5-2020

Characteristics of Tobacco Retailers and Proximity to Schools in a Midwest City

Sierra N. Garth
University of Nebraska Medical Center

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Sierra Garth, BSPH

Epidemiology

Committee Members

Jennie Hill, PhD

Hongying Dai, PhD

Kendra Ratnapradipa, PhD

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Abstract

This descriptive epidemiology project provides an overview of the number, characteristics, and proximity of retailers that sell tobacco and vaping products to middle and high schools. ArcGIS was used to map the proximity of these retailers to public and private middle and high schools in Lincoln, Nebraska. Mapping the retailers and schools allowed us to explore the potential exposures to these products teens experience on a daily basis.

Chapter 1 - Introduction

This project will address the following research questions:

1. How many tobacco and vape retailers are in the study area and what types of retailers (vape shops, grocery stores, convenience stores, etc.) sell these products?
2. What is the proximity of these retailers to middle and high schools in the study area?
3. What types of retailers are closest to the schools?
    a. Are there any census tracts with a higher density of retailers, in comparison to other census tracts?
    b. What is the Area Deprivation Index (ADI) of census tracts with the highest density of tobacco and vape retailers?

Chapter 2 - Background and Literature Review

While the rate of cigarette smoking among adolescents has decreased in recent years, the use of vaping products, such as e-cigarettes, has increased (Pepper et al., 2019). According to the Centers for Disease Control and Prevention (CDC), nine out of ten cigarette smokers first try cigarette smoking by age 18 (CDC, 2019b). In Nebraska 16.1% of high school students reported current use of any type of tobacco product, while 7.4% currently smoke cigarettes (CDC, 2019a). In 2019, 5.3 million adolescents reported using e-cigarettes (CDC, 2019b). In Nebraska 17.1% of high school students use e-cigarettes (Campaign for Tobacco-Free Kids, 2020). Nebraska law indicates that a person must be 21 years of age to purchase tobacco and vape products. Yet the data on prevalence indicates that teens have access to and can obtain these products. Current research has stated that these rates may be influenced by a variety of factors, including the availability of products, how adolescents obtain these products, policies, the proximity of retailers to schools, and advertisements (Perez et al., 2017).

Various e-cigarette devices are sold in retailers across the United States. E-cigarettes are a broad category of devices that are promoted as a 'smokeless' version of traditional cigarettes. These devices consist of a battery, heating element, and a place to hold a liquid (CDC, 2020). The liquid is heated into an aerosol that the user inhales and exhales (Smokefree, n.d.). Like traditional cigarettes, e-cigarettes deliver nicotine. These devices contain other harmful substances, such as lead, flavorings linked to lung disease, and cancer-causing chemicals (Smokefree, n.d.). E-cigarettes are especially harmful to adolescents, as the ingredients can affect brain development and the device itself can malfunction and cause unintended injuries (CDC, 2020).

Several recent studies have aimed to understand the prevalence of vaping among young people. In four Connecticut high schools, students were asked if they had ever tried various types of e-cigarettes, the age at which they first tried the product, and the number of times they used the device in the past 30 days (Krishnan-Sarin et al., 2018). The types of devices asked about included disposable cig-a-likes, a hookah-pen or vape-pen, a JUUL, and a Mod; all products popular with and marketed to young people. Thirty-five percent of the students have tried an e-cigarette product. Among this sample of ever-e-cigarette users, 84% of them have tried at least one of the four types of e-cigarettes presented in the survey and JUUL devices were identified to be used by 43%. Of those who currently use one device, 33% use the JUUL, which is at a higher rate than any of the other devices. Overall, the rates of using mods, vape/hookah pens, and the JUUL were higher than those of cig-a-likes. The ever-use of multiple devices is associated with the use of other tobacco products, such as cigarettes and cigars. An important take away is that regulatory and prevention efforts to lower youth e-cigarette use rates are needed, especially when addressing the use of multiple e-cigarette devices (Krishnan-Sarin et al., 2018).

With the variety of e-cigarette devices in use by youth, a key question is who or where are adolescents obtaining these devices and which retailers are likely to be selling products? Pepper and colleagues (2019) aimed to answer this question using an online survey to measure adolescents'—ages 15 to 17—attitudes towards vaping, ownership of vaping devices, how they obtain the devices, and if they borrow devices from others (Pepper et al., 2019). Like Krishnan-Sarin's study, 48% of participants vaped some days, while 32% vaped every day, and 19% rarely vaped. Sharing devices was common. Most participants (26%) indicate that they sometimes share their devices, while even a lesser proportion of participants share often (22%) and very

often (15%). In addition, 73% of participants had borrowed a device within the past 30 days (Pepper et al., 2019).

