



E-cigarette availability, price promotions and marketing at the point-of sale in the contiguous United States (2014–2015): National estimates and multilevel correlates

Heather D'Angelo^{a,*}, Shyanika W. Rose^{b,c}, Shelley D. Golden^{d,e}, Tara Queen^e, Kurt M. Ribisl^{d,e}

^a School of Medicine and Public Health, Carbone Cancer Center, University of Wisconsin-Madison, Madison, WI, USA

^b College of Medicine, Department of Behavioral Science, and Center for Health Equity Transformation, University of Kentucky, Lexington, KY, USA

^c Truth Initiative Schroeder Institute, Washington, DC, USA

^d Gillings School of Global Public Health, Department of Health Behavior, University of North Carolina, Chapel Hill, NC, USA

^e Lineberger Comprehensive Cancer Center, University of North Carolina, Chapel Hill, NC, USA

ARTICLE INFO

Keywords:

Electronic cigarettes
Marketing and promotions
Retail tobacco marketing
Neighborhood

ABSTRACT

Electronic cigarette (e-cigarette) sales and use have increased rapidly, yet point-of-sale e-cigarette availability and marketing is understudied. We estimated changes in e-cigarette availability and marketing among tobacco retailers in the U.S., and associations with neighborhood characteristics. A national sample of tobacco retailers in the Contiguous U.S. was audited in 2014 and 2015 ($n = 1,905$ and $n = 2,126$, respectively) to observe e-cigarette availability and marketing (signs, ads, displays and promotions) and generate national prevalence estimates. Store, neighborhood and state level correlates of 2015 e-cigarette availability, price promotions and exterior advertising were analyzed using multilevel mixed-effects generalized linear models. E-cigarettes were sold at 72.0% of retailers in 2014 and at 79.2% in 2015. Price promotions increased from 11.9% to 20.2% of retailers. Among retailers that did not previously sell e-cigarettes in 2012, availability in 2015 was greater for retailers in neighborhoods with the highest proportion of Black residents (vs. lowest). E-cigarette price promotions were more prevalent in neighborhoods with more Hispanic residents, while exterior e-cigarette marketing was more prevalent in neighborhoods with more Black residents. State smoking prevalence was positively associated with e-cigarette availability, promotions and advertising. E-cigarette point-of-sale availability and marketing increased between 2014 and 2015 and expanded to neighborhoods with a higher proportion of Black residents between 2012 and 2015. Retailers located within states with high smoking prevalence appear to be targeted by e-cigarette marketing. As e-cigarettes become the target of more regulations, understanding changes in the e-cigarette retail environment is critical to inform potential policies regulating their sale and marketing.

1. Introduction

The retail market for electronic cigarettes (“e-cigarettes”) in the United States (U.S.) has expanded rapidly in recent years. E-cigarettes are battery-operated devices containing nicotine, flavorings and other chemicals that are heated to deliver an aerosol that is inhaled into the lungs. Although some argue that e-cigarettes are less harmful than combustible products, and possibly a tool for smoking cessation, others are concerned that e-cigarettes may become popular among non-smokers, providing a pathway to nicotine addiction, especially for youth. Between 2010 and 2016, e-cigarette sales increased from \$11.6 million to \$751.2 million and 2020 retail e-cigarette sales are expected to exceed \$4B. (Cantrell et al., 2018; Wall, 2019) E-cigarette marketing

expenditures rose from \$12 million in 2011 to \$88 million in 2014. (King et al., 2018) Perhaps unsurprisingly, rates of e-cigarette use have risen as well, particularly among youth. (Arrazola et al., 2015; Cullen, 2018) More youth now currently use an e-cigarette than are current cigarette smokers. (Wang et al., 2018) These trends coincided with increased domination of the e-cigarette market by tobacco companies. By 2013, the major tobacco companies, including R.J. Reynolds (now owned by British American Tobacco) and Philip Morris (Altria), had acquired existing e-cigarette brands or were producing their own versions of e-cigarettes including brands such as Vuse and MarkTen. (Grana et al., 2014) Additionally, flavored e-cigarettes may be particularly appealing to youth, (Villanti et al., 2017) and the percent of e-cigarette retail sales that are flavored (excluding menthol) increased

* Corresponding author.

E-mail address: hdangelo@wisc.edu (H. D'Angelo).

<https://doi.org/10.1016/j.pmedr.2020.101152>

Received 2 January 2020; Received in revised form 18 May 2020; Accepted 20 June 2020

Available online 26 June 2020

2211-3355/ © 2020 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

from 2.4% in 2012 to 19.8% in 2016. (Kuiper et al., 2018) However, despite increases in both sales and use, little is currently known about where e-cigarettes are sold, the types of neighborhoods in which they are sold, and how they are being marketed to consumers at the point-of-sale.

Tobacco companies have historically targeted cigarette marketing to lower income, racial/ethnic minority populations (Yerger et al., 2007) and neighborhoods with more people of color and lower income residents have more tobacco marketing and promotions at the point-of-sale. (Lee et al., 2015; Ribisl et al., 2017) However, e-cigarettes may be sold and marketed differently. Our previous national study found that e-cigarettes were sold in 34% of retail stores that sold cigarettes in the U.S. in 2012, and were more likely to be sold in stores located in neighborhoods with higher median household income, and lower percentages of African-American and Hispanic residents. (Rose et al., 2014) Similarly, data from store audits in New York City revealed lower amounts of e-cigarette advertising in neighborhoods with more African American and Hispanic residents and greater availability of e-cigarettes in neighborhoods with more white residents. (Giovenco et al., 2019) However, as e-cigarette sales and use have expanded, changes in the way e-cigarettes are sold and marketed nationally may have also occurred.

