial data. We used generalized estimating equations to examine cessation outcomes in relation to the proximity and density of tobacco retail outlets near the home.

Setting—Eight large Designated Media Areas across the U.S.

Participants—A total of 2,377 baseline smokers followed over 3 waves from 2008 to 2010.

Measurements—Outlet addresses were identified through North American Industry Classification System codes and proximity and density measures were constructed for each participant at each wave. Outcomes included past 30-day abstinence and pro-cessation attitudes.

Findings—Smokers in high poverty census tracts living between 500 meters and 1.9 kilometers from an outlet were over 2 times more likely to be abstinent than those living fewer than 500 meters from an outlet ($p<.05$). Density within 500 meters of home was associated with reduced abstinence (OR: 0.94; CI: 0.90, 0.98) and lower pro-cessation attitudes (Coef: −0.07, CI: −0.10, −0.03) only in high poverty areas. In low poverty areas, density within 500 meters was associated

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DECLARATION OF INTERESTS

The authors have no competing interests to declare.

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with greater pro-cessation attitudes (OR: 0.06; CI: 0.01, 0.12). Gender, education and heaviness of smoking did not moderate the impact of outlet proximity and density on cessation outcomes.

Conclusions—In the US, density of tobacco outlets within 500 meters of the home residence appears to be negatively associated with smoking abstinence and pro-cessation attitudes only in poor areas.

INTRODUCTION

Smokers around the world struggle to quit (1, 2). The ready availability and convenience of cigarettes in the retail environment may contribute to the challenge of cessation. Surveys indicate that nearly one-third of smokers would either quit or cut down if cigarettes were not available within walking distance of their residence (3, 4)

Tobacco retail outlets may influence cessation by decreasing the time and resources needed to obtain cigarettes (5), encouraging impulse purchases (4, 6), increasing environmental cues to smoke (7), and normalizing tobacco use (8). In countries that allow point-of-sale (POS) tobacco marketing and pack displays (1), living close to an outlet or near a greater density of outlets may increase exposure to tobacco advertising, which has been linked to higher smoking in adults (9).

There is little research examining the impact of tobacco retail outlet proximity and density on individual tobacco use, particularly among adults. In a New Zealand national sample, a positive association between neighborhood access to tobacco retail outlets and smoking status disappeared after adjusting for area factors (10). Chuang et al. (11) examined smokers in 82 northern California communities and found that proximity to and density of convenience stores around the home were associated with a greater number of cigarettes smoked per day overall but living in neighborhoods with high store density was associated with greater consumption only for high-income smokers or smokers in high-income areas.

Findings regarding the impact of outlets on cessation have been similarly mixed. Reitzel et al. (12) found that residential proximity to outlets but not density reduced the likelihood of continuous abstinence after a specific quit attempt among a sample of treatment-seeking smokers. A similar study in a British sample of 611 treatment-seeking smokers found no relationship between residential outlet proximity or density and abstinence (13). A Finnish study of non-treatment seeking smokers found that living within walking distance of a tobacco outlet reduced the likelihood of smoking for male heavy-to-moderate smokers only (14).

Given the sparse and mixed findings from prior literature, this study aimed to answer several questions. First, given the absence of research examining the impact of outlets on cessation among a non-treatment seeking population in the U.S., we examined whether the proximity and density of outlets around the home reduced cessation over time among such a sample. Second, given prior literature noting a greater impact of outlets on smoking behavior among smokers in high-income areas, we examined whether the outlet environment influenced cessation differently in high versus low poverty areas. We hypothesized that the effect of outlets by neighborhood poverty may differ from the Chuang et al. study (11), as our outlet

measure encompassed a greater range of tobacco outlets, including liquor and tobacco stores not measured in the prior study and which may be more common in high poverty areas. Finally, given varied findings from earlier studies regarding differences in outlet impact on smoking by gender, individual SES and heaviness of smoking, we examined interactions between outlet proximity and density with these individual factors.