Along with sharing devices, most participants (31%) reported that they purchase their main vaping device from a store, vape shop, or online (Pepper et al., 2019). Among those who purchase their own device, 32% purchased online and 22% purchased from a vapor shop. Tobacco specialty stores, convenience stores, mall kiosks, and grocery stores were less common purchasing locations. Some indicate they buy their device from another person, give someone else money to buy on their behalf, receive the device as a gift, got the device from a parent, bought from a flea market, or stole the device. When purchasing from retailers, adolescents are asked for identification, based on the state laws that deny sales to those under age 18. However, adolescents under age 18 may find it easier to purchase online since not all online retailers have age verification (Pepper et al., 2019). While this article did not address the use and purchase of tobacco products, it is similar to that of vaping products, due to the legal age needed to purchase these products (Pepper, et al., 2019).

Since youth are purchasing from online and brick-and-mortar retailers, it is important to understand the total exposures in a community. Similar to studies that look at access to food in the food environment, the density of tobacco retailers in the community may influence the degree to which adolescents have opportunities to obtain these devices. Perez et al. (2017) conducted a study in Texas to identify the geospatial association between the presence of tobacco retail outlets (TRO) around schools and the current use of cigarettes and e-cigarettes among adolescents in four Texas counties (Perez et al., 2017). Like the previous studies, students were asked if they ever tried cigarettes and e-cigarettes, along with the how often they smoked and vaped in the past 30 days. However, this study also included questions to determine which

retailers or places may be near school and the marketing at those locations towards teens. The store types included gas stations, convenience stores, drug stores, and grocery stores. The signs referred to advertisements for cigarettes and e-cigarette devices and the warnings about the dangers of smoking (Perez et al., 2017).

In this study, current smokers were likely to be in the 10th grade. In two of the counties (Harris and Travis counties), students in 8th and 10th grades had higher odds than 6th grade students of current cigarette use. Similarly, in two counties (Dallas/Tarrant and Travis counties), students in 8th and 10th grades had higher odds of current e-cigarette use. The odds of current e-cigarette use were higher among those who recalled seeing marketing signs in stores around their school, in comparison to the students who did not recall marketing signs in stores around their school. This provides some preliminary data to support that teens are choices may be influenced by proximity of retailers and promotion of products (Perez et al., 2017).

Another study by Giovenco et al. (2016) focused on marketing of e-cigarette products near schools (Giovenco et al, 2016). Data from the New Jersey Youth Tobacco Survey, which was distributed to high school students, and store audit data were linked for the analysis. The store audits involved collecting data on e-cigarette availability and the number of e-cigarette advertisements on the retailer's exterior and interior. Over 40% of students reported to have ever tried tobacco products (excluding e-cigarettes) and 16% have used these products within the past month. Conversely, 24% of students reported ever trying an e-cigarette, while 12% used in the past month. When asked if they have seen tobacco advertisements in stores, half of the students reported "always" or "most of the time". Some of the schools (34%) did not have a tobacco retailer within a half mile radius. Of the schools that did have a tobacco retailer within a half mile radius (66%), an average of three retailers were near the schools. In addition, an average of

six e-cigarette advertisements were near each school. For every additional retailer within the half mile radius, the probability of a student being a past month user increased by 4%. For every additional e-cigarette advertisement, the probability of past month e-cigarette use increased by 1% (Giovenco et al., 2016). One of the conclusions from this study was that all measures of the retail environment were associated with past month e-cigarette use.

The prevalence of tobacco and e-cigarette use are influenced by how adolescents get the products, current policies, the location of the retailers, and advertisements (Perez et al., 2017). While the current research addresses these factors, more research is needed in additional locations to understand how this might vary based on state law, city or local regulations, and zoning. Additionally, the specific characteristics about types of retailers near schools is important to understand (Perez et al., 2017). This project will examine the characteristics and proximity of tobacco and vaping retailers to middle and high schools in the study area.

Chapter 3 - Data and Methods

Study Design and Setting

This study uses cross sectional environmental and retail data collected as part of a larger longitudinal study in Lincoln, Nebraska. The study area is defined as the city of Lincoln, which includes 72 census tracts. For ease in data collection, the census tracts were divided into four quadrants within the city, including the northeast, northwest, southeast, and southwest quadrants.

