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ORIGINAL PAPER

Geographic Variation in Condom Availability and Accessibility

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Abstract Identifying predictors that contribute to geographic disparities in sexually transmitted infections (STIs) is necessary in order to reduce disparities. This study assesses the spatial relationship condom availability and accessibility in order to better identify determinants of geographic disparities in STIs. We conducted a telephone-based audit among potential-condom selling establishments. Descriptive analyses were conducted to detect differences in condom-selling characteristics by stores and by store type. Geocoding, mapping, and spatial analysis were conducted to measure the availability of condoms. A total of 850 potential condom-selling establishments participated in the condom availability and accessibility audit in St. Louis city; 29 % sold condoms. There were several significant geographic clusters of stores identified across the study area. The first consisted of fewer convenience stores and gas stations that sold condoms in the northern section of the city, whereas condoms were less likely to be sold in non-convenience store settings in the southwestern and central parts of the city. Additionally, locations that distributed free condoms clustered significantly in city center. However, there was a dearth of businesses that were neither convenience stores nor gas stations in the northern region of the city, which also had the highest concentration of condoms sold. This initial study was conducted to provide evidence that condom availability and accessibility differ by geographic region, and likely are a determinant of social norms surrounding condom use and ultimately impact STI rates.

Keywords Condoms · Sexually transmitted disease · Geographic information systems · Sexually transmitted diseases · Health status disparities

Introduction

Each year, there are up to three million new infections of chlamydia and gonorrhea and an estimated 50,000 new HIV cases in the US [1, 2]. As many as 10–20 % of untreated cases of gonorrhea or chlamydia can result in pelvic inflammatory disease and long-term complications such as infertility [1]. While HIV infections have become more of a chronic disease, they continue to require long-term care management [3]. Previous findings suggest multi-level factors (e.g., personal, societal and neighborhood factors) influence rates of sexually transmitted infections (STIs) [4–6]. Of specific interest, geographic variation in STI/HIV infections has been noted, with higher rates occurring in areas with higher rates of concentrated disadvantage [6–9]. Patterns of STIs have been observed to vary based on race, ethnicity, income, education, and relationship status [6–9]. However, to our knowledge, geographic access to sexual health resources (e.g., access to condoms) has not been examined. Understanding the relationship between condom availability may help explain observed geographic disparities in STI/HIV rates.

Only consistent and correct use of condoms can prevent incident STIs among populations that are sexually active [1]. However, studies have shown that factors such as cost, embarrassment of purchasing condoms, and the location of

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condoms within stores serve as barriers to making condoms more readily available and accessible [10–12]. The Centers for Disease Control and Prevention (CDC) has recommended condom distribution interventions at the community-level in order to increase condom availability [13]. Thus, identifying communities with disparities in condom availability will help focus interventions toward geographic areas with the greatest needs.

Previous research has indicated that the lack of resources limits an individual's ability to make healthy choices, For example, geographic regions with poor access to fresh produce, often termed food deserts, have negative impact on the nutritional quality of food to which their residents have access [14, 15]. Specifically, locations where residents live more than one mile away from a grocery store and where residents have lower household incomes are less likely to purchase healthy food, which in turn reduces an individual's ability to consume a nutritious diet [16]. Along these same lines, geographic areas where residents live further away from places where condoms can be purchased may also limit the ability of those individuals to make healthy sexual behavior choices.

Health care access uses these measures for evaluation: availability, accessibility, accommodation, affordability and acceptability [17]. In order to adapt this concept for condom-related research, this study examines components of this measure of health care access to determine the relationship of condom access and geography. Availability was measured geospatially, we identified lack of businesses and concentration of types of businesses where condoms were sold. Accessibility was determined as an adequate supply (variety of choices) of condoms, accommodation as the number of condoms sold within each pack, affordability as the cost per unit, and physical acceptability was determined by where condoms were placed within the store [17, 18]. Overall, condom accessibility has previously been noted to include experiencing barriers in purchasing condoms when condoms are sold behind the counter or in a locked cabinet, when there are fewer choices in style, and high prices [12, 19]. Additionally, social norms likely further interrupt access to resources, which is highly relevant and identified as barriers to purchasing previously when considering condoms.

Furthermore, the Institute of Medicine reported that *place* matters as a factor of health outcomes [20]. Place provides access to health care resources, as well as access to resources that have a deleterious effect on health (i.e. limited fresh fruits and vegetables, few health care centers) [21, 22]. Geographic access to health care resources is often defined by the Euclidean or network distance from an individual's location to the point of service (e.g., clinic) [20, 23]. However, other measurements (such as distance buffers) have been utilized to identify disparities in access. For example, a given health care resource may be deemed as accessible if it is located within a 30 min drive of an individual's home [23]. Other studies, particularly in the fields of alcohol, tobacco, and food access, have measured access using smaller distances [24, 25]. For the purposes of this study, we aimed to assess the geographic access of condoms to persons of all ages, thus we defined businesses as accessible to the population of a given census tract if they were within a 1/4 mile radius of the census tract.