METHODS

Study setting and population—The sample is derived from a cohort of adult smokers aged 18–49 randomly selected from 8 Designated Media Areas (DMAs) across the U.S. The 8 DMAs were chosen to ensure variation on cessation-related factors, including geographic location, strength of tobacco control policies, smoking prevalence and race/ethnicity (15, 16).

This cohort was previously used to examine the impact of a national adult cessation mass media campaign (15–17) and was recruited by a list-assisted, random-digit dial method, with an oversampling of African-Americans and Hispanics. The response rate among those eligible for the telephone surveys was 66.1%. The baseline was conducted from February to April, 2008 (n=5,616), the first follow-up from August to October 2008 and the second from January to April, 2010. The response rate for the first and second follow-up relative to the baseline was 73% and 66% respectively. The rate for responding to both the first and second follow-up was 56%.

The sample used for this study included smokers who had data for all 3 waves, had a geocoding accuracy score of 80% or greater for their residence and maintained residence in any of the 8 DMA's at each wave. Environmental Systems Research Institute's ArcGIS software version 10.1 (18) was used to batch geocode participants' residential addresses, utilizing an address locator through ArcGIS Online geocoding services (18). Of the 3,162 participants with data at all 3 waves, 785 could not be geocoded at every wave with a high degree of accuracy due to poor address information or moving out of the DMA, resulting in a final analytic sample of n=2,377. The analytic sample differed from respondents in the excluded sample in terms of age, gender, race/ethnicity, education and employment but differences were minimal (see Table 1).

Tobacco outlet locations—A database of tobacco outlets in the 8 DMAs was created using the 2007 North American Industry Classification Systems (NAICS) codes (www.naics.com)(19, 20). NAICS was developed under the auspices of The Office of Management and Budget for use by federal statistical agencies in publishing data on the U.S. business economy (21). We obtained geocoded data for all businesses likely to sell tobacco products based on their primary classification code, including supermarkets and other grocery stores, convenience, beer/wine/liquor, drug and tobacco stores, pharmacies and gas stations. Among these 18,252 outlets, 162 were missing latitude/longitude and were geocoded using their physical address. We excluded 23 outlets that fell outside the 8 DMAs resulting in a total of 18,229 outlets.

Outlet proximity and density measures—Proximity of participants' residence to the closest tobacco outlet was measured using the New Closest Facility tool in ArcGIS Network Analyst to calculate the shortest walking distance in meters along the street network from each residence to the nearest outlet. Street network estimates a more accurate distance one would travel to obtain goods and services compared with straight-line distance (22). Proximity was categorized into quartiles based on the sample distribution at each time point (cut-points ranged from 502 to 510 meters at the 25th percentile, 902 to 925 meters at the 50th percentile; and 1.92 to 1.99 meters at the 75th percentile). Using the New Service Area and Spatial Join tools in ArcGIS, we calculated a count for the number of outlets that fell within each of 3 road network buffers and divided the count by the geographic land coverage of the buffer to obtain 3 density measures. To allow for comparisons with previous literature, a 500 meter, 1 kilometer and 1.6 kilometer (or 1 mile buffer) were used (11–13). This latter buffer approximates the average walking commute trip length in the U.S. (23)

Individual-level Measures—Outcomes included abstinence and pro-cessation attitudes. Abstinence was defined as not having smoked "even a puff" of a cigarette for 30 days or more. Pro-cessation attitudes was an index composed of 8 items asked of respondents at all 3 waves, with a higher score representing more favorable quitting attitudes (see Table 1 for details). Individual covariates included sociodemographics, awareness of the media campaign, living with a smoker, having a mental health condition or a tobacco-related disease, and the heaviness of smoking index (HSI) (see Table 1 for details) (24).

Census—Data from the 2000 census SF3 (25) were used to determine tract-level sociodemographic characteristics of individuals' neighborhoods, which included percentage of African-Americans, Hispanics, and persons below poverty. Tract size varied, with three-quarters of tracts smaller than approximately 25 square miles. We used a measure based on the Rural-Urban Commuting Area (RUCA) categories, a system for classifying census tracts that takes into account population density, urbanization and daily commuting (26, 27). See Table 2 for more details on RUCA categories.