Data Sources and Measurement

Retailers that may sell tobacco and/or vape products were identified using a licensing database and Google searches. There were 309 pre-identified retailers. We deleted 139 of the retailers (42.7%) because the retailer was closed, outside of the study area, did not sell tobacco or vape products, or was a duplicate entry, leaving 177 retailers in the study. Retailers were further sorted by type using the STARS and v-STARS retailer classifications (Kong et al., 2017; Laestadius et al., 2018). Types included those that primarily sell tobacco or vape products (e.g. Tobacco Shop, Vape Shop, and Beer/Wine/Liquor Store) and other retailers that sell tobacco products, including convenience stores, grocery stores, supercenters, and drugstores/pharmacies. The study area also included a head shop and two bar/cigar lounges, which sell tobacco and vape products. Because these retailers did not fit within the previous categories, these were classified as “other”. The addresses of the identified retailers were geocoded and a case count per census tract tallied.

After counting the retailers in each census tract, the addresses of retailers in census tracts with the highest density of tobacco retailers were entered into the Neighborhood Atlas. This tool produces the Area Deprivation Index (ADI) values at the state level, also known as state deciles.

The ADI values range from 1 to 10, with higher values indicating areas that are the more disadvantaged (Neighborhood Atlas, n.d.). To produce this score, the neighborhood disadvantage of the area is ranked against that of other areas in the same state (Kind and Buckingham, 2018). Public health studies have used the data from this tool to have a deeper understanding of the health outcomes of residents who live in various areas across the United States. It has been found that those who live in more disadvantaged areas are predicted to have poor health outcomes, compared to those who live in less disadvantaged areas (Kind and Buckingham, 2018).

Schools were identified and located through public school databases. Additional school addresses were obtained from a Google Search. Public and private middle schools (grades 6-8) and high schools (grades 9-12) were included.

Analytic Plan

After compiling the addresses and coordinates of the valid schools and retailers, this information was entered into ArcGIS. To determine the proximity of retailers to schools, Euclidean buffers were created. Three buffers, including 1-, 0.5-, and 0.25-mile were applied to each school and these distances were chosen as typical walking distances for youth supported by other literature (Perez et al., 2017; Giovenco et al., 2016). Descriptive counts of retailers and retailer types within each buffer of the school are reported in the results.

Chapter 4 - Results

Summary of Schools and Retailers

In the study area, there were 38 schools. Ten schools (26.3%) were in the northeast quadrant. The northwest quadrant contained only three schools (7.9%). Eight schools (21.1%) were in the southwest quadrant. A large proportion (44.7%) of the schools were in the southeast quadrant. The study area also included 177 tobacco retailers. Over half (53.7%) of these retailers were convenience stores. Most retailers (29.9%) were in the northeast quadrant.

ADI and Tobacco Retailer Density

Five census tracts had the highest density of tobacco retailers. Census tract 29.00 in the northeast quadrant had 12 retailers. In the southwest, census tracts 18.00 and 22.00 each had seven retailers. In the northwest quadrant, census tract 33.01 had seven retailers and census tract 30.03 included six retailers. Thirteen census tracts did not contain any tobacco retailers. The ADI values for these retailers ranged from 5 to 10 (moderately to most disadvantaged). Forty-three percent of these tobacco retailers were in areas with a disadvantage score of 9. One high school was in census tract 29.00, which had a score of 5. Conversely, there were eight schools that contained no more than two tobacco retailers within 1 mile. These schools were in areas with an ADI score ranging from 1 to 5 (least to moderately disadvantaged).

1 Mile Buffer

The analysis of each buffer (1-, 0.5-, and 0.25-mile) produced different findings. When a 1-mile buffer was placed around each school, the retailer count (RC) was a mean (M) of 8.74 with a standard deviation (SD) of 6.50 retailers around each school. Most of these retailers were convenience stores (M=4.29, SD=2.75) and vape shops (M=1.03, SD=0.92). Twenty-five

schools had at least one vape shop in their 1-mile buffer. This was also the same for drugstores. At least one tobacco shop was in 39.5% of the schools' buffers. Thirty-two percent of schools had at least one liquor store within the buffer.