If in fact the absence of condom availability or even limited accessibility may explain, in part, many of the observed negative sexual health outcomes, it is likely that these concepts reflect the social norms regarding sexual health in that community. This study proposes an initial proof of concept with the understanding that future research would be needed to examine the determinants of the observed patterns.

Subjective norms, as conceptualized in the Social Cognitive Theory, suggest that norms are influenced by a referent group, peers and neighbors, and the overall community [26]. Previous studies have examined sexual norms by risk exposure group, such as adolescents, men who have sex with men (MSM), and women [27–29]. Yet, sexual norms have been identified by neighborhoods; such as partner selection occurring more frequently within high HIV prevalence neighborhoods [9,] lower rates of unprotected sex occurring in communities with a higher proportion of homosexuals [30,] monogamous relationship varying across regions [31,] and earlier sexual initiation in some geographic communities [32]. These studies highlight the role of neighborhood context and sexual norms, suggesting more research needs to be done to understand the determinants of these geographic variations in order to develop interventions that are properly scaled and culturally appropriate. The purpose of this study was to assess whether geographic disparities exist in condom availability and accessibility. These initial analyses will test whether condom availability differs by geographic areas (does a business sell condoms) and then to be followed with analyzing accessibility characteristics to determine if there are increased barriers to purchasing condoms beyond availability in stores that sell condoms.

Methods

Virtual Business Audit

To examine the geographic variation in condom availability and accessibility, we developed and conducted an audit where contact information for local businesses were collected through online Yellow Pages, Google Earth business records, and vendor websites. Based on previous research, potential condom-selling vendors were defined as

gas stations, convenience stores, grocery stores, pharmacies, liquor stores, barber shops, beauty salons, bars, and retail stores (clothing, beauty supply, discount, and adult stores) [33]. Businesses were contacted by telephone and asked to participate in a brief assessment of their establishment during a 12 month period in 2011–2012. Upon successfully contacting a business, business staff were interviewed by telephone and asked to respond to five questions regarding condom availability and accessibility. Condom availability is defined in this study if condoms were sold in the store (yes/no). Physical accessibility of condoms was defined by where in the store they were sold (behind the counter or out in the open); accommodation: how many different types of condoms were sold in the store; affordability: what was the average cost of a 3-pack of condoms; and did the store sell condoms in packages containing >3 condoms. Higher overall condom accessibility was denoted in locations with condoms sold them out in the open, housed five or more different types, was not more expensive than the average, and sold packs that had more than three condoms. During the audit calls, those that did not answer the first attempt were called back approximately 1 h later on the same business day. If an answer was still not obtained, the business was called two additional times on two separate days. Disconnected numbers were checked for accuracy using Google search to determine if the company had a different or new phone number available; however, none were found. Of the 1271 stores that were contacted, 36 refused to participate, 271 had a disconnected number, 104 did not answer, and 8 had no telephone number listed. We assessed participation rate by store type and participation rate was equally likely/unlikely by store type. As this was business-related data, Institutional Review Board at Saint Louis University granted this study exempt.

In-Person Audit Validation

To assess the reliability of the Google Earth mapping procedures and telephone survey responses, we conducted an in-person audit of 100 vendors that participated in the study. The number of vendors were selected proportionally to reflect the percentage of total vendors identified in each ZIP code throughout the city. Systematic random sampling was then performed within each ZIP code until the correct number of vendors was obtained. Completed during the period from December 2012 through April 2013 between the hours of 9:00 AM and 5:00 PM, this field audit confirmed the location and address of the vendor sites, vendor business status (i.e., open, out of business, or new vendor), and the availability and accessibility of condoms.

The level of agreement was high for vendor location, with 98.9 % of vendors in the field audit having the same address and location as identified via Google Earth. Agreement was also high for measures of vendor business status (i.e., open or out of business), with only 14.2 % (n = 14) of vendors having discordant classifications when comparing virtual and in-person audit data. However, further analysis revealed that 8 out of the 14 (57.1 %) business status discrepancies arose when a new vendor opened up in the location of a vendor previously categorized as "out of business" during the virtual audit period.