Statistical Analysis

We used weighted generalized estimating equations (GEE) (29, 30) to assess associations between outlet proximity and density and the outcomes of 30-day abstinence and pro-cessation attitudes. We used a logit or identity link for dichotomous or linear outcomes, respectively, with an unstructured correlation structure as the working matrix, and included time varying and invariant variables including outlet, individual- and tract-level variables, and DMA fixed effects. For abstinence, the analysis was conducted among the full sample of smokers at baseline (n=2,377). The pro-cessation attitudes model was analyzed among a subsample of smokers who continued to smoke at each wave (n=2,048).

In addition to main effects models, we conducted analyses with interactions between each outlet proximity and density variable separately with census-tract level poverty, gender, individual education and HSI. If interactions were consistently significant across models at the p=.05 level, we stratified the sample to examine proximity and density within strata.

Given the level of attrition in the geocoded sample followed over 3 waves, we also conducted sensitivity analyses among a larger sample of participants who had complete geocoded survey data for the first 2 waves (n=3,187).

RESULTS

Table 2 shows fixed and time-varying demographics of participants followed over 3 waves (n=2,377). The majority of the sample was white, age 35 or older, with more females than males. Over half had a high school degree, graduate equivalency degree or less. Eighty-six percent of the sample was living in metropolitan areas. Mean tract-level proportion of individuals living in poverty was approximately 13% and the median was 11%. Mean proximity from home to the closest outlet ranged from 1.75 to 1.81 kilometers across waves while mean density ranged from 2.6 to 3.1. Nearly 4% of smokers at the first follow-up and 9.1% at the second had a period of 30-day abstinence. The mean for the pro-cessation attitudes index was approximately 22 out of a scale ranging from 8 to 32.

Table 3 presents results from the main effects models of abstinence and pro-cessation attitudes each regressed on proximity and density within varying buffers from home. Models show no association between proximity or density within 500 meters of residence with either outcome. For the abstinence model, a significant inverse association was found for outlet density within 1 kilometer (OR: 0.95; CI: 0.91, 0.99) and 1.6 kilometers (OR: 0.91; CI: 0.85, 0.98) from home. Density within a 1 kilometer and 1.6 kilometer buffer were both significant and negatively associated with pro-cessation attitudes.

For both outcomes, separate models with interactions between proximity and tract-level poverty as well as between density within 500 meters and poverty were all significant (see Appendix, Table A1). The interaction between density within 1.6 kilometers from home and poverty was not significant for either outcome while the interaction between density within 1 kilometer and poverty was significant for pro-cessation attitudes but not abstinence. We thus stratified the above models by poverty split at the median only for outlet proximity and density within 500 meters. Analyses with separate interactions between each of the outlet measures with gender, education and baseline heaviness of smoking were not significant across any of the models for 30-day abstinence or pro-cessation attitudes.

Table 4 presents results for models stratified by neighborhood poverty. Findings show a strong association between proximity and both outcomes as well as for density within 500 meters and both outcomes among those living in higher poverty areas. Those living between approximately 500 meters and 1.9 kilometers from an outlet were more than twice as likely to be abstinent for at least 30 days as compared with those living less than 500 meters from an outlet ($p<.05$). Those living within approximately 900 meters and 1.9 kilometers from an outlet had significantly greater pro-cessation attitudes than those living less than 500 meters from an outlet ($p<.05$) in high poverty tracts. In these same high poverty areas, an increase in the density of outlets within 500 meters of the home was significantly associated with a 6% reduced likelihood of quitting ($p<.01$) and lower pro-cessation attitudes ($p<.001$). In contrast, we found a positive association in low poverty areas between outlet density within

500 meters from home and both outcomes. This association was significant for pro-cessation attitudes ($p<.05$) but only marginally significant for abstinence ($p<.10$).

