

Tobacco-Free Pharmacies and U.S. Adult Smoking Behavior: Evidence From CVS Health's Removal of Tobacco Sales



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Introduction: Beginning September 3, 2014, CVS Health stopped selling tobacco products in all of its retail stores nationwide. This study assessed the impact of removing tobacco sales from CVS Health on cigarette smoking behaviors among U.S. adult smokers.

Methods: CVS Health retail location data (2012–2016) were linked with data from the Behavioral Risk Factor Surveillance System, a phone-based survey of the non-institutionalized civilian population aged ≥ 18 years. Using a difference-in-differences regression model, quit attempts and daily versus nondaily smoking were compared between smokers living in counties with CVS stores and counties without CVS stores, before and after CVS's removal of tobacco sales. Control variables included individuals' sociodemographic and health-related variables, state tobacco control variables, and urban status of counties. Analyses were conducted in 2018.

Results: During the 2-year period following the removal of tobacco sales from CVS Health, smokers living in counties with high CVS density (≥ 3.5 CVS stores per 100,000 people) had a 2.21% (95% CI=0.08, 4.33) increase in their quit attempt rates compared with smokers living in counties without CVS stores. This effect was greater in urban areas (marginal effect: 3.03%, 95% CI=0.81, 5.25); however, there was no statistically significant impact in rural areas. Additionally, there was no impact on daily versus nondaily smoking in either urban or rural areas.

Conclusions: Removing tobacco sales in retail pharmacies could help support cessation among U.S. adults who are attempting to quit smoking, particularly in urban areas.

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INTRODUCTION

Pharmacists are among the most trusted health-care providers for the public.¹ Selling tobacco products in pharmacies can send a mixed health message about the dangers of tobacco smoking and potentially reinforce positive attitudes about tobacco use. Although cigarette smoking continues to be the leading preventable cause of death in U.S., killing more than 480,000 Americans each year,² more than 50,000 pharmacies sold tobacco products as of 2015.³ Additionally, although cigarette sales declined 17% nationally between 2005 and 2009, sales in pharmacies increased 23% during that time.⁴ The tobacco industry also engages heavily in point-of-sale tobacco marketing (e.g.,

product placement and price promotions) in pharmacies.³ According to the 2016 *Point-of-Sale Report to the Nation*,³ “pharmacies have the second highest prevalence of interior tobacco promotions out of any other retailer type, including tobacco specialty shops and non-gas convenience stores.” A 2016 study found that

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cigarettes in pharmacies were less expensive than at other stores, which could make these locations more appealing for cigarette purchases given that price is inversely related to tobacco product consumption.⁵

Nearly 7 in 10 U.S. adults who currently smoke want to quit.⁶ However, the promotion and sale of tobacco products in the same places where smokers purchase cessation medications may trigger physical cravings to smoke and impede quitting.^{7,8} In fact, a 2014 study found that patients' visits to pharmacies for medications to treat smoking-related illnesses were associated with the purchase of cigarettes.⁹ Given the adverse health effects of smoking and the public perception of pharmacies as institutions focused on promoting health, there is generally broad population-based support for prohibiting tobacco sales in pharmacies. A 2014 survey showed that 66% of U.S. adults, including nearly half of those who smoke cigarettes, favored prohibiting tobacco sales in pharmacies.¹⁰ Additionally, the American Pharmacists Association opposes tobacco sales in pharmacies.¹¹

On September 3, 2014, CVS Health, the largest U.S. pharmacy chain, stopped tobacco sales in all of its 7,800 retail stores nationwide.¹² A CVS Health–conducted study suggested that there was a 1% reduction in cigarette purchases in states where CVS Health had $\geq 15\%$ market share compared with states with no CVS Health stores.¹² However, little is known about the potential impact of CVS's removal of tobacco sales on smoking behavior. To address this gap, this study assessed the impact of the removal of tobacco sales from CVS Health on quit attempts and daily versus nondaily smoking among U.S. adult cigarette smokers.

METHODS

Study Sample

Data came from the 2012–2016 Behavioral Risk Factor Surveillance System (BRFSS), a random-digit-dial, state-based, annual telephone (landline and cellular) survey of the non-institutionalized civilian population aged ≥ 18 years, conducted in 50 states and the District of Columbia. Response rates ranged from 47.7% to 49.1% for landlines and 35.3% to 47.2% for cell phones.¹³ BRFSS contains information on individual characteristics and cigarette smoking status.

