Associations of County Tobacco Retailer Availability With U.S. Adult Smoking Behaviors, 2014–2015

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Introduction: Greater availability of tobacco product retailers in an area may be associated with smoking behaviors, and the majority of people who smoke purchase their cigarettes at gas stations and convenience stores. This cross-sectional study investigates associations of overall tobacco retailer density and gas/convenience density with adult smoking behaviors.

Methods: This study built a list of tobacco retailers in 2014 and calculated the county-level number of retailers per 1,000 people. Individual-level smoking behavior data were drawn from the 2014–2015 Tobacco Use Supplement for a sample of adults (*n*=88,850) residing in metropolitan counties across the U.S. General estimating equation models were fit to investigate associations between retailer density and smoking behaviors (smoking status, quit attempt, quit length). Analyses were conducted in 2020.

Results: A greater number of tobacco retailers (AOR=1.63, 95% CI=1.35, 1.96) and gas stations and convenience stores (AOR=3.29, 95% CI=2.39, 4.52) per 1,000 people were each associated with a higher odds of a respondent smoking every day compared with those who do not smoke. Additionally, both measures were associated with a higher odds of a respondent being an every-day versus some-day smoker. Associations for gas/convenience density were similar in models that additionally controlled for other tobacco retailers (excluding gas/convenience). Study results did not support associations between retailer density and cessation.

Conclusions: Tobacco retailer density, especially gas/convenience density, is correlated with daily smoking, the most harmful tobacco use behavior. Calculating tobacco retailer density using gas/convenience stores may be a feasible proxy for overall tobacco retailer density.

INTRODUCTION

In the U.S., cigarette smoking is responsible for >480,000 deaths per year, accounting for 1 in 5 deaths.[1] Although smoking prevalence has decreased over the last several decades, 13.7% of adults still smoked in 2019.[2] Tobacco retailer density is a measure of the availability of tobacco retailers in a geographic area, often operationalized as the total number of retailers per 1,000 people. Both ecological and multilevel studies have indicated positive associations between tobacco retailer density and adult smoking behaviors, and negative associations with adult smoking-cessation behaviors.[3,4]

The presence and amount of tobacco marketing, which can cue smoking behaviors,[5] differ by tobacco retailer type.[6] In the U.S., tobacco stores had the highest average number of tobacco marketing materials, followed by gas stations and convenience (gas/convenience) stores.[6] This same pattern occurred for the proportion of retailers with exterior tobacco marketing and tobacco product price promotions.[6] As the majority of people who smoke purchase their cigarettes at gas/convenience stores,[7] and these store types may be easier to track than all tobacco retailer types, the availability of gas/convenience stores may be particularly relevant for smoking behaviors, and a potential proxy for overall tobacco retailers in an area. For example, in California, convenience store retailer density was positively associated with the number of cigarettes smoked per day.[8]

The purpose of this analysis is to investigate cross-sectional associations of both overall tobacco retailer density and gas/convenience store density with multiple smoking behaviors in a large sample of adults living in metropolitan counties across the U.S. in 2014–2015. A more

comprehensive understanding of these relationships can be used to craft better tobacco retailer reduction policies, which are increasingly being considered in local jurisdictions and counties.[9]

METHODS

Study Sample

Smoking behavior data were drawn from the 2014–2015 Tobacco Use Supplement (TUS).[10] The TUS is administered every 3–4 years to collect nationally and state representative data about tobacco use from the civilian, adult, non-institutionalized population.[11] The TUS is based on interviews with members of participating households. County of residence is provided for respondents residing in counties with >100,000 people. The 2014–2015 TUS included interviews conducted in July 2014, January 2015, and May 2015. Individuals who were inadvertently interviewed twice (n=10,290), who did not have county identifiers (i.e., counties with ≤100,000 people, n=131,522), and who did not report a smoking status (n=734) were excluded, resulting in an overall sample of 88,850 respondents (61,545 self-respondents, 27,305 proxy respondents) residing in 368 counties across 44 states (Appendix Table 1). Proxy respondents are household members who answered smoking status questions for respondents who were not present at the time of interview.

To further analyze self-reported smoking-cessation behaviors, 2 additional analytic samples were created: self-respondents who currently smoke every day or some days (n=7,332) and self-respondent smokers who recently made a quit attempt (n=2,915).