For the sensitivity analyses, which was conducted among the larger sample of participants who had complete geocoded survey data for the first 2 waves, main effects models were similar to the primary analyses for proximity and density at 500 meters for both outcomes. However, density at 1 kilometer was not significant for either outcome, nor was density at 1.6 kilometers for pro-cessation attitudes. For 30-day abstinence, the odds ratio for density at 1.6 kilometers was similar to the primary analyses but was only marginally significant. The interaction models were also comparable to the primary analyses, with the exception that the interaction between density at 1.6 kilometers and tract poverty was significant in the pro-cessation attitudes model. There was also some suggestion of a significant interaction between proximity and education as well as proximity and HSI in the abstinence model but the models were somewhat unstable and no coherent pattern emerged across other models. Patterns in the stratified models were analogous to the primary analyses, with the exception that the influence of proximity on 30-day abstinence in high poverty areas was not significant in the sensitivity analysis.

DISCUSSION

This is the first U.S. study to examine the impact of the retail outlet environment on smokers' abstinence and cessation attitudes among a sample of non-treatment seeking smokers and the first to examine these relationships across multiple geographic regions. Findings revealed that the density of outlets within 1 kilometer and 1.6 kilometers of residence was associated with a reduced likelihood of achieving 30-day abstinence and lower pro-cessation attitudes for all smokers. Proximity to the closest outlet and the density of outlets within 500 meters of the home negatively influenced abstinence and pro-cessation attitudes only in high poverty areas. In low poverty areas, there was a trend toward a protective effect of outlet density within 500 meters of home. Sensitivity analyses largely supported the primary analyses, although the negative effect of outlet density on cessation among smokers overall was weaker as was the harmful influence of proximity on 30-day abstinence among smokers in high poverty areas.

Findings align with some prior research and contradict other data. Neither Reitzel et. al (12) nor Han et al. (13) found an effect of outlet density at 500 meters or 1 kilometer from home on abstinence among smokers attempting to quit. We found a negative effect of density at 500 meters on abstinence and pro-cessation attitudes but only in high poverty areas. We also found a significant negative effect of outlet density within 1 kilometer and 1.6 kilometers from home among smokers overall. These latter effects may be related to smokers' mobility patterns and subsequent exposure to retail outlets. Previous research among smokers found that lapsing is increasingly likely with each additional contact with a tobacco outlet during the day (31). Smokers who travel further distances from home (23) are likely to encounter a greater number of outlets, which may increase the risk of smoking and reduce cessation.

Recent research supports the importance of proximity of outlets to home in increasing smoking urges (32) and reducing abstinence (12, 14). In our study, however, residential

proximity to an outlet as well as density of outlets within 500 meters of the home undermined cessation only among smokers in high poverty areas. These findings counter Chuang et al. (11), which demonstrated that convenience store proximity and density were positively associated with cigarettes per day only for smokers in low poverty areas. The difference in our findings may be due to a more sensitive measure of tobacco retail outlets or a difference in the impact of outlets on cessation versus daily cigarette consumption.

Individuals living in high poverty areas may be more vulnerable to tobacco outlets near their home as these smokers may be more constrained to their immediate residential environment due to limited transport options (33) and safety concerns (34–37). However, the harmful effect of outlet access in high poverty areas and the protective effect in low poverty areas suggest outlet-related factors may play a role. Tobacco advertising, pricing and products in outlets in high poverty areas may be inherently different than those in low poverty areas in ways that impact cessation. In high poverty areas in the U.S., outlets often have greater levels of tobacco advertising (38–40), which can increase smoking (9). Further, studies indicate that outlets in high poverty areas are smaller than average, which would make tobacco advertising even more noticeable and compelling (41). Recent evidence suggests cigarette prices are lower (42) and price promotions more prevalent (43) in outlets in low-income areas, making cigarettes more accessible to smokers living in these areas. Further, sales of ‘loosies’, or single cigarettes, were formerly available in outlets in some mostly low-income communities in the U.S. (44), further enhancing accessibility. In contrast, outlets in low poverty areas may be more likely to have health care services and related products such as nicotine replacement therapy (NRT) that help smokers quit, as has been found in previous research (45).