Studies that have directly measured the presence of e-cigarette marketing in retail stores are limited and often focus on youth and young adult exposure. One study found that the presence of e-cigarette advertisements in retail stores increased significantly between 2012 and 2013 among stores near community colleges in two states. (Wagoner et al., 2014) Nationally, 59.9% of middle and high school students in 2015 and 68% in 2016 reported seeing an e-cigarette ad at a retail store, a greater percentage than reporting advertising exposure via the internet, television/movies and newspapers and magazines. (Singh et al., 2016) Similar to the association between exposure to tobacco advertising and smoking among youth, (Robertson et al., 2016) frequent exposure to retail e-cigarette advertising has been associated with greater odds of current e-cigarette use among youth, (Singh et al., 2016; Dai and Hao, 2016) highlighting the importance of documenting the retail environment for e-cigarettes.

Flavored products, price promotions, and product placement at the point-of-sale have been studied for other tobacco products in addition to advertising, at the national level (Ribisl et al., 2017) and these measures have been associated with tobacco use. (Robertson et al., 2015) However, research examining the retail environment for e-cigarettes has primarily been conducted through local studies. (Wagoner et al., 2019; Brame et al., 2016; Escobedo et al., 2019) To address this gap in the literature, this study has three aims. The first aim was to document national estimates of retail e-cigarette availability and marketing overall and by store type including flavored products, ads, displays and promotions from 2014 to 2015 using a national sample of tobacco retailers. The second aim was to examine whether differences in state and neighborhood characteristics were associated with point-of-sale e-cigarette availability, and to examine new availability among stores that did not previously sell e-cigarettes. The third aim was to examine whether differences in state and neighborhood characteristics were associated with the presence of point-of-sale e-cigarette promotions and marketing among stores selling e-cigarettes.

2. Methods

2.1. Sample

Data for this study were collected as part of the Advancing Science and Policy in the Retail Environment (ASPiRE) project. Sampling and data collection methods have been described elsewhere. (Ribisl et al., 2017) Briefly, a two-stage probability sample proportionate to population size (PPS) design with minimal replacement was used to obtain a nationally representative sample of tobacco retailers in the contiguous

U.S. (48 states and the District of Columbia, excluding Alaska and Hawaii). In stage one, 97 counties were randomly selected proportionate to county population size with replacement, using 2010 Census data and the PPS method. In stage two, tobacco retailers were identified and randomly selected within each county from two commercial retailer lists (Reference USA and Dun & Bradstreet) using methods validated in a previous study. (D'Angelo et al., 2014) Retailers known to not sell tobacco products were excluded from the sampling frame (e.g., Target). In late 2014, CVS pharmacy stores stopped selling tobacco products and were excluded from the sample in 2015. Vape shops were not explicitly included in the sampling frame because the inclusion criteria specified that stores must sell cigarettes.

2.2. Data collection

Longitudinal data collection occurred in three waves (2012, 2014 and 2015). Data from the 2012 wave were previously reported (Rose et al., 2014) and the current study reports on the last two waves of store observations conducted between January and April of 2014 and May through August of 2015. In-person audits of the interior and exterior of each retailer were conducted to observe tobacco marketing, price promotions, product availability, and store characteristics. Auditors were trained in-person through instruction and a field test. (Feld et al., 2016) Auditors did not introduce themselves unless asked by a store employee. Data were collected electronically via the iSurvey application using Apple iPads. The University of North Carolina Office of Human Research Ethics determined that the study did not constitute human subjects research (12-0765).

This study reports on e-cigarette availability and marketing in stores in 2014 and 2015. In 2014, interior/exterior audits were completed in 2,272 stores. The analytic sample for 2014 included 1,905 stores after excluding CVS retail pharmacies to be consistent with the 2015 sample and stores determined to be subject to auditor error. The analytic sample for 2015 included 2,126 stores with complete interior/exterior audits.

2.3. Measures

2.3.1. E-cigarette measures

E-cigarette availability was defined as the presence of e-cigarettes (not including e-liquids) available for sale. *E-cigarette price promotions* were observed on the store exterior and interior and included signs advertising a special price (e.g. \$1.00 discount) or multi-buy (e.g. buy 1, get 1 free). *E-cigarette marketing* included the presence of exterior branded ads; interior branded ads (2015 only); branded header rows for Vuse, Blu, NJoy, and MarkTen; and branded displays and functional items (2015 only). *Flavored e-cigarettes* were defined as any e-cigarettes with any flavor other than tobacco. *E-cigarette product placement* measures included whether e-cigarettes were displayed within 12 in. of toys, candy or gum, slushy/soda machines, or ice cream; displays were placed on the counter; and whether e-cigarettes were self-service. Each was a dichotomous measure of "any vs. none".