Measures

Respondents (Analytic Sample 1, *n*=88,850) were asked: *Have you smoked at least 100 cigarettes in (your/his/her) entire life?* Those responding *yes* were then asked: *Do you now smoke cigarettes every day, some days, or not at all?* Responses were coded as "never smoker," "former smoker," "some-day smoker," and "every-day smoker." For analytic purposes, some-day smoker and every-day smoker were categorized as current smokers and never Smoker and former smoker as non-smokers. A binary variable was created for current smokers (1) and non-smokers (0).

For analyses among current smokers only, a variable to compare every-day (1) versus some-day smokers (0) was created where non-smokers were excluded from the model. Two binary variables were additionally created comparing every-day smokers (1) to non-smokers (0) where some-day smokers were excluded from the model and some-day smokers (1) to non-smokers (0) where every-day smokers were excluded from the model.

Among self-respondents, every-day and some-day smokers (Analytic Sample 2, *n*=7,332) were asked questions about past 12–month quit attempts. Proxy respondents were not asked smoking-cessation questions. Some-day smokers smoking <12 days in the past 30 days were asked: *During the past 12 months, have you tried to quit smoking completely?* Every-day and some-day smokers smoking ≥12 days during the past 30 days were asked: *During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?* and *During the past 12 months, have you made a serious attempt to stop smoking because you were trying to quit—even if you stopped for less than a day?* Prior research indicates that excluding quit attempts that last <1 day may underestimate serious quit attempts, and individuals who quit for

<24 hours may suffer from greater nicotine addiction.[12-14] These 3 questions were combined into a single quit attempt binary indicator (1=yes, 0=no) representing whether any quit attempt was made in the past 12 months, regardless of the quit length.

Self-respondent every-day and some-day smokers reporting a single quit attempt of ≥1 (Analytic Sample 3, *n*=2,915) were asked: *During the past 12 months, what is the length of time of this single quit attempt where you stopped smoking because you were trying to quit smoking?* Those with >1 quit attempt were asked this same question but about the quit attempt that lasted the longest. Quit length was converted to the total number of days. Because the survey question asked about quit attempts in the last 12 months, those quit lengths >365 days were excluded (*n*=76 respondents, range=465–18,250 days).

The U.S. Census Bureau uses North American Industry Classification System (NAICS) codes to classify business establishments in the U.S. Using reported tobacco product sales data from the 2012 Economic U.S. Census, NAICS codes that account for approximately 99% of all retail tobacco product sales (e.g., gasoline stations with convenience stores, tobacco stores) were identified.[15] There is no tobacco retailer licensing system in the U.S., so consistent with other studies,[3,16,17] a 2014 national list of probable tobacco retailers was created using these NAICS codes. This analysis used data from ReferenceUSA (RefUSA),[18] a database of businesses that contains both NAICS codes and retailer addresses to identify probable tobacco retailers (details are provided in Kong et al.[19]).

A per capita measure of county-level tobacco retailer density was used to account for the size of the market for retail tobacco products. Using a spatial join in ArcMap, version 10.5, each retailer was assigned to its respective county; the total number of retailers was then summed for each county. Total population data were gathered from the 5-year 2010–2014 American Community Survey.[20,21] The total number of tobacco retailers by the population of each county (converted to per 1,000 people), herein referred to as overall tobacco retailer density, was calculated. Overall tobacco retailer density was further disaggregated into 2 measures: (1) gas/convenience stores per 1,000 people (i.e., gas/convenience density) and (2) other tobacco retailers (excluding gas/convenience) per 1,000 people (i.e., other tobacco retailer density). Retailer density data were then joined to each respondent using county of residence.

Statistical Analysis

Respondents from the same county may have more similar smoking behaviors than those from other counties owing to many reasons, such as exposure to county policies that regulate smoking behaviors (e.g., smoke-free air policies). To account for this within-county dependence, general estimating equation models with an exchangeable working correlation matrix, which adjusts both parameter estimates and SEs to account for this dependence, were fit in SAS, version 9.4.