The locations of businesses were geocoded using ArcGIS version 10.2.2 [34]. Geocoding is a process that takes the business address and translates it into the longitude and latitude of the location. Businesses were categorized as (1) free locations, (2) convenience vendors (defined as gas stations and convenience stores) or (3) other (defined as liquor stores, bars, pharmacies, beauty salons, barbershops, grocery stores, and retail stores). Businesses were categorized in this manner due to hypothesized similarities in accessibility and condom inventory. In order to account for the mobility of people across administrative boundaries, and in agreement with other studies of the built environment, we computed the number of vendors within a 0.25 mile buffer of the border of each census tract [35]. This buffer distance was selected because it represents a 10–15 min walk, which is considered as the maximum walking distance for people [36]. Using the 0.25 mile buffer, the mean number of vendors in each census tract was 4.96 (SD = 2.8; Min = 0; Max = 19) for convenience vendors and 0.93 (SD = 1.4; Min = 0; Max = 15) for free locations, respectively. The number of convenience and free vendors were then divided by the total number of vendors to estimate the proportion of convenience and free vendors within each census tract.

Data Analysis

We conducted a descriptive analysis of condom accessibility by the aforementioned business types using Chi square tests of association for categorical variables and t-tests for continuous variables in 2013. Details of condom accessibility and accommodation were not available for free condom locations; therefore they were not included in these descriptive analyses. Since we were interested in the geographic distribution of condom vendors in St. Louis city, we used Kuldorff's spatial scan statistic to test for clustering patterns of businesses in SaTScan software version 9.3.1 (Information Management Services, Boston, MA, USA) [37]. Kuldorff's spatial scan statistic imposes a circular window with a variable size radius across the study area to identify statistically significant geographic clusters of higher (lower) than expected outcomes [38]. We conducted cluster analyses to determine the patterns of

Table 1 Characteristics of condom-selling establishment

Characteristic	Bar	Barber or beauty salon	Convenience store	Gas station	Grocery store	Liquor store	Pharmacy	Retail store*
Participation rate by store type	61.80 %	67.90 %	65.00 %	79.60 %	76.90 %	60.60 %	68.20 %	67.80 %
Participation status								
Total (N = 1269)	374 (50.4 %)	369 (50.0 %)	177 (52.4 %)	97 (50.0 %)	78 (50.0 %)	33 (50.8 %)	21 (50.0 %)	120 (50.0 %)
Agree (n = 829)	232 (31.3 %)	250 (33.9 %)	103 (30.5 %)	74 (38.4 %)	59 (37.8 %)	18 (27.8 %)	14 (31.2 %)	79 (32.6 %)
No answer (n = 104)	56 (7.5 %)	25 (3.4 %)	22 (6.5 %)	8 (4.1 %)	4 (2.6 %)	1 (1.5 %)	2 (4.5 %)	9 (3.7 %)
Disconnected or unlisted number (n = 295)	82 (10.8 %)	87 (11.8 %)	32 (8.9 %)	15 (7.7 %)	8 (5.1 %)	12 (15.4 %)	7 (11.4 %)	27 (21.5 %)
Refuse (n = 49)	9 (1.2 %)	9 (1.2 %)	8 (2.3 %)	0 (0.0 %)	8 (5.1 %)	4 (5.9 %)	3 (6.4 %)	8 (3.3 %)
Sell condoms (N = 829)								
Yes (n = 242)	10 (4.3 %)	2 (.01 %)	74 (71.8 %)	72 (97.3 %)	38 (64.4 %)	15 (83.3 %)	8 (57.1 %)	23 (29.1 %)
No (n = 587)	222 (95.7 %)	248 (99.2 %)	29 (28.2 %)	2 (2.7 %)	21 (35.6 %)	3 (16.7 %)	6 (42.9 %)	56 (70.9 %)
Pack size greater than 3 sold (N = 257)								
Yes (n = 43)	0 (0.0 %)	0 (0.0 %)	15 (20.8 %)	0 (0.0 %)	13 (36.1 %)	0 (0.0 %)	8 (100 %)	9 (22.7 %)
No (n = 214)	9 (100.0 %)	2 (100.0 %)	57 (79.2 %)	70 (100.0 %)	23 (63.9 %)	13 (100.0 %)	0 (0.0 %)	17 (77.3 %)
Condom location in store (N = 260)**								
Behind the counter (n = 202)	2 (20.0 %)	1 (50.0 %)	54 (75.0 %)	63 (90.0 %)	31 (88.6 %)	12 (92.3 %)	4 (50.0 %)	12 (54.5 %)
Out in the open (n = 58)	8 (80.0 %)	1 (50.0 %)	18 (25.0 %)	7 (10.0 %)	4 (11.4 %)	1 (7.7 %)	4 (50.0 %)	10 (45.5 %)
Number of condom varieties (N = 246)								
Low: 1 variety (n = 58)	2 (22.2 %)	0 (0.0 %)	17 (23.6 %)	9 (12.9 %)	7 (20.6 %)	3 (23.1 %)	2 (28.6 %)	9 (40.9 %)
Medium: 2–4 varieties (n = 91)	2 (22.2 %)	0 (0.0 %)	25 (34.7 %)	22 (31.4 %)	16 (47.1 %)	6 (46.2 %)	0 (0.0 %)	6 (27.3 %)
High: 5 or more varieties (n = 97)	5 (55.6 %)	1 (100.0 %)	30 (41.7 %)	39 (59.7 %)	11 (32.4 %)	4 (30.8 %)	5 (71.4 %)	7 (31.8 %)
Price per condom (N = 244)***								
Mean price (SD)	N/A	N/A	$1.26 (0.437)	$1.24 (0.173)	$1.04 (0.210)	$1.08 (0.284)	$1.38 (0.707)	$0.98 (0.485)
Minimum price	N/A	N/A	$0.43	$0.83	$0.58	$0.33	$0.66	$0.17
Maximum price	N/A	N/A	$2.33	$1.66	$1.43	$1.50	$2.33	$2.33