Prior studies have identified stronger effects of outlet proximity or density on smoking behavior among certain subgroups (11, 14). In contrast, we identified no consistent differences in outlet proximity or density by gender, education or heaviness of smoking. Our findings suggest that factors related to the neighborhood environment were more important for shaping the influencing of outlet proximity and density on cessation than individual-level factors.

Limitations

Limitations include the fact that outlet listings were limited to 2007, as NAICS data is updated only every five years. Data suggest that commercial retail outlet datasets may underestimate the number of outlets in the environment (46, 47). Yet it may also be the case that outlets included did not actually sell tobacco, which would overestimate exposure. Unlike in some countries (14), the U.S. federal government does not maintain a national registry of outlets selling tobacco. Commercial listings are currently the primary source of national data for studies that cover several U.S. regions. Also, the study included only 8 DMA, thus results may not be generalizable. However findings may be indicative of DMAs with similar attributes.

Additional limitations include a significant degree of attrition for the sample over the 18-month follow-up time period and some differences in demographics for the sample followed and the sample not followed. This might have led to biased regression estimates, although

recent work suggests selective attrition may have a limited effect on regression estimates in certain cases (48). We were also not able to geocode a certain portion of the sample with sufficient accuracy at each wave so those respondents were excluded. Eliminating respondents with low geocoding accuracy was designed to ensure the highest precision for calculating the key outlet variables in the analyses; however exclusion of this group may have contributed to biased estimates as there were some differences, albeit minimal, between the analytic sample and the non-geocoded sample. We were not able to distinguish between the impact of tobacco availability and tobacco advertising or price marketing in outlets given that exposure to outlets via proximity and density and exposure to tobacco advertising and price marketing in outlets are closely linked in the U.S. Research is needed to examine the separate impact of tobacco outlet availability and outlet advertising on smoking behavior, as well as whether advertising or price mediates the impact of outlet proximity and density (49).

Study strengths include use of a large non-treatment seeking sample followed over time across diverse U.S. regions. In addition, we incorporated a variety of outlet measures and interactions suggested by previous studies, which allowed for comparisons to prior literature.

Implications

Strategies for limiting the impact of outlet proximity and density near the home on cessation include tobacco outlet licensing legislation to monitor the number, type and location of outlets, particularly in high poverty communities where the impact of outlets may be most detrimental. Residential zoning laws could mandate a specified distance between outlets to reduce density in residential or high poverty areas (5, 49–52). Since POS advertising and price marketing may be key mechanisms through which exposure to outlets impact smoking behavior, particularly in high poverty areas, research linking POS marketing, behavior and policy is critical. Finally, more work is needed to understand all smoking and cessation-related products and services available in tobacco retail outlets and how these may differ by neighborhood poverty, as these factors may modify the impact of outlets on smoking.

CONCLUSIONS

Findings from this study indicate that the density of outlets within walking distance of the home may reduce cessation activity among all smokers. Further, the impact of outlets closest to home may be most detrimental for cessation among smokers in higher poverty areas. The widespread availability of cigarettes with few restrictions contrasts with commonly accepted regulation of other potentially harmful products, such as alcohol and pharmaceuticals. Cessation among smokers may be undermined by the current landscape of tobacco retailing in the U.S., which may make cigarettes easier to access than products that help smokers quit, particularly for those living in high poverty areas.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographic characteristics and smoking behavior at baseline among full sample (n=2,377) and those who were not followed for 3 waves (unweighted)