2.3.2. Store type

Each retailer was coded as one of the following store types: convenience store without a gas station (i.e., food marts primarily engaged in retailing a limited line of goods that generally includes milk, bread, soda, and snacks); convenience store with gas station; drug store/pharmacy; beer, wine, or liquor store; grocery store or supermarket; mass merchandiser (e.g. Walmart); discount/dollar store (e.g. Family Dollar); tobacco shop; or other store type (e.g. newsstand, kiosk).

2.3.3. Neighborhood and state level variables

The location of each retailer was geocoded using GPS coordinates collected in person at each store location by data collectors while they conducted store audits and linked with data from the American

Community Survey 5-year estimates, 2011–2015. Neighborhood demographics at the census tract level included the percent non-Hispanic Black residents, percent Hispanic residents, and median household income. Quartiles were created for each census variable (1 = lowest quartile, 4 = highest quartile). Current adult state smoking prevalence was obtained from the Behavioral Risk Factor Surveillance System (BRFSS) from the Centers for Disease Control State Tobacco Activities Tracking and Evaluation (STATE) System for 2011–2016.

2.4. Statistical analysis

National estimates for each e-cigarette measure were generated by applying sampling weights that accounted for both county and store selection in the sampling design, and nonresponse for data collected in 2014 and 2015. Store, neighborhood and state level correlates of 1) e-cigarette availability, 2) e-cigarette promotions and 3) e-cigarette exterior advertising in 2015 were analyzed using multilevel mixed-effects generalized linear models to account for the clustering of stores within county. We estimated prevalence ratios using a Poisson model because outcomes were dichotomous and common. (Zou, 2004) Two models (A and B) were created for e-cigarette availability. Model A included all retailers in the 2015 sample with non-missing data on all covariates (n = 2,122) ('E-cigarette availability') and Model B was a longitudinal model subset to stores that did not previously sell e-cigarettes in the first data collection wave in 2012 (n = 1,214) ('New e-cigarette availability'). Model B therefore examines the correlates of adding e-cigarettes as a product line between 2012 and 2015, as the e-cigarette retail market was expanding. Models examining correlates of e-cigarette promotions and exterior advertising were subset to stores selling e-cigarettes in 2015 (n = 1,702). StataSE 15 was used for all analyses.

3. Results

3.1. Descriptive statistics

3.1.1. E-cigarette availability, price promotions and marketing, 2014 to 2015

Among all retailers, e-cigarettes were sold at 72.0% (95% CI: 69.2%, 74.7%) of tobacco retailers in 2014 and at 79.2% (95% CI: 77.1%, 81.1%) of retailers in 2015 (Table 1). E-cigarette availability varied by store type. Over 90% of pharmacies, tobacco shops, mass merchandisers, and dollar stores sold e-cigarettes in 2015 (Table 1). The greatest increase in e-cigarette availability between 2014 and 2015 occurred at dollar stores and supermarkets.

Among e-cigarette retailers, the presence of interior price promotions increased from 11.9% of retailers in 2014 to 20.2% in 2015 (Table 2). Branded signs/ads for e-cigarettes were common on the store exterior, present at about a third of retailers in 2014 and over 40% in

Table 2

E-cigarette price promotions and marketing among tobacco retailers selling e-cigarettes in the contiguous U.S., 2014–2015.

	2014 (n = 1,364)		2015 (n = 1,708)	
	%	95% CI	%	95% CI
Interior price promotions	11.9	(9.4,14.9)	20.2	(18.1, 22.4)
Exterior price promotions	1.7	(1.0, 2.9)	2.9	(2.2, 3.9)
Interior branded signs/ads ^b	–		78.8	(76.5, 80.8)
Exterior branded signs/ads	33.8	(29.8, 38.1)	43.1	(40.1,45.8)
Branded header row ^a	10.2	(8.0, 12.7)	10.3	(8.7, 12.0)
Branded displays ^b	–		71.5	(69.0, 73.9)
Displays on counter ^{b,c}	–		50.8	(47.7, 54.0)
Branded functional items ^b	–		9.3	(7.8, 11.1)
Signs/ads displayed below 3 feet	16.2	(13.6, 19.2)	21.2	(19.1,23.5)
Product displayed near candy, gum, soda, ice cream	26.0	(22.8, 30.0)	20.0	(17.9, 22.2)
Flavored products available	63.6	(58.1, 68.8)	71.9	(69.3, 74.2)
Self-service of e-cigarettes	7.5	(5.7, 9.9)	5.5	(4.4, 6.9)

^aBranded header rows for Vuse, Njoy, Blu or MarkTen. ^bItem was not measured in wave 2/2014. ^cAmong stores with displays)

2015. Interior e-cigarette signs or ads were present in nearly 80% of retailers in 2015; among those ads, 21.2% were located at child eye level (below 3 ft). Branded displays were present at 71.5% of retailers; among those, half were placed on the check-out counter. E-cigarettes were displayed near candy, gum, soda, or ice cream in 26.0% of retailers in 2014, and in 20.0% in 2015. Flavored e-cigarettes were present in 63.6% of retailers in 2014 and flavored e-cigarette availability increased to 71.9% of retailers in 2015. Self-service e-cigarette displays were present at 7.5% of retailers in 2014, and in 5.5% of retailers in 2015.