0.5 and 0.25 Mile Buffers

Using a smaller buffer reduced the number of retailers near schools. For example, by using a 0.5-mile buffer the average number of retailers was M=2.34 (SD=2.65) within a ½ mile of school. Approximately one convenience store was within a 0.5-mile radius across the study area. Ten schools had a vape shop in their buffer, while only six schools contained a tobacco shop in their buffer. Liquor stores were also within the buffer for six schools. A buffer of 0.25-mile captured the least number of retailers (M=0.50, SD=0.86). Like the other buffers, convenience stores (M=0.24, SD=0.49) were the most common retail type in this buffer. However, most schools (68.4%) did not contain any retailer in their buffer. Overall, convenience stores were the main retailer type near schools.

Figure 1: Tobacco Retailers CONSORT Diagram

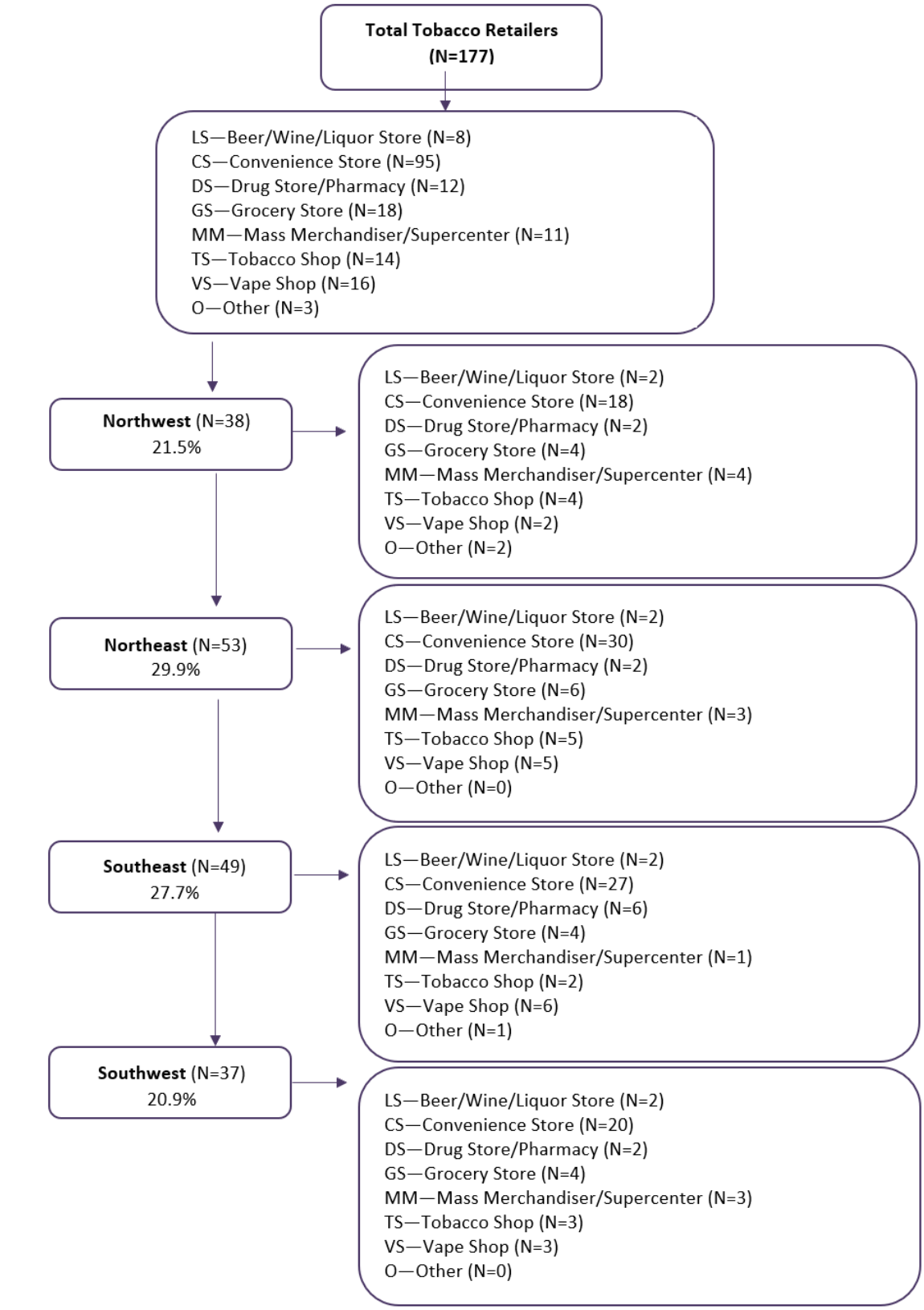


Table 1: Retailers Selling Tobacco and/or Vape Products

Retailer Type	Count	Percent
Beer, Wine, or Liquor Store (LS)	8	4.5
Convenience Store (CS)	95	53.7
Drug Store/Pharmacy (DS)	12	6.8
Grocery Store (GS)	18	10.2
Mass Merchandiser/Supercenter (MM)	11	6.2
Tobacco Shop (TS)	14	7.9
Vape Shop (VS)	16	9.0
Other (O)	3	1.7

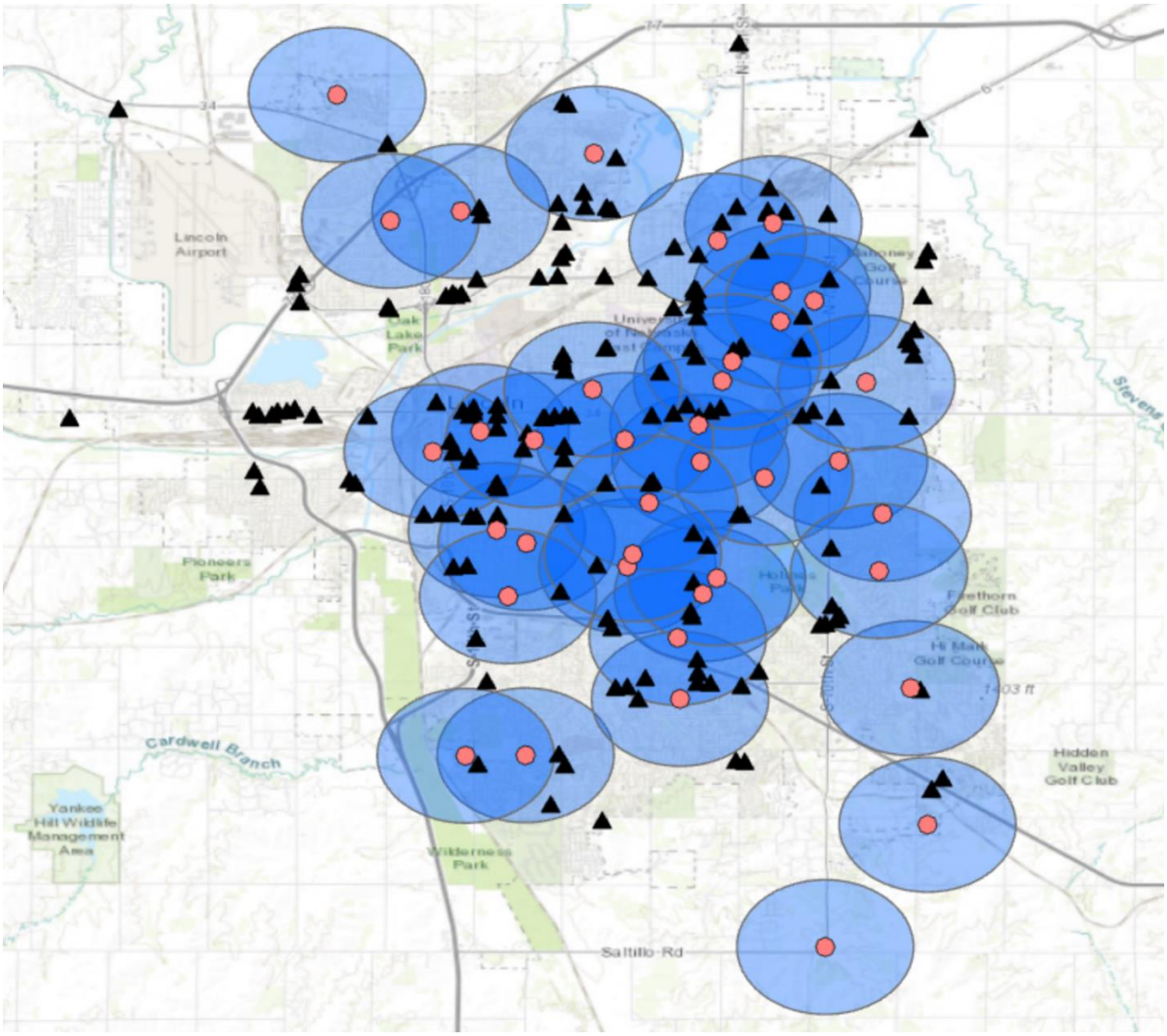
Table 2: Average Number of Retailers Within 1-, 0.5-, and 0.25-Mile of Schools