First, associations between all retailers per 1,000 people (i.e., overall retailer density) and each of the smoking behavior outcomes were tested. To isolate the association of gas/convenience density, models were fit that simultaneously included 2 measures: gas/convenience density and other tobacco retailer (excluding gas/convenience) density. Finally, to examine whether gas/convenience density alone could potentially be used as a proxy for overall tobacco retailer density, models that included just the gas/convenience density measure were fit. A logit function

was specified for smoking status and quit attempt outcomes, and a negative binomial function was specified for quit length (number of days). Data were analyzed in 2020.

Several individual-level sociodemographic characteristics are associated with smoking status and may also influence the counties that people choose to reside in, and thus, their retailer density. Consistent with other studies investigating associations of retailer density with smoking behaviors,[22] adjusted models included several self-reported individual-level control variables: race and ethnicity (non-Hispanic White, Black, Asian or Hawaiian/Pacific Islander, American Indian/Alaskan Native, Other Multi-race, and Hispanic or Latino ethnicity [any race]), household income (<$50,000, ≥$50,000), educational attainment (less than high school, high school graduate, some college/associate's degree, bachelor's degree or more), age, and sex (male, female).

To further control for potential confounders, adjusted models included 2 state-level 2014 tobacco control policy variables, including state cigarette excise tax (in dollars and cents)[23] and a dichotomous indicator of whether a state had a comprehensive smoke-free air law.[24]

Some studies assessing relationships between retailer density and smoking behaviors have included controls for area-level race and SES.[22] In sensitivity analyses, county-level proportion of non-Hispanic Black or African American residents and those living below 150% of the federal poverty level were included: associations were unchanged and area-level controls were not significant (not shown); therefore, the more parsimonious models that only included individual-level controls are presented.

RESULTS

Table 1 describes smoking behavior, individual-level demographic, county-level demographic, and tobacco retailer density characteristics for each of the analytic samples. For the full sample (Analytic Sample 1, *n*=88,850), the majority of respondents reported not smoking (88.2%), and about 3% and 9% reported smoking some days and every day, respectively. In the full sample, overall retailer density and gas/convenience store density had a Pearson correlation coefficient of 0.66.

Unadjusted and adjusted models (Table 2) indicated that overall retailer density (Measure 1) was associated with a higher odds of an individual being a current smoker (versus a non-smoker). However, there was no significant association between overall retailer density and the odds that a respondent was a some-day versus non-smoker (Measure 1: AOR=1.29, 95% CI=0.95, 1.74). When comparing every-day smokers with non-smokers, even after controlling for several individual-level sociodemographic factors and state tobacco control policies, overall retailer density was associated with a higher odds of a respondent being an every-day smoker (Measure 1: AOR=1.63, 95% CI=1.35, 1.96). Overall retailer density was also associated with a higher odds of a respondent being an every-day versus some-day smoker.

In adjusted models (Table 2) that included both gas/convenience density and all other retailers (excluding gas/convenience) per 1,000 people (Measure 2), model estimates for gas/convenience density were similar in terms of directionality and statistical significance as those models that

only included overall tobacco retailer density (Measure 1). However, estimates for all other retailers per 1,000 people were not statistically significant.

For models that included gas/convenience density alone (Table 2, Measure 3), estimates were similar in terms of directionality and significance as models that included overall tobacco retailer density alone (Measure 1).

In both unadjusted and adjusted models, there were no significant associations between any measure of retailer density and the odds of a respondent having a quit attempt in the last 12 months (Table 4). Similarly, retailer density was not significantly associated with quit length.

Because effect sizes are not comparable to one another in raw units, retailer density measures were standardized to compare the magnitude of associations. AOR estimates and corresponding 95% CIs were similar and inclusive across measures (Tables 3 and 4).

DISCUSSION

Using a large national sample of adults in metropolitan counties, this study found that overall retailer density was associated with a greater odds of an individual smoking every day, versus some days or not at all. These results extend prior studies showing associations between retailer density and current smoking status.[25,26]

A greater supply of tobacco retailers may reduce the travel cost (time) of acquiring the products, potentially making it easier to sustain every-day smoking.[27] Additionally, areas with greater

retailer density may expose individuals to more tobacco product marketing,[28,29] which cues impulse purchases in those that smoke daily.[5,30,31] For example, in a sample of adults who smoked daily, 22% made unplanned cigarette purchases after entering a tobacco retailer, and 8% reported purchasing cigarettes after seeing point-of-sale marketing.[30] Daily smoking may signal nicotine addition,[32,33] and daily smokers may have higher susceptibility to point-of-sale product availability and marketing.