* Includes beauty supply, clothing, adult, and department stores

** Two stores reported condoms located both behind the counter and out in the open, thus two points were added to each category

*** Values in US dollars; excludes condoms distributed for free (bar and barber/beauty salons)

Table 2 Comparison by condom-selling establishments types*

Characteristic	Convenience store or gas station	Other store**	p value
Participation (N = 829)			
Yes	193 (70.2 %)	177 (69.7 %)	0.901
No	82 (29.8 %)	77 (30.3 %)	
Sell condoms			
Yes	146 (82.5 %)	96 (14.7 %)	<0.001
No	31 (17.5 %)	556 (85.3 %)	
Pack size greater than 3 sold			
Yes	15 (10.6 %)	25 (28.1 %)	<0.001
No	127 (89.4 %)	64 (71.9 %)	
Condom location in store			
Behind the counter	116 (65.5 %)	61 (9.4 %)	<0.001
Out in the open	61 (34.5 %)	591 (90.6 %)	
Number of condom varieties			
Low: 1–3 varieties	62 (35.0 %)	44 (6.7 %)	<0.001
High: 4 or more varieties	115 (65.0 %)	608 (93.3 %)	
Price per condom (N = 244)			
Mean price (SD)	1.25 (0.338)	1.06 (0.376)	<0.001
Minimum price	0.43	0.17	
Maximum price	2.33	2.33	

* Excludes bars and barber/beauty salons (small cell counts)

** Includes grocery stores, liquor stores, pharmacies, and retail stores

condom accessibility for (1) convenience vendors, (2) other vendors, and (3) free locations. We also conducted a cluster analysis comparing the distribution of business vendors (convenience and other vendors combined) to the distribution of free condom locations. In all instances, a purely spatial Poisson model was used to detect clusters of condom vendors. A circular scan with a maximum spatial cluster size of 50 % of the total population was used. For statistical inference, 999 Monte Carlo replications were performed. The null hypothesis of spatial randomness was rejected when the simulated p value $\leq$0.05. Results from the scan statistic were mapped using ArcGIS 10.2.2 [34].

In addition to the scan statistic, we also used indirect standardization to calculate the standardized vendor ratio (SVR) for each census tract, [39, 40] which represents the observed count of condom vendors relative to the expected count of condom vendors. However, since ratios like the SVR have been shown to have large variance in areas where the expected values are small (thus distorting the interpretations of mapped values), we smoothed the SVRs using local Empirical Bayes techniques from package spdep in version 3.0.1 of R [41]. Empirical Bayes has long been used in disease mapping and has been explained extensively elsewhere [42, 43]. Briefly, Empirical Bayes smoothing causes extreme values from census tracts with more variability to be attenuated toward the mean value of the entire study area (the global mean) by accounting for the values in neighboring (adjacent) census tracts. We smoothed both the SVRs and the proportion of condom-selling establishments within each census tract, in order to display patterns of condom access. All geospatial analyses were conducted in 2015.

Results

Of the 1269 businesses that were contacted, 850 agreed to participate. Only 36 businesses (2.8 %) refused to participate, 271 had disconnected telephone numbers; there were no answers at 104 businesses, and 8 with no listed telephone number. There were no significant differences in participation between store types. A summary of businesses identified by the audit is presented in Table 1. Approximately one-third of participating businesses (n = 260) that were identified as potential condom vendors sold condoms. The businesses most likely to sell condoms were gas stations (n = 75; 96 %), liquor stores (n = 17; 85 %) and convenience stores (n = 84; 73 %).