Buffer	RC M, SD	LS M, SD	CS M, SD	DS M, SD	GS M, SD	MM M, SD	O M, SD	TS M, SD	VS M, SD
1-Mile	8.74 6.50	0.39 0.64	4.29 2.75	0.71 0.57	0.87 0.99	0.29 0.46	0.26 0.76	0.89 1.31	1.03 0.92
0.5-Mile	2.34 2.65	0.16 0.37	1.26 1.27	0.13 0.34	0.21 0.47	0.05 0.23	0.08 0.36	0.16 0.37	0.29 0.52
0.25-Mile	0.50 0.86	0.08 0.27	0.24 0.49	0.08 0.27	0.03 0.16	0.03 0.16	0.00 0.00	0.00 0.00	0.05 0.23

1

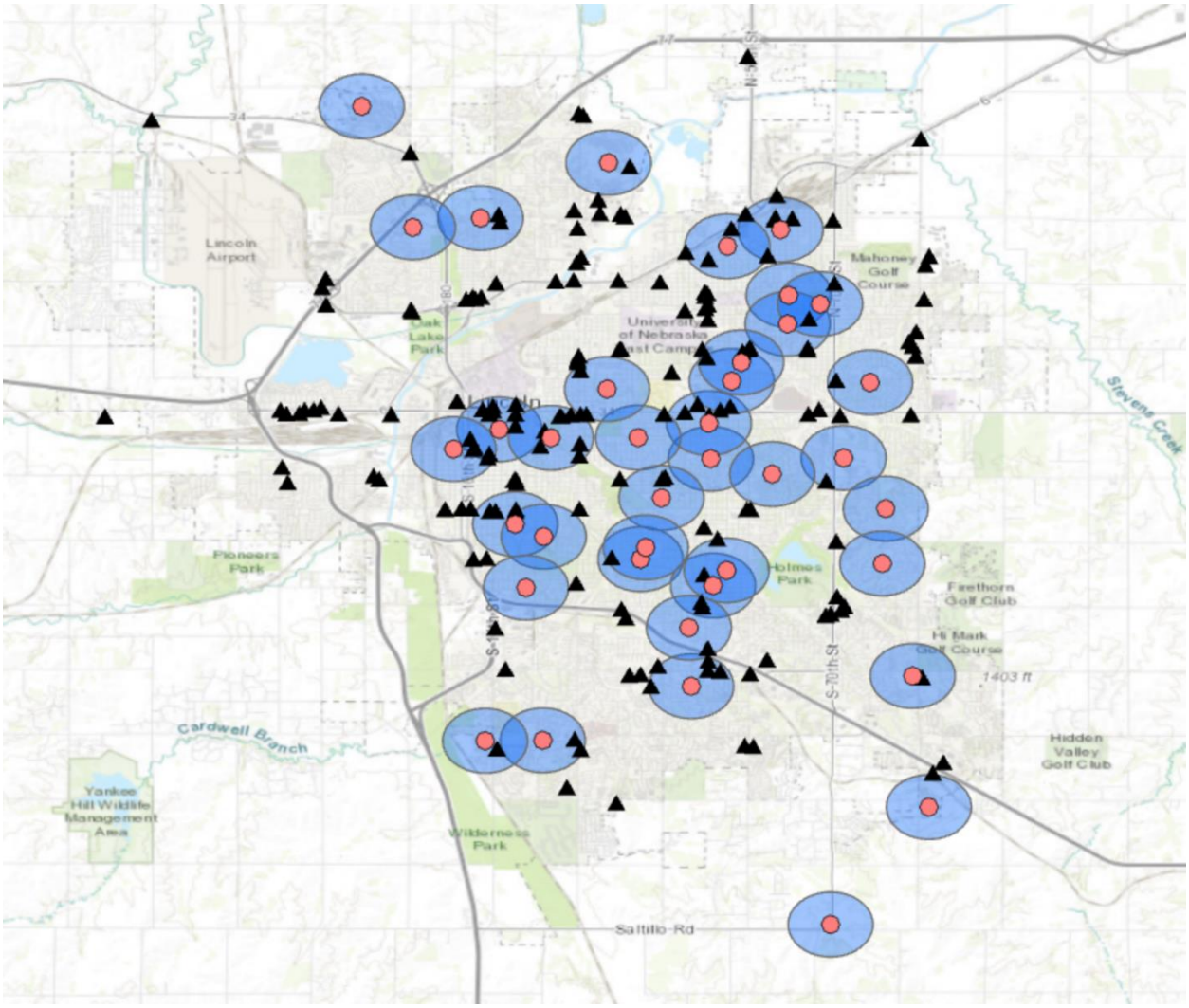
[1] RC= Retailer Count

Figure 2: Map with 1-Mile Buffer Applied[2]



[2] Black triangle= retailer
Red circle= school
Blue circle= 1-mile buffer around school

Figure 3: Map With 0.5-Mile Buffer Applied[3]



[3] Black triangle= retailer
Red circle= school
Blue circle= 0.5-mile buffer around school

Chapter 5 - Discussion

Summary

This research was intended to describe the citywide distribution of tobacco and vape retailers, including their proximity to schools, retailer types, and the ADI of areas in the city with a high and low density of retailers. The results indicate that adolescents may encounter more retailers in certain areas of the city, compared to other areas.

Key Results

This study examined the distribution of tobacco retailers that are within a typical walking distance from schools. Not surprising, the results indicate that the smaller the buffer is around a school, the less retailers will be captured in that buffer. Perez et al. (2017) found that 75% of schools in their study had at least one tobacco retailer within a half-mile radius. This is similar to our project, in which 73.7% of schools had at least one retailer within the 0.5-mile buffer. Our results indicated there were an average of 2.34 retailers within a half mile of the school. This finding was lower than that of Giovenco et al. (2016), which averaged three retailers in each buffer and included more schools in the study area (41 vs 38). While a 0.5-mile buffer is commonly used in tobacco research (Perez et al., 2017; Giovenco et al., 2016), we also used 1- and 0.25-mile buffers to further examine the locations of tobacco retailers.

To date, there are policies in other states that limit the locations of tobacco retailers near schools. However, no data has been found to report that the same is being done in this study area. The study area only included one city. This is a smaller study area compared to other studies that examined the retailers in multiple areas. Perez et al. (2017) analyzed the geospatial association of

retailers within four Texas counties. Additionally, few tobacco studies have examined the ADI values of areas with high and low densities of tobacco retailers.

Strengths and Limitations