Policies that reduce tobacco retailer density, which might also reduce tobacco marketing,[34] may be especially important for people who smoke daily. Recommended tobacco retailer reduction policies include prohibiting tobacco sales at specific store types (e.g., pharmacies) or within a certain distance of schools, capping the number of tobacco retailers within a geographic area, and implementing and raising tobacco licensing fees.[27,35-38] Across the U.S., there is geographic variation in the implementation and strength of several tobacco control policies (e.g., smoke-free air policies, tobacco excise taxes). Tobacco retailer density may also be greater in non-metropolitan (versus metropolitan) counties.[3] Research exploring whether more traditional tobacco control policies are also associated with tobacco retailer reduction policies and tobacco retailer density, which may synergistically impact smoking, is needed.

This study did not find evidence that greater retailer density is associated with the odds that an individual is a some-day smoker (versus non-smoker). These results are similar to a study in Australia.[39] A subset of individuals who smoke non-daily include “social smokers” who are typically younger and primarily use tobacco when in social settings, such as bars.[40-42] Social smokers typically consume fewer cigarettes per day and may also be less nicotine dependent than

those that smoke daily.[41,42] It is plausible that adults who smoke non-daily may also be less likely to purchase tobacco products in the retail setting, relying more on social groups.

This analysis did not uncover statistically significant associations between retailer density and either quit attempts or quit length, similar to some other studies.[43,44] One study found that residential proximity to the nearest tobacco retailer, rather than density, had a significant inverse relationship with smoking abstinence.[43] Residential proximity to a tobacco retailer, representing an easily accessible supply of tobacco products and marketing that a person may be more likely to interact with more frequently,[45] may be more influential on smoking behaviors than simply the overall concentration of retailers in a neighborhood.[46] Proximity measures are ill defined for larger areal geographic units such as counties, however. Future research exploring whether various measures of retailer density are sufficient proxies for residential and activity space-based retailer density and proximity measures are needed.[4,47]

In this study, different measures of tobacco retailer density were used. Models that included density of both gas/convenience and all other tobacco retailers (excluding gas/convenience) found that gas/convenience density contributed to associations with smoking behavior more so than other tobacco retailer density. The majority of adults who smoke purchase cigarettes from gas/convenience stores.[7] Gas/convenience stores may represent a greater potential smoking risk compared with other store types such as pharmacies or supermarkets, suggesting that gas/convenience stores could be important targets of tobacco retailer policy efforts. Additionally, standardized effect sizes for models that separately included overall retailer density versus gas/convenience store density alone were similar in terms of magnitude and significance. In the

absence of licensing system and associated validated tobacco retailer lists in much of the country, many researchers and communities are tasked with building their own retailer lists. Results from this study indicate that compiling a list of gas and convenience stores alone may be a more feasible proxy for a list that includes all types of tobacco retailers, at least for the purpose of examining associations with adult smoking behaviors.

Limitations

There are several limitations of this study. As both retailer density and smoking status are measured in the same year, causality or whether retailer density precedes smoking behaviors (e.g., retailers may be locating in places with more smokers) cannot be determined. Additionally, the TUS relies on retrospective reporting of smoking-cessation behaviors, which may have errors in reporting and recall. Longitudinal studies are needed to establish temporality and to disentangle what mechanisms (e.g., marketing, product pricing) may be contributing to these associations.

A major challenge of place-based health research is that geo-identifiers of where people live are often limited or unavailable. In this study, the smallest available geo-identifier of TUS respondents was a county indicator, and counties may be too large of an area to capture the spaces where individuals spend their time. Yet, understanding whether county-level retailer density is associated with individual-level smoking behaviors is informative because counties are often the government level with jurisdiction for implementing tobacco control policies.[9]

Although this study's sample is limited to a select number of individuals residing in U.S. metropolitan counties and may not be generalizable to rural populations, metropolitan areas may

be particularly important places in which to investigate the role of retailer density on smoking behavior. Individuals living in metropolitan areas travel less distance per day,[48] which may decrease the travel costs to obtain tobacco products.[27] Future research is needed, however, to understand whether retailer density is associated with smoking behaviors in more rural areas.[3]

Though the adjusted models control for several individual-, county- (in sensitivity test), and state-level confounders, there may be other county-level factors contributing to associations that warrant further investigation, including smoking and tobacco use prevalence and tobacco control policies.