Access to BRFSS county identifiers (Federal Information Processing Standards codes) was obtained through the U.S. Centers for Disease Control and Prevention (CDC). County identifiers were linked with data on the number of CVS stores in each county in each year during 2012–2016, purchased from Aggregate Data Company (AggData.com).

The analytical sample included current cigarette smokers and former smokers who quit in the previous 12 months. Total combined sample size was 406,583 observations (sample sizes were 86,685 for 2012, 89,437 for 2013, 77,166 for 2014, 71,056 for 2015, and 82,239 for 2016). Current smokers were defined as

respondents who reported smoking at least 100 cigarettes in their lifetime and were smoking every day or some days at the time of the survey, using the survey questions: *Have you smoked at least 100 cigarettes in your entire life? (yes/no)* and *Do you now smoke cigarettes every day, some days, or not at all? (every day, some days, or not at all)*. Sample size of current smokers was 344,303 observations. Former smokers who quit in the previous 12 months were defined as those who reported smoking at least 100 cigarettes during their lifetime but were not smoking cigarettes at all at the time of the survey and the last time they smoked was within the previous 12 months, using the survey question: *How long has it been since you last smoked a cigarette, even one or two puffs? (<1 month, 1 to <3 months, 3 to <6 months, 6 months to <1 year, 1 to <5 years, 5 to <10 years, ≥ 10 years, never smoked regularly, or don't know/not sure/refused)*. Sample size for the first 4 responses was 62,280 observations.

Measures

Quit attempts was measured with a dichotomous variable, where 1 denoted current smokers who made at least 1 quit attempt in the past 12 months (*During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?*) or former smokers who quit within the past 12 months, and 0 denoted current smokers who did not make a quit attempt. This study included recent former smokers, consistent with previous CDC studies on quit attempts,^{6,14} because of the high risk of smoking relapse within the first year of quitting.^{15,16}

Daily smoking was measured with a dichotomous variable, where 1 denoted current smokers who smoked daily in the past 30 days (daily), and 0 denoted current smokers who did not smoke daily in the past 30 days (some days).

Two measures were used to define intervention and comparison groups. The first was a dichotomous measure of presence of CVS stores: at least 1 CVS store in the county of residence at the time of the survey (intervention counties) versus none (comparison counties). The second measure captured the density of CVS stores. Specifically, the number of CVS stores in each county in each year was divided by the county-year population size^{17–19} (from the U.S. Census data), and the quartiles of this measure were then computed. The first quartile included counties with no CVS stores (the comparison group), the second quartile included counties with 0.1 to <1.7 CVS stores per 100,000 people, the third quartile included counties with 1.7 to <3.5 CVS stores per 100,000 people, and the fourth quartile included counties with ≥ 3.5 CVS stores per 100,000 people.

Additionally, an indicator variable for the date when CVS Health stopped tobacco sales was created, dichotomized as respondents interviewed September 3, 2014 to December 31, 2016 versus respondents interviewed January 1, 2012 to September 2, 2014.

Individual-level sociodemographic variables included sex (male, female, unknown), age (18–24 years, 25–44 years, 45–64 years, ≥ 65 years, unknown), race/ethnicity (white, non-Hispanic; black, non-Hispanic; other races, non-Hispanic; Hispanic; unknown), education (less than high school, high school diploma or GED degree, some college, college degree or higher, unknown), marital status (married, nonmarried, unknown), annual household income ($< \$15,000$, $\$15,000$ – $\$34,999$, $\$35,000$ – $\$49,999$, $\$50,000$ – $\$74,999$, $\geq \$75,000$, unknown), and employment status

(employed, unemployed, retired, unknown). Individual-level health-related variables included general health status (excellent, very good, good, fair, poor, unknown), being physically active in the past 30 days (yes, no, unknown), and having health problems requiring special equipment (yes, no, unknown). State-level variables included state cigarette excise taxes rates, state tobacco control funding per capita, and a set of indicators for the extent of statewide smoke-free air laws in restaurants, bars, and workplaces (none, 1 place, 2 places, 3 places). All were obtained from the CDC State Tobacco Activities Tracking & Evaluation System (<https://www.cdc.gov/statesystem/index.html>).²⁰ County-level variables included population size and urban/rural status, using the 2013 urban–rural classification scheme from the National Center for Health Statistics.²¹