Condom physical accessibility was ascertained by determining whether condoms were sold behind the counter or out in the open. Among the businesses that sold condoms, 78 % (n = 200) were sold behind the counter. Pharmacies (n = 5; 56 %) and retail stores (n = 12; 50 %)

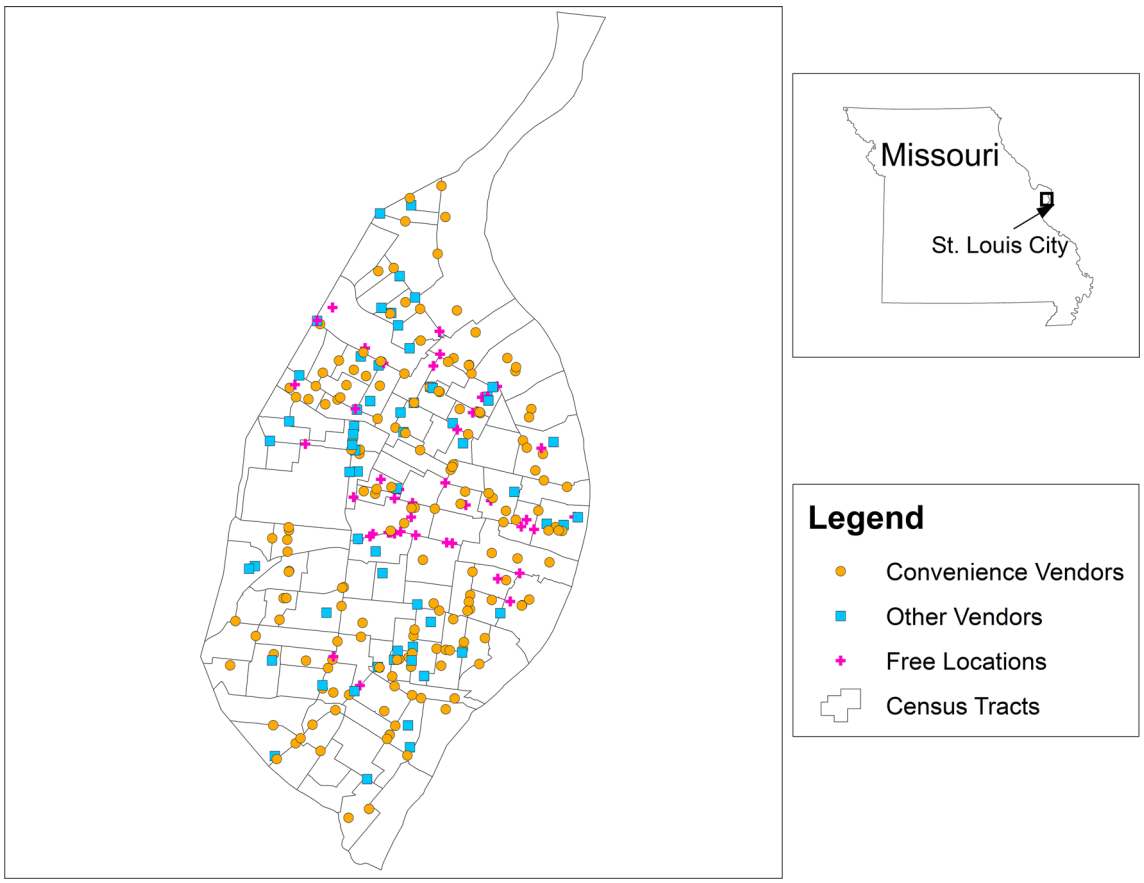

Fig. 1 This figure shows the spatial distribution of condom vendors and free condom locations across census tracts in St. Louis, MI

sold condoms more frequently in the open, compared to liquor stores, gas stations and grocery stores where condoms were most commonly behind the counter (94, 89, and 90 %, respectively). Accommodation was determined by the variety of types of condoms sold and the size of the packages sold. One-fifth (n = 50) of the stores had single condoms available as the smallest number individuals could purchase and 17 % (n = 43) had pack sizes containing more than three condoms. The most commonly available pack size was a 3-pack of condoms (79 %; n = 201). Condom variety was another component of accommodation and was assessed by the number of brands available. Overall, 24 % (n = 58) of the vendors had only one condom brand, 37 % (n = 91) of vendors had 2–4 options; and 39 % had 5 or more condom varieties. Factors of condom availability and accessibility are detailed in Table 1.