3.2. Multilevel correlates of e-cigarette availability in 2015

Among all retailers in 2015, e-cigarette availability was significantly greater in all store types compared to supermarkets, except for beer/wine stores (PR 0.68, 95% CI 0.52, 0.89) (Table 3, Model A). However, in Model B, which included retailers that did not sell e-cigarettes in 2012, only tobacco shops and gas/convenience stores had a significantly greater prevalence of new e-cigarette availability in 2015 compared with supermarkets (Table 3, Model B). At the neighborhood level in 2015, e-cigarette availability was significantly higher among all retailers with each higher quartile of neighborhood median household income compared with the lowest income quartile (Table 3, Model A). The positive association between neighborhood income level and e-cigarette availability was stronger for new e-cigarette availability (Table 3, Model B). In Model B, retailers that did not sell e-cigarettes in 2012 that were located in neighborhoods within the highest income

Table 1

E-cigarette availability by store type among tobacco retailers in the contiguous U.S., 2014 & 2015.

Store type	2014		2015			
	Number of retailers	E-cigarette availability		Number of retailers	E-cigarette availability	
		%	95% CI		%	95% CI
All retailers	1905	72.0	(69.2, 74.7)	2126	79.2	(77.1,81.1)
Drug Store/Pharmacy	124	93.7	(84.7, 97.6)	131	97.5	(94.1,99.0)
Tobacco Shop	71	91.5	(81.5,96.3)	71	100.0	
Mass Merchandiser	57	91.3	(80.2, 96.5)	48	90.6	(78.8,96.1)
Gas/Convenience Store	764	85.1	(80.7,88.7)	802	88.0	(85.2,90.3)
Dollar Store	121	81.6	(70.9, 89.0)	146	97.3	(92.1,99.1)
Convenience Store (without gas)	174	77.3	(71.3,82.4)	166	75.5	(68.0,81.7)
Other store type	13	77.2	(50.9,91.7)	7	30.9	(12.9,57.4)
Supermarket/Grocery Store	315	52.8	(45.1,60.4)	234	65.0	(59.6,70.0)
Beer, Wine, or Liquor Store	191	39.5	(28.5,51.6)	103	44.1	(36.7,51.8)

Table 3
Store, neighborhood and state level determinants of the prevalence of e-cigarette availability among tobacco retailers in the Contiguous U.S., 2015

Store Type	Model A: All retailers (n = 2,122)			Model B: New e-cigarette retailers 2015 (n = 1,214)		
	PR	95% CI		PR	95% CI	
Supermarket/grocery store	ref			ref		
Convenience Store (without gas)	1.17	1.03	1.33	1.16	0.99	1.37
Gas/Convenience Store	1.35	1.22	1.49	1.36	1.20	1.54
Drug Store/Pharmacy	1.47	1.33	1.64	1.33	0.98	1.81
Beer, Wine, or Liquor Store	0.68	0.52	0.89	0.61	0.45	0.82
Mass Merchandiser	1.38	1.20	1.59	1.20	0.91	1.59
Tobacco Shop	1.54	1.39	1.70	1.60	1.40	1.83
Dollar Store	1.49	1.35	1.64	0.40	0.06	2.46
Other store type	0.48	0.22	1.02	0.38	0.13	1.09
Neighborhood Characteristics						
Non-Hispanic Black Residents (%)						
Q1: 0–1.07	ref			ref		
Q2: 1.08–4.93	1.08	0.99	1.16	1.16	1.03	1.30
Q3: 4.94–15.2	1.05	0.98	1.13	1.10	0.97	1.25
Q4: 15.3–98.8	1.07	0.99	1.16	1.15	1.01	1.31
Hispanic Residents (%)						
Q1: 0–2.76						
Q2: 2.77–8.06	0.99	0.93	1.06	0.99	0.87	1.10
Q3: 8.07–22.8	1.00	0.93	1.08	1.00	0.87	1.12
Q4: 22.9–99.5	1.04	0.95	1.13	1.04	0.88	1.20
Median Household Income (\$)						
Q1: 8,007–37,816						
Q2: 37,817–50,055	1.08	1.01	1.15	1.14	1.02	1.27
Q3: 50,056–67,044	1.09	1.02	1.15	1.14	1.02	1.27
Q4: 67,045–196,635	1.17	1.07	1.27	1.23	1.08	1.41
State Characteristics						
State smoking prevalence (%)	1.01	1.00	1.03	1.02	1.00	1.04

Bold indicates significance at $p < 0.05$.

quartile had 1.23 times greater prevalence of e-cigarette availability compared to retailers in the lowest income quartile (95% CI, 1.08, 1.41). The prevalence of e-cigarette availability was not associated with the percentage of non-Hispanic Black residents among all retailers (Model A). However, for new e-cigarette availability (Model B), the prevalence was 1.15 times greater (95% CI 1.01, 1.31) in retailers located in neighborhoods with the highest proportion of non-Hispanic Black residents compared with the lowest proportion. E-cigarette availability was not associated with store neighborhood proportion of Hispanic residents. At the state level, greater e-cigarette availability was positively associated with higher smoking prevalence in both models.