Statistical Analysis

A difference-in-differences regression model was used to compare probabilities of quit attempts and daily versus nondaily smoking between smokers living in counties with CVS stores and counties without CVS stores, after versus before CVS's removal of tobacco sales. The difference-in-differences models included an indicator for the intervention counties, an indicator for the period after September 2, 2014, and an interaction term between these 2 indicator variables in addition to the following interaction terms: (1) an interaction between the intervention counties indicator and an urban/rural indicator; (2) an interaction between the indicator for the period after September 2, 2014 and the urban/rural indicator; and (3) an interaction between the intervention counties indicator, the indicator for the period after September 2, 2014, and the urban/rural indicator. Control variables included secular trend, intervention-specific time trend, state fixed effects, state-specific time trend, and a set of indicator variables for each quarter in addition to all the other aforementioned variables (individual-, state-, and county-level variables).

For the past-year quit attempt model, respondents who were interviewed September 1, 2014 through September 30, 2015 (representing 19% of the total sample) were excluded because it was unknown whether their past-year quit attempts happened after or before CVS stopped tobacco sales. This exclusion reduced the total sample size from 406,583 observations to 329,210 observations. Additionally, 1,177 observations (0.36%) with missing information on quit attempts were excluded. Thus, the final analytical sample for the quit attempt outcome included 328,033 observations. All current smokers ($n=344,303$) were included in the analytical sample for the daily smoking outcome.

The difference-in-differences analytical approach was implemented using logistic regression models. In addition, cluster-robust SEs with clustering on counties were computed to account for within-county correlation and heteroskedasticity.²² Marginal effects (in percentage points) along with 95% CIs were reported overall and by urban/rural status. Data used for this analysis were de-identified, and thus IRB approval was not sought. Analyses were conducted in 2018 using Stata, version 14. Statistical significance was considered at $p<0.05$.

RESULTS

Both counties with and without CVS stores had similar sex and age compositions before CVS removed tobacco

sales (Table 1). Differences between the 2 groups were observed by race/ethnicity, education level, and urban status. Counties with CVS stores had higher percentages of black non-Hispanics (12.2% vs 4.2%), respondents with a college degree or higher (20.3% vs 15.3%), and more urban areas (83.3% vs 40.1%) than counties without CVS stores. Small, but statistically significant, differences also were observed by annual household income, marital status, general health status, physical activity, and having health problems requiring special equipment.

Overall, the prevalence of quit attempts among U.S. adult smokers slightly decreased from 63.9% before CVS removed tobacco sales to 63.1% after removal (Table 2). In urban areas, the reduction was greater in counties without CVS stores (from 63.5% to 61.4%; relative change, -3.3%) than in counties with CVS stores (65.5% to 64.9%; relative change, -0.9%). Similarly, in rural areas, this reduction was statistically significant in counties without CVS stores (relative change, -1.1%) but not statistically significant in counties with CVS stores. Using the density measure, prevalence of quit attempts did not change significantly over time among smokers living in counties with high CVS density (≥ 3.5 CVS stores per 100,000 people). This was true overall and among urban and rural counties.

During the same period, among current smokers, the prevalence of daily smoking decreased from 71.9% before CVS's removal of tobacco sales to 71.1% after removal (Table 2). Small, but statistically significant, differences were observed in urban areas between counties without CVS stores (relative change, -1.2%) and counties with CVS stores (relative change, -1.6%). No significant differences were observed in rural areas. Using the intervention density measure, statistically significant decreases were observed in urban counties in all quartiles. No significant differences were observed in rural areas, except for counties in the fourth quartile.