This project provided an overview of the number and characteristics of the tobacco retailers that adolescents may be exposed to on a daily basis, focusing on proximity to middle and high schools. By including additional buffers of 1- and 0.25-mile, we were able to determine how influential these distances are when analyzing the number of retailers near a school. Use of the ADI score provides additional information about the potential disparities in health outcomes of residents in areas with the highest densities of tobacco retailers. Similar to other studies, areas with the higher densities of retailers were in areas with higher deprivation scores, compared to areas with few or no retailers.

While this project examined retailers that are within a 1-, 0.5-, and 0.25-mile radius of a school, it should be noted that teens typically travel more than 1 mile away from their school. In this study area, the public-school district provides transportation to students who live more than four miles away from the school in their attendance area. It is likely that students are exposed to even more retailers than what was found in this study, especially when traveling by vehicle. It is also common for some teens to live and/or work in an area that is not close to their school. This also increases the number of retailers they are exposed to regularly. Unlike other studies, this project did not include a questionnaire for adolescents to report their tobacco and vaping habits. This additional information could have further predicted the health outcomes of adolescents, while also examining exposures.

Conclusions

Our study finds that adolescents encounter many tobacco retailers on a daily basis near their schools. Building on these findings, future efforts in the study area should aim to add data that create a more robust understanding of exposures. For example, students' home addresses could be used to compute a network distance between home and school, in addition to the buffers that were only around schools. To further examine disadvantaged areas, comparing the ADI values of students' home and school addresses may be useful. Researching the open campus policies at schools and policies in cities related to retailer type and proximity to schools are important as well. Additional data on students, such as their smoking/vaping use or school level vaping/tobacco prevalence, would expand the usefulness of the proximity information. An assessment of the retailers in the study area, including marketing and promotions and types of products sold and promoted would help determine if products teens use is promoted and available near their schools. These findings can be used to inform public health programs and policy recommendations to address vaping and tobacco use in adolescents.

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