3.3. Multilevel correlates of e-cigarette price promotions in 2015

In 2015, the prevalence of e-cigarette price promotions was 6.7 times greater in pharmacies (95% CI 4.3, 10.5) compared with supermarkets (Table 4). Tobacco stores (PR 2.9, 95% CI 1.6, 5.25), gas/convenience stores (PR 1.81, 95% CI 1.1, 2.98) and other store types (PR 3.4, 95% CI 1.11, 10.4) also had a significantly greater prevalence of e-cigarette promotions compared with supermarkets. At the neighborhood level, the prevalence of e-cigarette promotions was greater at retailers located in neighborhoods in the third quartile of Hispanic residents compared with the lowest quartile (PR 1.39, 95% CI 1.04, 1.86). The prevalence of e-cigarette promotions was not associated with the percentage of non-Hispanic Black residents, or with neighborhood median household income. However, higher state smoking rates were associated with higher prevalence of e-cigarette price promotions (PR

Table 4
Multilevel correlates of e-cigarette price promotions and exterior ads at retailers selling e-cigarettes in the Contiguous U.S., 2015 (n = 1,702)

Store Type	Any Price Promotions			Any Exterior Ads		
	PR	95% CI		PR	95% CI	
Supermarket/grocery store	ref			ref		
Convenience Store (without gas)	0.87	0.44	1.72	3.92	2.60	5.91
Gas/Convenience Store	1.81	1.10	2.98	3.67	2.42	5.58
Drug Store/Pharmacy	6.71	4.29	10.48	0.08	0.01	0.55
Beer, Wine, or Liquor Store	0.43	0.15	1.23	2.68	1.61	4.45
Mass Merchandiser	0.69	0.22	2.17	0.06	0.01	0.46
Tobacco Shop	2.90	1.60	5.25	4.14	2.55	6.73
Dollar Store	1.54	0.69	3.43	4.43	2.85	6.89
Other store type	3.40	1.11	10.44	4.22	2.11	8.43
Neighborhood Characteristics						
Non-Hispanic Black Residents (%)						
Q1: 0–1.07	ref			ref		
Q2: 1.08–4.93	1.00	0.76	1.31	1.16	0.97	1.37
Q3: 4.94–15.2	1.11	0.83	1.49	1.06	0.88	1.28
Q4: 15.3–98.8	0.97	0.70	1.34	1.20	1.00	1.42
Hispanic Residents (%)						
Q1: 0–2.76				ref		
Q2: 2.77–8.06	1.27	0.94	1.71	0.98	0.83	1.14
Q3: 8.07–22.8	1.39	1.04	1.86	1.13	0.96	1.34
Q4: 22.9–99.5	1.18	0.79	1.76	1.03	0.81	1.31
Median Household Income (\$)						
Q1: 8,007–37,816				ref		
Q2: 37,817–50,055	0.81	0.62	1.05	1.05	0.90	1.24
Q3: 50,056–67,044	0.99	0.76	1.29	1.00	0.84	1.20
Q4: 67,045–196,635	1.13	0.81	1.57	1.01	0.82	1.24
State Characteristics						
State smoking prevalence (%)	1.09	1.04	1.14	1.03	1.00	1.06

Bold indicates significance at $p < 0.05$

1.09, 95% CI 1.04, 1.14).

3.4. Multilevel correlates of e-cigarette exterior advertising in 2015

E-cigarette exterior advertising was significantly more prevalent at all store types compared with supermarkets in 2015, except for drug stores/pharmacies and mass merchandisers (Table 4). Exterior e-cigarette advertising was 1.2 times more prevalent at retailers located in neighborhoods in the highest quartile of Black residents (95% CI 1.0, 1.42) compared with the lowest. No other neighborhood demographics were associated with the presence of exterior e-cigarette advertising. However, e-cigarette exterior advertising prevalence was positively associated with state smoking rate (PR 1.03, 95% CI 1.0, 1.06).

4. Discussion

E-cigarette availability at retail outlets that sell cigarettes in the U.S. increased from 34% in our 2012 national study, (Rose et al., 2014) to 79% in 2015. This rapid growth is mirrored in other studies with availability increasing almost 2.5 times in a one year period from 2012 to 2013 in retailers near colleges in North Carolina and Virginia (Wagoner et al., 2014) and national sales of e-cigarettes increasing 133% in the same period. (Giovenco et al., 2015) Additionally, this growth has extended to multiple store types. From 2014 to 2015, there was a 10% growth in e-cigarette availability across all tobacco retailers in our national sample. In 2015, over 90% of pharmacy/drug stores (excluding CVS), dollar stores, tobacco shops, and mass merchandisers sold e-cigarettes. However, the largest percent growth by store type was

among supermarkets, dollar stores, and beer, wine, and liquor stores, indicating that e-cigarettes are expanding into nearly all retail store types that sell tobacco. This also corresponds with an increase in e-cigarette sales from traditional cigarette manufacturers who may already have contracts with tobacco retailers. (King et al., 2018)

E-cigarette availability was higher in higher income neighborhoods in the current study and in the previous 2012 national study. (Rose et al., 2014) However, associations with other neighborhood demographics may have shifted. E-cigarette availability was lower in neighborhoods with more Black residents in 2012, (Rose et al., 2014) but in the current study, new e-cigarette availability in 2015 was greater in stores located in neighborhoods with greater proportions of non-Hispanic Black residents. The prevalence of e-cigarette use among non-Hispanic Black adults and youth, while increasing over time, has remained lower compared with non-Hispanic Whites. (Wang et al., 2018 Nov 9; Wang et al., 2018 Jun 8) Therefore the finding that e-cigarettes were newly available in non-Hispanic Black neighborhoods may signal increased targeting of this population as the e-cigarette market expands. In a New York City study in 2017, Giovenco and colleagues note that the greater availability of combustible tobacco combined with the lack of availability of potentially lower harm e-cigarettes in African-American neighborhoods may increase tobacco use disparities. (Giovenco et al., 2019) However, our findings suggest that while there may be local differences, nationally such neighborhood demographic differences may be leveling off as e-cigarettes become more ubiquitous.