Comparisons by business type are presented in Table 2. Of note, convenience stores and gas stations (convenience vendors) were more likely than other businesses to sell condoms ($\chi^2 = 44.394$, 1 df, $p < 0.001$). In addition, the average cost per condom was more expensive in these convenience vendors compared to other stores ($t = 4.107$, 1 df, $p < 0.001$). Convenience vendors were also less likely to sell condoms in packs with >3 condoms compared to other businesses ($\chi^2 = 11.502$, 1 df, $p < 0.001$).

We geocoded and mapped the location of each business that participated in the audit. Figure 1 shows the distribution of businesses that sold condoms by business type. Figure 2 shows the results from the cluster analyses by business type. Considering only the convenience vendors in the study region, there were lower proportions of convenience vendors that sold condoms in the northwestern part of the city compared to all other census tracts in the study area ($p = 0.041$; see Fig. 2a). Among all other stores, a total of three clusters were identified. The first was located in the northern part of the city and was comprised of a significantly high cluster of condom-selling establishments relative to all other census tracts ($p < 0.00001$). Two clusters where condoms were sold significantly less frequently by other stores relative to all other census tracts were detected in the central eastern part of the city ($p = 0.014$) and in the southwestern part of the city ($p = 0.000049$). These clusters are shown in Fig. 2b. Finally, a cluster of free condom distribution locations was identified in the center of the city ($p < 0.00001$) and is

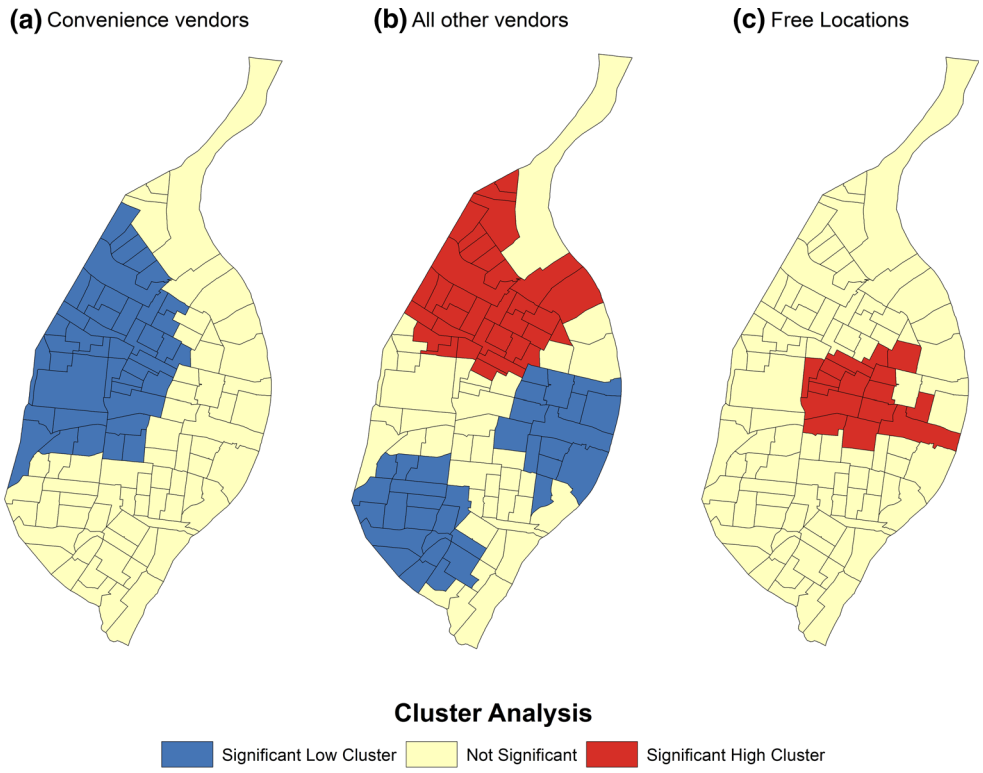

Fig. 2 This figure shows the results of the cluster analyses of condom vendors across 106 census tracts in St. Louis, Missouri. Census tracts with statistically significant *high* (*low*) proportions of condom vendors that cluster spatially are shown in *red* (*blue*). Results are shown for convenience vendors, all other stores, and free condom locations in **a**, **b** and **c**, respectively. Clusters with p-values less than 0.05 were considered as statistically significant

highlighted in Fig. 2c. Figure 3 shows the smoothed SVRs and the proportion of condom-selling establishments by business type for each census tract. Panel (a) reveals lower than expected number of convenience vendors in the center and southwest parts of the city. Panel (b) reveals a similar pattern among all other store types, with lower than expected number of stores in the southern half of the city. It should also be noted that there was a high density of all other store types in the northern part of the city. Panels (c) and (d) show the smoothed proportion of convenience vendors and all other stores that reported selling condoms, respectively. Importantly, the proportion of condom-selling establishments varied across census tracts. The proportion of condom-selling establishments was between 0.61 and 1.0 for convenience vendors, whereas the proportion among all other stores was between 0.03 and 0.42.