	Full sample (n=2,377) (% or mean (SE))	Sample not followed for 3 waves (n=3,239) (% or mean (SE))	P-value
Age			<0.001
18–24	12.1	19.2	
25–34	24.2	29.3	
35–49	63.8	51.5	
Gender			0.012
Male	44.9	48.3	
Female	55.1	51.7	
Race			<0.001
White, Non-Hispanic	73.4	70.9	
Black, Non-Hispanic	13.1	11.6	
Hispanic	6.7	9.9	
Other	6.8	7.7	
Marital status			0.064
Married/Partner	61.1	58.0	
Never Married	21.0	22.9	
Divorce/Widowed/Separated	17.9	19.1	
HSI[a] at baseline (mean & SE)	4.5 (0.03)	4.5 (0.03)	0.822
Tobacco-related Disease (Yes)	8.1	7.2	0.233
Education			0.001
Less than High School/HS diploma/GED	58.7	63.7	
Some Col/Tech or Associate's Degree	31.2	27.5	
At least a college degree	10.2	8.8	
Employment status			0.004
Employed	67.5	65.6	
Unemployed	10.3	13.1	
Not in Labor force	22.2	22.4	
Smokers in household (Yes)	59.2	57.8	0.298
Pro-Cessation Attitudes index[b] (mean (SE))	22.1 (0.11)	22.1 (0.10)	0.832
30-day abstinence	n/a	n/a	
	n=2,377	**n=2,174[c]**	
Proximity (in kilometers, mean(SE))	1.75 (.047)	1.75 (.054)	0.955
Outlet density (500 meters) (mean & SE)	3.1 (0.14)	3.7 (0.16)	0.006
Outlet density (1 kilometer) (mean & SE)	3.0 (0.08)	3.3 (0.09)	0.009
Outlet density (1.6 kilometers buffer) (mean & SE)	2.7 (0.06)	2.8 (0.06)	0.061

Abbreviations: SE-standard error; HSI-Heaviness of smoking; HS-high school; GED-graduate equivalency degree.

[a] Heaviness of smoking index (HSI) is created to represent tobacco dependence level based on number of cigarettes per day (CPD) and time to the first cigarette of the day from waking up (TTFU). TTFU was reported on a 4-point scale [(1) 61 or more minutes, (2) 31–60 minutes, (3) 6–30

minutes, and (4) within 5 minutes]. CPD was reported on a continuous scale and categorized into four groups [(1) 0–10, (2) 11–20, (3) 21–30, (4) 31 or more]. The index was created by totaling the two 4-point scales, such that higher scores on the index represent a higher level of tobacco dependence.

[b] Pro-cessation attitudes included 8 items. The first four items were statements, with responses on a 4-point Likert scale ranging from "strongly agree" to "strongly disagree." Statements included "I have been thinking a lot about quitting smoking recently"; "I am eager for a life without smoking"; "Lately, I have been thinking about which cigarettes during my day would be the hardest to give up"; and "I am not prepared to make changes in my life to quit smoking." The following four items are based on items utilized in other large surveys to capture motivation and readiness to quit: "On a scale of 1–10, where 1 equals not at all and 10 equals very much, how much do you want to quit smoking?"; "Are you seriously thinking of quitting in the next 30 days, the next 6 months, or not at all?"; "On a scale of 1–5, where 1 is the lowest and 5 is the highest, how would you rate quitting smoking as a priority in your life?"; "During the last 30 days, would you say you have thought about the changes you will have to make in your life to quit smoking?" Response options for the last item were every day, most days, some days, or rarely. The pro-cessation attitudes index score (Cronbach a=0.79) was calculated by recoding the items to a standard scale, which ranged from 8 to 32 in this sample, and averaging across the 8 items.

[c] This includes the baseline sample not followed for 3 waves with sufficient address data for geocoding.

Table 2

Demographic characteristics and smoking behavior among full sample (n=2,377) – Longitudinal Cohort (unweighted)