Among stores selling e-cigarettes, price promotions were more prevalent in neighborhoods with a greater proportion of Hispanic residents, and exterior ads were more prevalent in neighborhoods with the greatest proportion of Black residents, in contrast with a 2014 study in Omaha, Nebraska. (Wan et al., 2017) This may indicate that the companies that distribute e-cigarettes, largely tobacco companies, are focusing marketing efforts at retailers located in these areas. These efforts, combined with the fact that tobacco outlet density is greater near schools with more racial/ethnic minority students (D'Angelo et al., 2016 Sep) and in neighborhoods with more Black residents, (Fakunle et al., 2019 May) could create a community retail environment with greater exposure to e-cigarette marketing, promotions and flavored products for the youth who live or attend school there.

E-cigarette marketing was higher in states with a higher smoking prevalence. This could be due to targeted marketing of smokers as an alternative to combustible products for those wanting to quit. However, dual product use is common, with most adult e-cigarette users being current smokers. (Glasser et al., 2017) Traditional tobacco manufacturers may have increased marketing for their e-cigarette brands, which has the effect of promoting e-cigarettes along with cigarettes. While an estimated 5.7 million of the 10.8 million adult e-cigarette users in the US are also current combustible cigarette smokers, the results of increased retail availability on use patterns of e-cigarettes among smokers is as yet unknown. (Mirbolouk et al., 2018)

Among stores that sold e-cigarettes, the overall amount of e-cigarette marketing also increased in this one-year period and started to mirror traditional tobacco marketing patterns. (Ribisl et al., 2017) The presence of price promotions doubled overall, and interior ads were present in nearly 80% of e-cigarette retailers. About 1 in 5 retailers had ads that were placed at child eye-level and sold e-cigarettes near candy, gum, soda or ice-cream. Encouragingly, self-service displays, which can be accessed without clerk assistance, declined between 2014 and 2015. The FDA Center for Tobacco products restricts self-service displays for cigarettes and smokeless tobacco, but not for e-cigarettes. However, with the rise of youth e-cigarette use, (Cullen, 2018) restricting youth self-service access to these products may be worth considering. Flavored e-cigarettes were also highly available in 7 in 10 retailers in 2015, consistent with sales data showing increases in flavored products. (Kuiper et al., 2018) In March 2019, the U.S. Food and Drug Administration issued draft guidance for industry regarding restricting sales of flavored e-cigarette products that may be particularly appealing to

youth, (U. S. Department of Health and Human Services, FDA, Center for Tobacco Products. Modifications to Compliance Policy for Certain Deemed Tobacco Products: Draft Guidance for Industry. Federal Register., 2019) and in September 2019 the current administration and acting FDA Director announced they are considering ban on flavored e-cigarettes. (McGinley, 9/11/2019, 2019.) If either guidance is finalized, flavored e-cigarette availability should substantially decrease in the future.

Price promotions for e-cigarettes in pharmacies are also of concern. Similar to our findings, a 2013 study found that e-cigarette promotions were most prevalent in pharmacies. (Wagoner et al., 2014) While CVS voluntarily stopped selling all tobacco products, and recently Walgreens discontinued e-cigarette sales, other pharmacy chains continue to sell tobacco products. Pharmacies compared with other store types have also been found to be more likely to be non-adherent with FDA sales restrictions, (Rose et al., 2013) and top pharmacy chains had a minor's access violation rate of 7.7% in federal inspections. (Lee et al., 2018) Local or state policies that ban e-cigarette sales in pharmacies that also sell pharmacotherapy for smoking cessation may also reduce consumer confusion over whether e-cigarettes are an approved cessation aid. (Brennan and Schroeder, 2014 Mar 19)

Strengths of this study include the use of a national sample of tobacco retailers and in-person observations of e-cigarette retail availability and marketing over two time points. The sample included a variety of store types that adults and children might visit as part of other retail shopping and therefore may best capture unintended exposure to e-cigarette products and marketing. A limitation of the study is that only retailers that sold cigarettes were included in the sample, therefore the estimates do not include vape shops or any store types that may sell e-cigarettes but not cigarettes. The study does not include observations of the brand-leader JUUL e-cigarettes or marketing because JUUL was introduced into the U.S. market in 2015. However, our reported estimates capture the baseline estimate of e-cigarette availability, marketing, and promotions before JUUL entered the market. (Huang et al., 2019 Mar 1) The landscape of retail e-cigarette use, availability and marketing in the U.S. has changed rapidly, and documentation of these measures before and after major shifts in the e-cigarette market is critical to understanding how e-cigarette availability and marketing may influence use.