Following CVS's removal of tobacco sales, the changes in the adjusted probabilities of quit attempts and daily smoking were not statistically different between counties with CVS stores and counties without CVS stores (using the dichotomous measure of presence of any CVS stores) (Table 3). However, using the density measure, counties with high CVS density (≥ 3.5 CVS stores per 100,000 people) experienced an increase in the adjusted probability of quit attempts by 2.21% (95% CI=0.08, 4.33) compared with counties without CVS stores. The effect was greater in urban counties with high CVS density compared with urban counties with no CVS stores. Specifically, the increase was 3.03% (95% CI=0.81, 5.25). There was no significant impact observed in rural areas. Additionally, there was no significant impact on

Table 1. Characteristics of U.S. Adult Smokers Before CVS's Removal of Tobacco Sales

Variables	% of smokers in counties without CVS stores	% of smokers in counties with CVS stores
Sex		
Female	54.6	54.4
Male	45.4	45.6
Age, years		
18–24	6.7	6.9
25–44	29.7	30.1
45–64	45.4	45.0
65+	17.9	17.5
Unknown	0.4	0.5
Race/ethnicity		
White, non-Hispanic	80.6	73.0
Black, non-Hispanic	4.2	12.2
Others, non-Hispanic	8.9	6.8
Hispanic	5.0	6.5
Unknown	1.3	1.5
Education level		
<High school	13.7	13.3
High school/GED	39.7	36.1
Some college	31.2	30.1
College or higher	15.3	20.3
Unknown	0.1	0.2
Annual household income		
<\$15,000	18.3	17.4
\$15,000–\$34,999	33.5	31.9
\$35,000–\$49,999	13.4	12.2
\$50,000–\$74,999	11.4	11.6
≥\$75,000	12.6	15.4
Unknown	10.8	11.5
Employment status		
Employed	51.4	50.1
Unemployed	31.9	32.7
Retired	16.4	16.7
Unknown	0.3	0.4
Marital status		
Married	42.0	36.8
Nonmarried	57.7	62.7
Unknown	0.4	0.5
Urban/rural status		
Rural	59.9	16.2
Urban	40.1	83.8
General health status		
Excellent	10.2	11.2
Very good	26.8	27.2
Good	34.0	33.5
Fair	18.6	18.4
Poor	9.9	9.3
Unknown	0.3	0.4

(continued on next page)

Table 1. Characteristics of U.S. Adult Smokers Before CVS's Removal of Tobacco Sales (*continued*)

Variables	% of smokers in counties without CVS stores	% of smokers in counties with CVS stores
Exercise in the past 30 days		
Yes	64.2	65.1
No	33.6	32.5
Unknown	2.2	2.4
Having health problems requiring special equipment		
Yes	12.4	12.9
No	87.5	86.8
Unknown	0.1	0.3

Note: Boldface indicates statistical significance ($p < 0.05$). Standard chi-square tests were used to calculate p -values for the statistical differences between intervention and comparison groups. This table includes the period from January 1, 2012, to September 2, 2014.

daily versus nondaily smoking in either urban or rural counties.

DISCUSSION

The findings of this study suggest that eliminating tobacco sales in CVS stores increased quit attempts among U.S. adult smokers living in counties with high CVS density (≥ 3.5 CVS stores per 100,000 people) and that the effect was greater among those living in urban areas. These findings carry public health significance because tobacco use continues to cause major health and economic burdens in the U.S., but more than 50,000 pharmacies continue to advertise and sell tobacco products while also providing health promotion products and services, including those for smoking cessation.^{23–26} Pharmacists are essential members of the nation's health-care team and are effective providers of smoking-cessation interventions that can help smokers quit.^{23–26} The role of pharmacists in smoking cessation has evolved substantially in recent years, and some states now allow pharmacies to prescribe cessation medications directly to clients.²⁷ Therefore, as pharmacies expand their role in promoting healthy lifestyle behaviors, including smoking cessation, the sale of tobacco products is contradictory to this role and could undermine their credibility.