	Full sample (n=2,377)		
	Baseline (% or mean (SE))	**6 month Follow-up (% or mean (SE))**	**18 month Follow-up (% or mean (SE))**
Fixed characteristics			
Age at baseline			
18–24	12.1		
25–34	24.2		
35–49	63.8		
Gender			
Male	44.9		
Female	55.1		
Race			
White, Non-Hispanic	73.4		
African American, Non-Hispanic	13.1		
Hispanic	6.7		
Other	6.8		
Marital status at baseline			
Married/Partner	61.1		
Never Married	21.0		
Divorce/Widowed/Separated	17.9		
Awareness of media campaign (at wave 2)[a/]	43.0		
Mental Health Condition (at wave 3)[b/]	27.8		
Tobacco-related disease at baseline (Yes)	8.1		
HSI[C] **at baseline (mean & SE)**	4.5 (0.03)		
Time-varying characteristics			
Education			
Less than High School/HS diploma/GED	58.7	56.0	52.5
Some Col/Tech or Associate's Degree	31.2	33.3	35.4
At least a college degree	10.2	10.7	11.9
Employment status			
Employed	67.5	67.1	60.3
Unemployed	10.3	10.1	14.6
Not in Labor force	22.2	22.8	25.1
Smokers in household (Yes)	59.2	55.3	56.0
Pro-cessation attitudes index (mean (SE]))	22.1 (0.11)	22.0 (0.12)	22.5 (0.13)
Cessation Activity	n/a	3.9	9.1
Proximity (in kilometers, mean(SE))	1.75 (.047)	1.75 (.047)	1.81 (.049)
Density within 500 meters (mean & SE)	3.1 (0.14)	2.9 (0.13)	2.9 (0.13)

	Full sample (n=2,377)		
	Baseline (% or mean (SE))	**6 month Follow-up (% or mean (SE))**	**18 month Follow-up (% or mean (SE))**
Density within 1 kilometer (mean & SE)	3.0 (0.08)	3.0 (0.08)	2.9 (0.08)
Density within 1.6 kilometers (mean & SE)	2.7 (0.06)	2.6 (0.06)	2.7 (0.07)
% of Non-Hispanic African American population (Tract 2000)	12.3 (0.45)	12.2 (0.45)	12.2 (0.45)
% of Hispanic population (Tract 2000)	10.8 (0.36)	10.8 (0.36)	10.5 (0.35)
% of population in poverty (Tract 2000)	13.3 (0.20)	13.3 (0.20)	13.2 (0.20)
% in metropolitan RUCA[c]	86.1	86.0	85.7
DMA[d]			
Birmingham, AL	16.4	16.5	16.5
Kansas City, MO	12.5	12.5	12.5
Columbus, OH	10.4	10.4	10.3
Fort Smith/Fayetteville, AR	10.4	10.4	10.5
Houston, TX	22.8	22.8	22.8
Phoenix/Prescott, AZ	9.2	9.1	9.2
Pittsburgh, PA	10.0	9.9	9.9
Portland, OR	8.3	8.4	8.4

Abbreviations: SE-standard error; HSI-Heaviness of Smoking Index; HS-high school; GED-Graduate Equivalency Degree; RUCA: Rural Urban Commuting Area; RUCA-Rural Urban Commuting Area; DMA-Designated Media Area; AL-Alabama; MO-Missouri; OH-Ohio; AR-Arkansas; TX-Texas; AZ-Arizona; PA-Pennsylvania; OR-Oregon.

[a] Awareness of the media was measured only at Wave 2, which was immediately after the campaign ran.

[b] The mental health variable was only measured at Wave 3.

[c] The 2000 Rural-Urban commuting area (RUCA) codes were used to define Metropolitan. RUCA has 10 categories: (1) Metropolitan area core; (2) Metropolitan area high commuting; (3) Metropolitan area low commuting; (4) Micropolitan area core; (5) Micropolitan high commuting; (6) Micropolitan low commuting); (7) Small town core; (8) Small town high commuting; (9) Small town low commuting; (10) Rural areas. For this table, categories (1) – (3) were coded as Metropolitan.

Table 3

Main effects models-Odds ratios (for 30-day abstinence outcome) and coefficients (for pro-cessation attitudes outcome) from multivariate models of the outcomes on outlet variables, tract-level sociodemographics and individual covariates.