Retail e-cigarette availability, flavored e-cigarette products and most types of e-cigarette marketing increased between 2014 and 2015, coinciding with an upswing in both e-cigarette sales and use. Future research should examine associations between exposure to retail e-cigarette marketing and promotions and e-cigarette use, especially among youth as well as among smokers. Monitoring and tracking changes in the e-cigarette retail landscape and where and how e-cigarettes are targeted to consumers at the point-of-sale can inform e-cigarette policies and regulations.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

This work was supported by the National Cancer Institute at the National Institutes of Health (P01 CA225597 to K.M.R., Project name: ASPIRE). The funders had no involvement in the study design, collection, analysis, writing, or interpretation.

Dr. Lisa Henriksen was instrumental in developing the study and providing critical feedback to earlier versions of this manuscript.

References

- Arrazola, R.A., Singh, T., Corey, C.G., et al., 2015. Tobacco use among middle and high school students—United States, 2011–2014. *MMWR Morb. Mortal. Wkly Rep.* 64 (14), 381–385.
- Brame, L.S., Mowls, D.S., Damphousse, K.E., Beebe, L.A., 2016. Electronic nicotine delivery system landscape in licensed tobacco retailers: results of a county-level survey in Oklahoma. *BMJ Open.* 6 (6), e011053.
- Brennan, T.A., Schroeder, S.A., 2014. Ending Sales of Tobacco Products in Pharmacies. *JAMA.* 311 (11), 1105–1106.
- Cantrell, J., Huang, J., Greenberg, M., Willett, J., Hair, E., Vallon, D., 2018. History and Current Trends in the Electronic Nicotine Delivery Systems Retail Marketplace in the United States: 2010–2016. *Nicotine Tob. Res.* <https://doi.org/10.1093/ntr/nty214>.
- Cullen, K.A., 2018. Notes from the Field—United States, 2011–2018. *MMWR Morb. Mortal Wkly Rep.* 67.
- D'Angelo, H., Fleischhacker, S., Rose, S.W., Ribisl, K.M., 2014. Field validation of secondary data sources for enumerating retail tobacco outlets in a state without tobacco outlet licensing. *Health Place.* 28, 38–44.
- D'Angelo, H., Ammerman, A., Gordon-Larsen, P., Linnan, L., Lytle, L., Ribisl, K.M., 2016. Sociodemographic Disparities in Proximity of Schools to Tobacco Outlets and Fast-Food Restaurants. *Am J Public Health.* 106 (9), 1556–1562.
- Dai, H., Hao, J., 2016. Exposure to Advertisements and Susceptibility to Electronic Cigarette Use Among Youth. *J. Adolesc. Health.* 59 (6), 620–626.
- Escobedo P, Garcia R, Soto C, Rodriguez Y, Barahona R, Baezconde-Garbanati L. Comparison of e-cigarette marketing and availability in tobacco retail outlets among diverse low-income communities in California. *Tob Control.* 2019 Jul 19:tobacco-control-2019.
- Fakunle, D.O., Curriero, F.C., Leaf, P.J., Furr-Holden, D.M., Thorpe, R.J., 2019 May. Black, white, or green? The effects of racial composition and socioeconomic status on neighborhood-level tobacco outlet density. *Ethnicity & health.* 25, 1–6.
- Feld, A.L., Johnson, T.O., Byerly, K.W., Ribisl, K.M., 2016. How to Conduct Store Observations of Tobacco Marketing and Products. *Prev Chronic Dis.* 13, E25.
- Giovenco, D.P., Hammond, D., Corey, C.G., Ambrose, B.K., 2015. Delnevo CD. E-Cigarette Market Trends in Traditional U.S. Retail Channels, 2012–2013. *Nicotine Tob Res.* 17 (10), 1279–1283.
- Giovenco, D.P., Spillane, T.E., Merizier, J.M., 2019. Neighborhood Differences in Alternative Tobacco Product Availability and Advertising in New York City: Implications for Health Disparities. *Nicotine Tob Res.* 21 (7), 896–902.
- Glasser, A.M., Collins, L., Pearson, J.L., et al., 2017. Overview of Electronic Nicotine Delivery Systems: A Systematic Review. *Am J Prev Med.* 52 (2), e33–e66.
- Grana, R., Benowitz, N., Glantz, S.A., 2014. E-cigarettes: a scientific review. *Circulation* 129 (19), 1972–1986.
- Huang, J., Duan, Z., Kwok, J., et al., 2019. Vaping versus JUULing: how the extraordinary growth and marketing of JUUL transformed the US retail e-cigarette market. *Tob. Control.* 28 (2), 146–151.
- King, B.A., Gammon, D.G., Marynak, K.L., Rogers, T., 2018. Electronic Cigarette Sales in the United States, 2013–2017. *JAMA.* 320 (13), 1379–1380.
- Kuiper, N.M., Loomis, B.R., Falvey, K.T., et al., 2018. Trends in Unit Sales of Flavored and Menthol Electronic Cigarettes in the United States, 2012–2016. *Prev. Chronic Dis.* 15, E105.