Finally, this study considered density measures based on population, rather than land area. A post hoc sensitivity test using the number of retailers per square mile detected some differences in associations compared with per population measures (Appendix Tables 2 and 3). Land area varied widely across sample counties (range=15–20,057 square miles) and captures a different aspect of a region than population size, which may explain these differences. More conceptual work is needed to understand whether per population and per land area measures capture different tobacco retailer environment risks and experiences at various geographic scales (e.g., Census tract versus county).

CONCLUSIONS

Results from this study indicate that among a national sample of adults living in metropolitan counties, greater tobacco retailer and gas and convenience store density was associated with higher odds of someone smoking every day, as compared with smoking some days or not at all.

In addition to smoking-cessation resources, policies that reduce tobacco retailer density, especially gas/convenience store density, may be important for decreasing smoking behaviors.

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Table 1. Descriptive Sample Characteristics for Analytic Samples, 2014–2015 Tobacco Use Supplement, U.S.

Characteristics	**Analytic sample 1: Full sample (n=88,850)**	**Analytic sample 2: Self-respondent smokers (n=7,332)[a]**	**Analytic sample 3: Self-respondent smokers with quit attempt (n=2,915)[b]**
	n (%)	**n (%)**	**n (%)**
Smoking status			
Non-smoker	78,403 (88.2)	–	–
Current smokers	10,447 (11.8)	7,332 (100.0)	2,915 (100.0)
Some day smoker	2,391 (2.7)	1,705 (23.2)	899 (30.8)
Every day smoker	8,056 (9.1)	5,627 (76.8)	2,016 (69.2)
Quit attempt in last 12 months	–	3,433 (46.8)	2,915 (100.0)
Quit length (days), mean (SD)	–	–	44.8 (77.1)
Race and ethnicity			
Non-Hispanic White	54,491 (61.3)	5,026 (68.6)	1,935 (66.4)
Non-Hispanic Black	10,033 (11.3)	1,021 (13.9)	451 (15.5)
Non-Hispanic Asian or Hawaiian/Pacific Islander	7,201 (8.1)	288 (3.9)	110 (3.8)
Non-Hispanic American Indian/Alaskan Native	483 (0.5)	58 (0.8)	27 (0.9)
Non-Hispanic other multi-race	1,288 (1.5)	113 (1.5)	50 (1.7)
Hispanic or Latino ethnicity (any race)	15,354 (17.3)	826 (11.3)	342 (11.7)
Household income			
<$50,000	38,461 (43.3)	4,547 (62.0)	1,821 (62.5)
≥$50,000	50,389 (56.7)	2,785 (38.0)	1,094 (37.5)
Educational attainment			
Less than high school	9,689 (10.9)	1,082 (14.8)	419 (14.4)
High school graduate	23,724 (26.7)	2,697 (36.8)	1,032 (35.4)
Some college/associates degree	24,620 (27.7)	2,429 (33.1)	1,016 (34.9)
Bachelor's degree or more	30,817 (34.7)	1,124 (15.3)	448 (15.3)
Age, mean (SD)	47.9 (17.8)	46.9 (15.1)	45.4 (15.0)
Sex			
Male	41,503 (46.7)	3,763 (51.3)	1,429 (49.0)
Female	47,347 (53.3)	3,569 (48.7)	1,486 (51.0)
County-level			

sociodemographics, mean (SD)			
Percent non-Hispanic Black	13.4 (13.4)	14.3 (13.8)	14.6 (14.2)
Percent living below 150% FPL	9.1 (2.5)	9.3 (2.4)	9.3 (2.4)
County-level tobacco retailer density (per 1,000 people), mean (SD)			
Overall	1.05 (0.2)	1.09 (0.2)	1.10 (0.2)
Other tobacco retailer (excluding gas/convenience)	0.65 (0.2)	0.66 (0.2)	0.67 (0.2)
Gas stations and convenience stores	0.40 (0.1)	0.43 (0.1)	0.43 (0.1)