The findings from this study show that the impact of CVS's removal of tobacco sales on quit attempts was greater in urban counties than rural counties. This could be due to the concentration of CVS stores in urban areas. Specifically, two thirds of CVS stores are located in urban counties. Because higher retail density is associated with greater tobacco use,²⁸ a reduction in the number of tobacco retail outlets—and thus a reduction in overall tobacco retailer density in the community—may help promote quit attempts among current smokers.^{29,30} Furthermore, the data show that the biggest impact happened in urban counties with the highest density of CVS

stores. This suggests that jurisdiction-wide policies eliminating tobacco sales in all pharmacies at once may have greater public health benefits.³¹ As of 2017, such policies have been implemented by hundreds of communities including San Francisco, California; Rockland County, New York; Rock County, Minnesota; and more than 150 localities in Massachusetts.³² State and local laws that prohibit tobacco sales in pharmacies as well as voluntary actions by pharmacies to remove all tobacco sales could help reduce the density of tobacco retailers and the number of cigarette purchases.^{12,31} As the tobacco product landscape continues to evolve, it is critical that these policies keep pace by including the diversity of tobacco products being sold in the U.S., including e-cigarettes.³³

Several potential mechanisms may explain the increase in quit attempts because of removing tobacco sales from CVS Health. First, CVS Health has more than 9,800 retail locations nationwide, and 76% of the U.S. population lives within 5 miles of a CVS Pharmacy.³⁴ Studies have shown that living within walking distance of a tobacco store reduces the likelihood of smoking cessation.^{29,30} Therefore, removing tobacco sales from CVS Health might have reduced access to cigarettes among smokers who find it convenient to shop at pharmacies. Second, studies have shown that smoking cues and cigarette availability increase craving and tobacco use.^{7,8} Thus, eliminating tobacco sales from CVS Health might have reduced exposure to smoking cues among smokers who visit pharmacies. Finally, the removal of tobacco sales from pharmacies might further help denormalize tobacco product use, which was shown to be associated with higher rates of smoking cessation in urban areas.³⁵ Further research that isolates these mechanisms can help improve understanding of the impact of tobacco-free pharmacies on smoking behavior.

The impact of CVS's removal of tobacco sales on daily versus nondaily smoking was not statistically significant. Daily smokers might have reduced the number of

Table 2. Prevalence of Quit Attempts and Daily Smoking Among U.S. Adult Smokers, 2012–2016

Measure	Overall		Urban		Rural	
	% (95% CI) before Sep 3, 2014	% (95% CI) on or after Sep 3, 2014	% (95% CI) before Sep 3, 2014	% (95% CI) on or after Sep 3, 2014	% (95% CI) before Sep 3, 2014	% (95% CI) on or after Sep 3, 2014
Quit attempt (<i>n</i> =328,033) ^a						
Overall	63.9 (63.7, 64.1)	63.1 (62.8, 63.4)	65.1 (64.8, 65.3)	64.2 (63.8, 64.6)	61.4 (61.1, 61.8)	60.8 (60.3, 61.4)
Dichotomous intervention ^b measure						
Counties without CVS stores	61.9 (61.6, 62.3)	60.7 (60.2, 61.2)	63.5 (63.0, 64.0)	61.4 (60.6, 62.3)	60.9 (60.5, 61.3)	60.2 (59.6, 60.9)
Counties with CVS stores	65.1 (64.8, 65.3)	64.3 (63.9, 64.7)	65.5 (65.2, 65.8)	64.9 (64.5, 65.3)	62.6 (62.0, 63.3)	61.9 (61.0, 62.7)
Density intervention measure						
1st quartile: no CVS stores	61.9 (61.6, 62.3)	60.7 (60.2, 61.2)	63.5 (63.0, 64.0)	61.4 (60.6, 62.3)	60.9 (60.5, 61.3)	60.2 (59.6, 60.9)
2nd quartile: 0.1–1.7 CVS stores per 100,000 people	64.1 (63.6, 64.7)	63.6 (62.8, 64.4)	64.6 (64.0, 65.2)	64.1 (63.3, 65.0)	60.7 (59.1, 62.3)	60.0 (57.7, 62.2)
3rd quartile: 1.7–3.5 CVS stores per 100,000 people	64.9 (64.5, 65.3)	64.0 (63.4, 64.6)	65.4 (65.0, 65.8)	64.6 (63.9, 65.2)	62.7 (61.8, 63.7)	62.1 (60.8, 63.4)
4th quartile: ≥3.5 CVS stores per 100,000 people	65.6 (65.3, 66.0)	65.0 (64.4, 65.5)	66.1 (65.7, 66.5)	65.6 (65.0, 66.2)	63.3 (62.3, 64.2)	62.3 (60.9, 63.6)
Daily smoking (<i>n</i> =344,303) ^c						
Overall	71.9 (71.7, 72.1)	71.1 (70.9, 71.3)	70.5 (70.3, 70.8)	69.5 (69.2, 69.7)	74.6 (74.3, 75)	74.2 (73.8, 74.6)
Dichotomous intervention measure						
Counties without CVS	73.6 (73.3, 73.9)	73.1 (72.7, 73.5)	72.2 (71.7, 72.7)	71.3 (70.7, 71.9)	74.5 (74.1, 74.9)	74.2 (73.7, 74.7)
All counties with CVS	70.9 (70.6, 71.1)	70.0 (69.7, 70.3)	70.1 (69.8, 70.3)	69 (68.7, 69.3)	74.8 (74.2, 75.4)	74.3 (73.6, 74.9)
Density intervention measure						
1st quartile: no CVS stores	73.6 (73.3, 73.9)	73.1 (72.7, 73.5)	72.2 (71.7, 72.7)	71.3 (70.7, 71.9)	74.5 (74.1, 74.9)	74.2 (73.7, 74.7)
2nd quartile: 0.1–1.7 CVS stores per 100,000 people	70.4 (69.8, 71.0)	69.7 (69.1, 70.4)	69.8 (69.1, 70.4)	68.9 (68.2, 69.6)	74.6 (73.1, 76.2)	75.5 (73.9, 77.2)
3rd quartile: 1.7–3.5 CVS stores per 100,000 people	70.8 (70.4, 71.2)	70.0 (69.6, 70.5)	69.9 (69.4, 70.3)	68.9 (68.3, 69.4)	74.8 (73.9, 75.8)	74.3 (73.4, 75.3)
4th quartile: ≥3.5 CVS stores per 100,000 people	28.8 (28.4, 29.2)	30.0 (29.5, 30.5)	70.4 (69.9, 70.8)	69.2 (68.6, 69.7)	74.9 (74.0, 75.8)	73.7 (72.6, 74.7)