- Lee, J.G., Henriksen, L., Rose, S.W., Moreland-Russell, S., Ribisl, K.M., 2015. A Systematic Review of Neighborhood Disparities in Point-of-Sale Tobacco Marketing. *Am. J. Public Health.* 105 (9), e8–e18.
- Lee, J.G.L., Schleicher, N.C., Leas, E.C., Henriksen, L., 2018. US Food and Drug Administration Inspection of Tobacco Sales to Minors at Top Pharmacies, 2012–2017. *JAMA Pediatr.* 172 (11), 1089–1090.
- McGinley L. Trump moves to ban flavored e-cigarettes. *The Washington Post.* 9/11/2019, 2019.
- Mirbolouk M, Charkhchi P, Kianoush S, et al. Prevalence and Distribution of E-Cigarette Use Among U.S. Adults: Behavioral Risk Factor Surveillance System, 2016. *Ann Intern Med.* 2018;169(7):429-438.
- Ribisl, K.M., D'Angelo, H., Feld, A.L., et al., 2017. Disparities in tobacco marketing and product availability at the point of sale: results of a national study. *Prev. Med.* 105, 381–388.
- Robertson, L., McGee, R., Marsh, L., Hoek, J., 2015. A systematic review on the impact of point-of-sale tobacco promotion on smoking. *Nicotine Tob. Res.* 17 (1), 2–17.
- Robertson, L., Cameron, C., McGee, R., Marsh, L., Hoek, J., 2016. Point-of-sale tobacco promotion and youth smoking: a meta-analysis. *Tob. Control.* 25 (e2), e83–e89.
- Rose, Shyanika W, Barker, Dianne C, D'Angelo, Heather, Khan, Tamkeen, Huang, Jidong, Chaloupka, Frank J, Ribisl, Kurt M, 2014. The availability of electronic cigarettes in US retail outlets, 2012: results of two national studies. *Tob. Control* 23 (suppl 3), iii10–iii16. <https://doi.org/10.1136/tobaccocontrol-2013-051461>.
- Rose, S.W., Myers, A.E., D'Angelo, H., Ribisl, K.M., 2013. Retailer adherence to Family Smoking Prevention and Tobacco Control Act, North Carolina, 2011. *Prev. Chronic Dis.* 10, E47.
- Singh T, Agaku IT, Arrazola RA, et al. Exposure to Advertisements and Electronic Cigarette Use Among US Middle and High School Students. *Pediatrics.* 2016;137(5).
- Singh, T., Marynak, K., Arrazola, R.A., Cox, S., Rolle, I.V., King, B.A., 2016. Vital Signs: Exposure to Electronic Cigarette Advertising Among Middle School and High School Students - United States, 2014. *MMWR Morb. Mortal Wkly Rep.* 64 (52), 1403–1408.
- U. S. Department of Health and Human Services, FDA, Center for Tobacco Products. Modifications to Compliance Policy for Certain Deemed Tobacco Products: Draft Guidance for Industry. *Federal Register.* 2019;84 FR 9345(50):9345-9346.
- Villanti, A.C., Johnson, A.L., Ambrose, B.K., et al., 2017. Flavored Tobacco Product Use in Youth and Adults: Findings From the First Wave of the PATH Study (2013–2014). *Am. J. Prev. Med.* 53 (2), 139–151.
- Wagoner, K.G., Song, E.Y., Egan, K.L., et al., 2014. E-cigarette availability and promotion among retail outlets near college campuses in two southeastern states. *Nicotine Tob Res.* 16 (8), 1150–1155.
- Wagoner, K.G., Song, E.Y., King, J.L., Egan, K.L., Debinski, B., Wolfson, M., Spangler, J., Sutfin, E.L., 2019. Availability and Placement of Electronic Nicotine Delivery Systems at the Point-of-Sale. *Nicotine Tob Res.* 20 (8), 1020–1024.
- Herzog B. Wall Street Tobacco Industry Update: NATO Education Seminar. 2019; http://www.natocentral.org/uploads/Wall_Street_Update_Slide_Deck_February_2019.pdf. Accessed 7/17/2019.
- Wan, N., Siahpush, M., Shaikh, R.A., McCarthy, M., Ramos, A., Correa, A., 2017. Point-of-Sale E-cigarette Advertising Among Tobacco Stores. *J Community Health.* 42 (6), 1179–1186.
- Wang, T.W., Gentzke, A., Sharapova, S., Cullen, K.A., Ambrose, B.K., Jamal, A., 2018. Tobacco product use among middle and high school students—United States, 2011–2017. *Morbidity and Mortality Weekly Report.* 67 (22), 629.
- Wang, T.W., Gentzke, A., Sharapova, S., Cullen, K.A., Ambrose, B.K., Jamal, A., 2018. Tobacco product use among middle and high school students—United States, 2011–2017. *MMWR Morb Mortal Wkly Rep.* 67 (22), 629.
- Wang, T.W., Asman, K., Gentzke, A.S., Cullen, K.A., Holder-Hayes, E., Reyes-Guzman, C., Jamal, A., Neff, L., King, B.A., 2018 Nov 9. Tobacco product use among adults—United States, 2017. *MMWR Morb Mortal Wkly Rep.* 67 (44), 1225.
- Yerger, V.B., Przewoznik, J., Malone, R.E., 2007. Racialized geography, corporate activity, and health disparities: tobacco industry targeting of inner cities. *J. Health Care Poor Underserved.* 18 (4 Suppl), 10–38.
- Zou, G., 2004. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol.* 159 (7), 702–706.