30-Day Abstinence[a/](Full sample, n=2,377)								
	Model 1a		Model 1b		Model 1c		Model 1d	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Proximity (Quartiles) to residence [b/]								
1st Quartile	Ref.							
2nd Quartile	. 1.41	(0.88, 2.26)						
3rd Quartile	1.58	(0.95, 2.64)						
4th Quartile	1.07	(0.59, 1.93)						
Density (within 500 meters of residence)			0.99	(0.96, 1.02)				
Density (within 1km of residence)					0.95*	(0.91, 1.00)		
Density within 1.6 km of residence							0.91*	(0.85, 0.98)

Pro-Cessation Attitudes[a/](Continuing smokers, n=2,048)								
	Model 2a		Model 2b		Model 2c		Model 2d	
	Coef	95% CI	Coef	95% CI	Coef	95% CI	Coef	95% CI
Proximity (Quartiles) to residence[b/]								
1st Quartile	Ref.							
2nd Quartile	−0.19	(−0.76, 0.37)						
3rd Quartile	−0.06	(−0.71, 0.60)						
4th Quartile	−0.17	(−0.89, 0.55)						
Density (within 500 meters of residence)			−0.01	(−0.04, 0.02)				
Density (within 1km of residence)					−0.06*	(−0.12, −0.002)		
Density (within 1.6 km of residence)							−0.10*	(−0.19, −0.01)

*P-value<0.05;

**P-value<=0.01;

***P-value<=0.001

Abbreviations: OR-odds ratio; Coef.-coefficient; CI-confidence interval;.

[a/] Variables adjusted for included wave, age, gender, race/ethnicity, education, employment status, marital status, awareness of anti-tobacco campaign, residence with a smoker, mental health condition, tobacco-related disease, Heaviness of Smoking index (at baseline), Rural Urban Commuting Area classification, DMA, tract % of non-Hispanic African Americans, tract % of Hispanics, tract % in poverty.;

[b/] Cut-points for proximity quartiles were 502–510 meters at the 25th percentile, 902–925 meters at the 50th percentile and 1.92 to 1.99 meters at the 75th percentile.

Table 4

Odds ratios (for 30-day abstinence outcome) and coefficients (for pro-cessation attitudes outcome) from multivariate models of the outcomes on outlet variables and individual covariates, with models stratified by census-tract poverty (low/high).

	30-Day Abstinence [a/] (Full sample, n=2,377)			
		Low Poverty Area		High Poverty Area
	OR & 95% CI	OR & 95% CI	OR & 95% CI	OR & 95% CI
Proximity (Quartiles) to residence [b/]				
1st Quartile	Ref.		Ref.	
2nd Quartile	0.58 (0.30, 1.10)		2.80*** (1.51, 5.19)	
3rd Quartile	1.07 (0.58, 1.98)		2.28* (1.12, 4.61)	
4th Quartile	0.80 (0.42, 1.55)		1.04 (0.34, 3.18)	
Density (within 500 meters of residence)		1.03ǂ (1.00, 1.07)		0.94** (0.90, 0.98)

	Pro-Cessation Attitudes [a/] (Continuous smokers, n=2,048)			
		Low Poverty Area		High Poverty Area
	Coef & 95% CI	Coef & 95% CI	Coef & 95% CI	Coef & 95% CI
Proximity (Quartiles) to residence [b/]				
31st Quartile	Ref.		Ref.	
32nd Quartile	−0.69 (−1.62, 0.23)		0.56 (−0.16, 1.29)	
33rd Quartile	−0.76 (−1.63, 0.12)		1.04* (0.11, 1.97)	
34th Quartile	−0.55 (−1.52, 0.42)		0.35 (−0.72, 1.41)	
Density (within 500 meters of residence)		0.06* (0.01, 0.12)		−0.07*** (−0.10, −0.03)

ǂ P-value<0.10;

* P-value<0.05;

** P-value<=0.01;

*** P-value<=0.001

Abbreviations: OR-odds ratio; Coef.-coefficient; CI-confidence interval.

[a/] Models adjusted for wave, age, gender, race/ethnicity, education, employment, marital status, awareness of the anti-tobacco campaign, residence with a smoker, mental health condition, tobacco-related disease, Heaviness of Smoking index (at baseline), Rural Urban Commuting Area classification, DMA, tract % Non-hispanic African American, and tract % Hispanic.

[b/] Cut-points for proximity quartiles were 502–510 meters at the 25th percentile, 902–925 meters at the 50th percentile and 1.92 to 1.99 meters at the 75th percentile.