Discussion

This study was conducted to assess spatial disparities of condom availability and accessibility. Through a telephone-based audit and geospatial analysis, we were able to identify geographic variation in condom availability, where only 29 % of the potential condom selling establishments sold condoms. We identified disparities in patterns of condom access rooted by geography, suggesting that spatial disparities in condom accessibility exist in St. Louis City. This implies that STI rates in neighborhoods with limited access to condoms will persist without interventions to increase correct and consistent use of condoms.

We found limited availability and accessibility of condoms across St. Louis City. Encouraging existing businesses in neighborhoods with high rates of STIs/HIV to sell condoms, as well as selling them in a more accommodating manner will likely diminish the observed effect of condom deserts. Interestingly, we identified three clusters of different condom availability patterns: (1) higher availability in the northern end of the city, which was primarily provided by convenience vendors, (2) lower availability in the central eastern part of the city, and (3) significantly lower availability in the southwestern part of the city. The locations where condoms were distributed free of charge were concentrated in the central part of the city, providing a response to the scarce availability of condoms in that region. This particular finding provides positive reinforcement for the condom distribution campaign that the St. Louis City Department of Health and Human Services was implementing as they provided a high concentration of free and available condoms in a region with little to no availability of condoms. The evidence-based condom distribution campaign was implemented in 2012 and continues at the time of this publication [44].

This study also revealed that there were areas with higher concentrations of convenience vendors (e.g., corner