Note: Descriptive means and frequencies are not adjusted for sampling differences.
[a]Analytic sample 2 was used to test associations of retailer density with self-respondent quit attempt in the last 12 months. Although there were 7,560 self-respondents reporting that they were current smokers, only 7,332 (97.0%) of these respondents reported whether they had a quit attempt in the last 12 months.
[b]Analytic sample 3 was used to test associations of retailer density with quit lengths of 1 day or longer. Although there were 3,433 self-respondents reporting that they had a quit attempt in the last 12 months, only 2,915 (84.9%) of these respondents reported a quit length between 1 and up to 365 days.

FPL, federal poverty level.

Table 2. Unstandardized Associations of Tobacco Retailer Density With Individual Smoking Status (Analytic Sample 1, n=88,850)

Retailer density measures (per 1,000 people)	**Current smokers vs non-smoker (n=88,850)**		**Some-day smoker vs non-smoker (n=80,794)**		**Every-day smoker vs non-smoker (n=86,459)**		**Every-day smoker vs some-day smoker (n=10,447)**	
	Unadjusted OR (95% CI)	**Adjusted AOR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted AOR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted AOR (95% CI)**	**Unadjusted OR (95% CI)**	**Adjusted AOR (95% CI)**
M1. Overall tobacco retailers (alone)	**1.90 (1.54, 2.33)**	**1.57 (1.31, 1.87)**	**1.46 (1.09, 1.96)**	1.29 (0.95, 1.74)	**2.02 (1.62, 2.52)**	**1.63 (1.35, 1.96)**	**1.52 (1.10, 2.09)**	**1.40 (1.05, 1.86)**
M2. Gas stations and convenience stores	**5.21 (3.83, 7.08)**	**3.00 (2.20, 4.08)**	**1.87 (1.18, 2.96)**	1.50 (0.95, 2.38)	**6.49 (4.61, 9.14)**	**3.37 (2.42, 4.68)**	**4.36 (2.55, 7.44)**	**2.44 (1.55, 3.82)**
All other tobacco retailers (excluding gas/convenience)	0.86 (0.65, 1.15)	0.95 (0.75, 1.21)	1.22 (0.79, 1.89)	1.16 (0.75, 1.78)	0.79 (0.57, 1.09)	0.93 (0.72, 1.19)	0.68 (0.42, 1.09)	0.92 (0.60, 1.40)
M3. Gas stations and convenience stores (alone)	**4.92 (3.61, 6.69)**	**2.94 (2.17, 3.98)**	**2.01 (1.26, 3.23)**	1.58 (0.98, 2.53)	**5.87 (4.19, 8.23)**	**3.29 (2.39, 4.52)**	**3.82 (2.20, 6.64)**	**2.37 (1.52, 3.71)**

Note: Boldface indicates statistical significance ($p<0.05$). Each column represents a model outcome while each row represents models that included a different measure of tobacco retailer density (per 1,000 people in a county) entered either alone (M1, M3) or simultaneously (M2). Unadjusted models only include the tobacco retailer density measure(s) while adjusted models included control variables for respondent race and ethnicity, household income, educational attainment, age, sex, and state-level smoke-free air laws and state cigarette excise tax. Binary variables were created comparing current smokers (=1) to non-smokers (0); some-day smokers (=1) to non-smokers (0) where every-day smokers were excluded from the model; every-day smokers (=1) to non-smokers (reference) where some-day smokers were excluded from the model; and every-day smokers (=1) vs some-day smokers (0) where non-smokers were excluded from the model. Generalized estimating equations were used to account for the nesting of individuals within counties in all models.

M, Measure.