Note: Boldface indicates statistical significance ($p < 0.05$). Standard chi-square tests were used to calculate p -values for statistical differences between the period on or after CVS Health removed tobacco products sales versus the period before the removal.

^aThis sample size included current cigarette smokers and recent former smokers who quit in the past 12 months, combined using 5 waves of BRFSS data (2012–2016). Excluded from this total were respondents interviewed between September 1, 2014 and September 31, 2015 (representing 19% of total) and respondents with missing information on quit attempts (0.36%).

^bThe density measure was computed by dividing the number of CVS stores in each county in each year by the county–year population size (from U.S. Census data), then computing the quartiles of this measure.

^cThis is the sample size of current cigarette smokers, combined using 5 waves of BRFSS data (2012–2016).

BRFSS, Behavioral Risk Factor Surveillance System; Sep, September.

Table 3. Difference in Differences Analyses Using Logistic Regressions, U.S. Adult Smokers (2012–2016)

Outcomes	Marginal effects ^a in percentage points (95% CI)		
	Overall	Urban	Rural
Quit attempts (n=328,033)			
Dichotomous intervention measure			
Counties without CVS	ref	ref	ref
All counties with CVS	1.32 (–0.40, 3.04)	1.86 (0.00, 3.72)	0.26 (–1.76, 2.28)
Density intervention measure			
1st quartile: no CVS stores	ref	ref	ref
2nd quartile: 0.1–1.7 CVS stores per 100,000 people	–0.48 (–3.05, 2.10)	–0.23 (–2.94, 2.48)	–0.97 (–4.17, 2.23)
3rd quartile: 1.7–3.5 CVS stores per 100,000 people	1.57 (–0.58, 3.71)	2.00 (–0.26, 4.26)	0.71 (–1.97, 3.40)
4th quartile: ≥3.5 CVS stores per 100,000 people	2.21 (0.08, 4.33)	3.03 (0.81, 5.25)	0.58 (–2.08, 3.25)
Daily smoking (n=344,303)			
Dichotomous intervention measure			
Counties without CVS	ref	ref	ref
All counties with CVS	1.15 (–0.17, 2.47)	1.05 (–0.43, 2.53)	1.36 (–0.15, 2.87)
Density intervention measure			
1st quartile: no CVS stores	ref	ref	ref
2nd quartile: 0.1–1.7 CVS stores per 100,000 people	0.97 (–0.90, 2.83)	0.52 (–1.51, 2.56)	1.89 (–0.58, 4.35)
3rd quartile: 1.7–3.5 CVS stores per 100,000 people	1.33 (–0.32, 2.97)	1.26 (–0.55, 3.07)	1.46 (–0.47, 3.40)
4th quartile: ≥3.5 CVS stores per 100,000 people	1.00 (–0.67, 2.68)	0.96 (–0.85, 2.77)	1.10 (–1.01, 3.20)