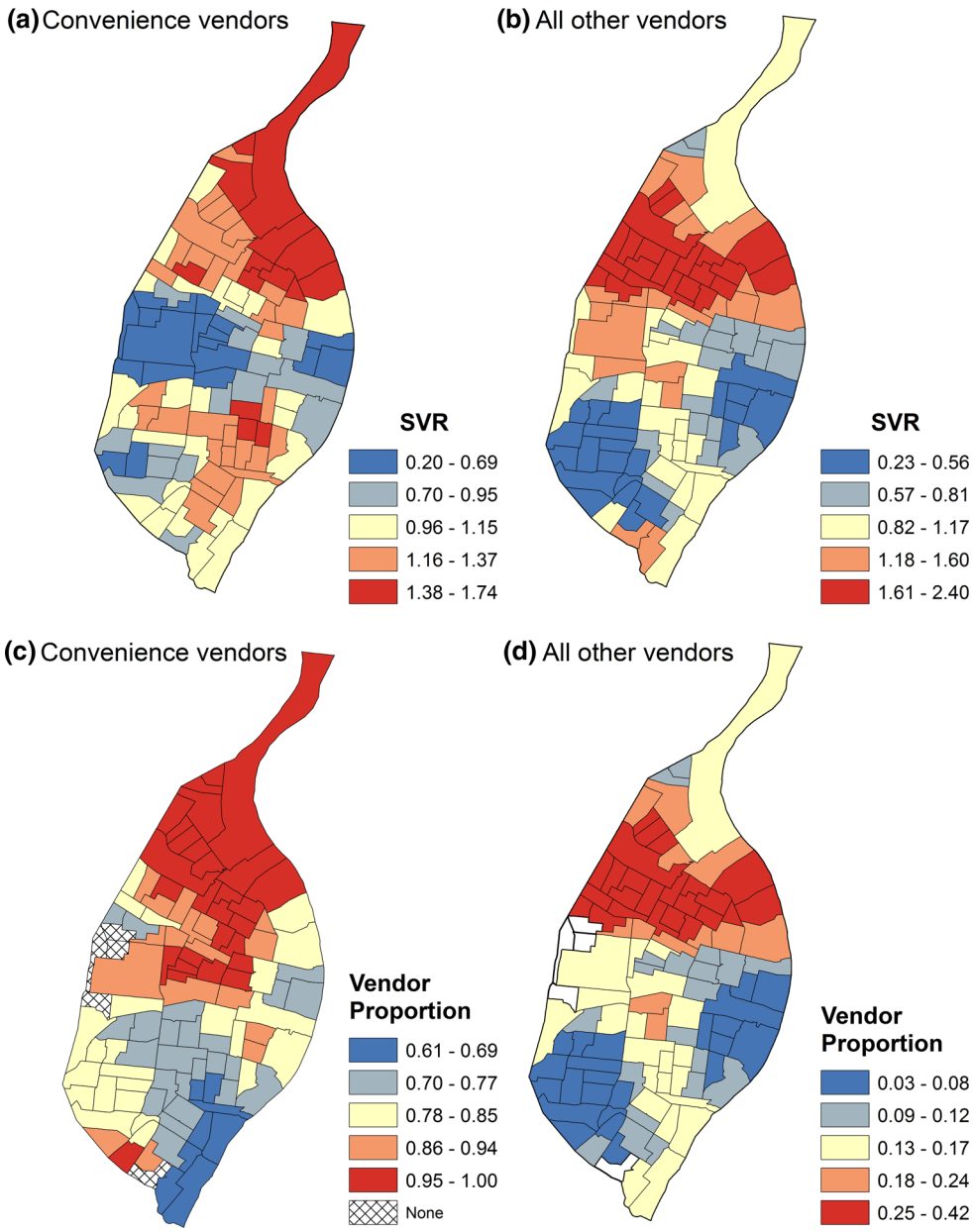

Fig. 3 This figures shows the geographic distribution of standardized vendor ratios (SVRs) which denote higher (lower) than expected stores in a given census tract, and the proportion of stores selling condoms across 106 census tracts in St. Louis, Missouri. Panels **a** and **b** show the SVRs for convenience vendors and all other stores, respectively. Census tracts shaded in *red* (*blue*) have *higher* (*lower*) than expected numbers of stores. Panels **c** and **d** show the proportion of stores that sell condoms, with census tracts in *red* (*blue*) denoting those with *higher* (*lower*) proportions

stores, gas stations, and convenience stores) relative to other types of businesses. These findings suggest that in some neighborhoods, residents may only have easy access to convenience vendors, which limits their exposure to health-related resources, variety in condom selection choices, as well as increased condom prices. These results highlight that there may be an overall lack of resources in specific areas or neighborhoods, which likely influence health outcomes and contribute to health disparities in low resource settings. Previously, these disparities have been identified as physical gaps in health care and food access [45–47]. This study suggests that sexual health resources should also be included in assessing the needed resources in physical environments that serve as barriers to positive health outcomes.

In our study, we identified that condoms were physically available in higher concentrations in the northern part of the city, which overlaps with resource poor neighborhoods. Poor accommodation of condoms was associated with condoms being sold behind the counter, fewer choices in brand, smaller pack size, and higher cost. Overwhelmingly, condoms were sold behind the counter. This delineation is understated, as the research team was able to identify significant barriers to finding condoms during the in-person audit. Far too often, only one brand of condoms and single condom packages were available for purchase. Although

available condoms were considered as a positive finding in this study, increasing choice and removing barriers such cost per condom by selling larger packs, placing condoms in more reachable locations in order to reduce embarrassment with asking employees for condoms, and lack of variety are likely to have greater impact at preventing STI transmission within regions of low condom access [11, 12, 48]. Addressing these and other barriers will be crucial for developing successful community distribution programs recommended by the CDC.

These findings highlight that there is likely a negative influence on social norms around condom usage [49, 50]. These findings did not identify that there was limited physical access to condoms in areas with high concentrated disadvantage, yet highlighted the need to improve condom accessibility. While accessibility and availability are integral to the use of condoms, this research does not assume that just by having condoms available, individuals will use them. Ultimately, having community members see condoms present in a variety of local businesses may help them consider that people like themselves (their referent group) use condoms. Thus, increasing overall access to condoms could influence social norms; and ultimately reduce rates of STIs, including HIV infection.

Finally, this exploratory study also examined the accuracy of utilizing Google Earth as a tool for conducting virtual neighborhood audits, as well as its capacity to contribute to studies of business characteristics when used jointly with a telephone survey. This method was reliable as there were very few in inconsistencies between the in-person and audit measures. Limitation of this study include that the data were cross-sectional and cannot render causal inference. Additionally, study results may not be representative of the greater metropolitan statistical area or of other cities. The study area was selected because public health resources are allocated within city limits. This aligned with our purpose of exploring variation in condom accessibility and availability with the intention of informing community interventions to improve condom distribution and use.

In conclusion, this study highlights the need to evaluate condom availability and accessibility by geographic location to better inform STI and HIV prevention efforts. Condom deserts may also serve to influence social norms and act as barriers to condom use. Future studies are needed to assess the geographic variation of condom vendors after accounting for STI incidence and other known STI risk factors. Understanding the role of condom locations and risk of STIs across geographic areas should be considered when addressing STI health inequities.

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Compliance with Ethical Standards

Conflict of interests The authors have no conflicts of interests or financial disclosures to report.

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