Table 3. Standardized Adjusted Associations of Tobacco Retailer Density With Individual Smoking Status (Analytic Sample 1, n=88,850)

Retailer density measures (per 1,000 people)	**Current smokers vs non-smoker (n=88,850)**	**Some-day smoker vs non-smoker (n=80,794)**	**Every-day smoker vs non-smoker (n=86,459)**	**Every-day smoker vs some-day smoker (n=10,447)**
	AOR (95% CI)	**AOR (95% CI)**	**AOR (95% CI)**	**AOR (95% CI)**
M1. Overall tobacco retailers (alone)	**1.10 (1.06, 1.15)**	1.06 (0.99, 1.13)	**1.11 (1.07, 1.16)**	**1.08 (1.01, 1.14)**
M2. Gas stations and convenience stores	**1.14 (1.10, 1.19)**	1.05 (0.99, 1.11)	**1.16 (1.11, 1.21)**	**1.12 (1.06, 1.18)**
All other tobacco retailers (excluding gas/convenience)	0.99 (0.95, 1.03)	1.02 (0.95, 1.10)	0.99 (0.95, 1.03)	0.99 (0.92, 1.06)
M3. Gas stations and convenience stores (alone)	**1.14 (1.10, 1.18)**	1.06 (1.00, 1.12)	**1.16 (1.11, 1.20)**	**1.11 (1.05, 1.18)**

Note: Boldface indicates statistical significance ($p<0.05$). Each column represents a model outcome while each row represents models that included a different measure of tobacco retailer density (per 1,000 people in a county) entered either alone (M1, M3) or simultaneously (M2). Adjusted models included control variables for respondent race and ethnicity, household income, educational attainment, age, sex, and state-level smoke-free air laws and state cigarette excise tax. Because effect sizes are not comparable to one another in raw units, measures were standardized to compare the magnitude of associations. Binary variables were created comparing current smokers (=1) to non-smokers (0); some-day smokers (=1) to non-smokers (0) where every-day smokers were excluded from the model; every-day smokers (=1) to non-smokers (reference) where some-day smokers were excluded from the model; and every-day smokers (=1) vs some-day smokers (0) where non-smokers were excluded from the model. Generalized estimating equations were used to account for the nesting of individuals within counties in all models.

M, Measure.

Table 4. Associations of Tobacco Retailer Density With Individual Quit Attempt (Analytic Sample 2, n=7,332) and Quit Length (Analytic Sample 3, n=2,915)

Retailer density measures (per 1,000 people)	**Quit attempt in last 12 months (n=7,332)**			**Quit length (days) (n=2,915)**		
	Unstandardized unadjusted OR (95% CI)	**Unstandardized adjusted AOR (95% CI)**	**Standardized adjusted AOR (95% CI)**	**Unstandardized unadjusted OR (95% CI)**	**Unstandardized adjusted AOR (95% CI)**	**Standardized adjusted AOR (95% CI)**
M1. Overall tobacco retailers (alone)	1.07 (0.85, 1.34)	1.04 (0.83, 1.32)	1.01 (0.96, 1.07)	0.93 (0.71, 1.21)	0.90 (0.68, 1.19)	0.98 (0.91, 1.04)
M2. Gas stations and convenience stores	1.00 (0.66, 1.52)	1.10 (0.71, 1.69)	1.01 (0.96, 1.07)	1.06 (0.61, 1.82)	1.07 (0.61, 1.87)	1.01 (0.93, 1.09)
All other tobacco retailers (excluding gas/convenience)	1.12 (0.80, 1.57)	1.01 (0.72, 1.41)	1.00 (0.95, 1.06)	0.83 (0.57, 1.22)	0.80 (0.51, 1.25)	0.96 (0.89, 1.04)
M3. Gas stations and convenience stores (alone)	1.04 (0.69, 1.56)	1.09 (0.72, 1.67)	1.01 (0.96, 1.07)	1.00 (0.59, 1.70)	0.99 (0.58, 1.69)	1.00 (0.93, 1.07)

Note: Each column represents a model outcome while each row represents models that included a different measure of tobacco retailer density (per 1,000 people in a county) entered either alone (M1, M3) or simultaneously (M2). Unadjusted models only include the tobacco retailer density measure(s) while adjusted models included control variables for respondent race and ethnicity, household income, educational attainment, age, sex, and state-level smoke-free air laws and state cigarette excise tax. Because effect sizes are not comparable to one another in raw units, measures were standardized to compare the magnitude of associations. Generalized estimating equation were used to account for the nesting of individuals within counties in all models.

M, Measure.