Note: Boldface indicates statistical significance ($p < 0.05$). The DID models included an indicator for the intervention counties, an indicator for the period after September 2, 2014, and an interaction term between these 2 indicator variables, in addition to the following interaction terms: (1) an interaction between the intervention counties indicator and an urban–rural indicator; (2) an interaction between the indicator for the period after September 2, 2014 and the urban–rural indicator; and (3) an interaction between the intervention counties indicator, the indicator for the period after September 2, 2014, and the urban–rural indicator. Analysis controlled for secular trend, intervention-specific time trend, state fixed effects, state-specific time trend, quarters' dummies, sex, age, race/ethnicity, education level completed, marital status, annual household income, employment status, general health status, being physically active in the past 30 days, and having health problems requiring special equipment. Analysis also controlled for state cigarette excise taxes rates, state tobacco control funding per capita, a set of indicator variables for the extent of statewide smoke-free air laws in restaurants, bars, and workplaces (none, 1 place, 2 places, and 3 places), county population size, and county urban–rural status.

^aMarginal effects (in percentage points) were obtained using logistic regressions adjusted for all covariates listed above. These marginal effects represent the adjusted increases/decreases in the probability of quit attempts and the probability of daily smoking following CVS's removal of tobacco products sales in intervention counties compared with the comparison counties.

DID, difference in differences.

cigarettes smoked per day instead of reducing the number of days on which they smoked. However, the BRFSS survey does not provide information on the number of cigarettes smoked. As intensity of cigarette consumption affects nicotine addiction and smokers' ability to quit,^{36,37} further research that examines more nuanced changes in the intensity of cigarette consumption is critical. Furthermore, this study assessed only smoking patterns and quit attempts. Absence of information on county of residence at time of smoking initiation and at time of quitting prevented analysis of these outcomes. Future research analyzing these outcomes in addition to other potential outcomes that may have been affected by CVS's removal of tobacco sales is warranted.

Limitations

This study is subject to limitations. First, BRFSS data are self-reported and might be subject to reporting bias. Second, response rates for the BRFSS data are low; however, BRFSS tobacco use estimates have been shown to be

valid and reliable.³⁸ Third, the state-based BRFSS survey does not provide national or county weights and so descriptive statistics in this analysis should be interpreted with caution. Fourth, counties where individuals resided at the time of survey were assumed to be the same counties where they resided when they made their quit attempts during the past 12 months. Fifth, an assumption was made that smokers living in counties without CVS stores (comparison group) did not buy cigarettes from CVS stores before September 3, 2014 in counties with CVS stores. The violation of this assumption would imply that the comparison group was likely exposed to the removal of tobacco sales from CVS health (spillover effects), which might bias the results downward. Finally, this study may not have accounted for all potential tobacco-related policies that happened at the same time when CVS Health removed tobacco sales, and for which the magnitude of these policy changes differed systematically between counties with CVS stores and counties without CVS stores.

CONCLUSIONS

This is the first study, to the authors' knowledge, to examine the impact of the removal of tobacco sales from CVS stores on quit attempts and daily versus nondaily smoking. The findings suggest that a large, nationwide retailer's decision to remove tobacco products from its stores could support cessation among U.S. adult smokers in urban areas. Additionally, jurisdiction-wide policies eliminating tobacco sales in all pharmacies may have a greater impact on cessation behaviors. Further evaluation research on the relationship between individual smoking behaviors and sales restrictions on tobacco products in pharmacies could help inform tobacco control policy, planning, and practice.

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