Journal of Urban Health: Bulletin of the New York Academy of Medicine, Vol. 90, No. 6
doi:10.1007/s11524-013-9798-7

Factors Associated with Presence of Pharmacies and Pharmacies that Sell Syringes Over-the-Counter in Los Angeles County

Thomas J. Stopka, Estella M. Geraghty, Rahman Azari, Ellen B. Gold, and Kathryn DeRiemer

ABSTRACT *Community pharmacies serve as key locations for public health services including interventions to enhance the availability of syringes sold over-the-counter (OTC), an important strategy to prevent injection-mediated HIV transmission. Little is known about the community characteristics associated with the availability of pharmacies and pharmacies that sell syringes OTC. We conducted multivariable regression analyses to determine whether the sociodemographic characteristics of census tract residents were associated with pharmacy presence in Los Angeles (LA) County during 2008. Using a geographic information system, we conducted hot-spot analyses to identify clusters of pharmacies, OTC syringe-selling pharmacies, sociodemographic variables, and their relationships. For LA County census tracts (N=2,054), population size (adjusted odds ratio [AOR], 1.22; 95 % confidence interval [CI], 1.16, 1.28), median age of residents (AOR, 1.03; 95 % CI, 1.01, 1.05), and the percent of households receiving public assistance (AOR, 0.97; 95 % CI, 0.94, 0.99) were independently associated with the presence of all pharmacies. Only 12 % of census tracts had at least one OTC syringe-selling pharmacy and sociodemographic variables were not independently associated with the presence of OTC syringe-selling pharmacies. Clusters of pharmacies ($p<0.01$) were located proximally to clusters of older populations and were distant from clusters of poorer populations. Our combined statistical and spatial analyses provided an innovative approach to assess the sociodemographic and geographic factors associated with the presence of community pharmacies and pharmacies that participate in OTC syringe sales.*

KEYWORDS *Pharmacies, Syringe access, HIV prevention, GIS, Health policy*

INTRODUCTION

Pharmacies are among the most prevalent community-level connections that the general populace has to healthcare and public health services. Increasingly, community pharmacies are used to screen patients,[1] provide vaccinations,[2] and offer disease prevention and harm reduction interventions.[3] However, few studies to date have focused on the characteristics of a local community that are associated

Stopka, Geraghty, Azari, Gold, and DeRiemer are with the Graduate Group in Epidemiology, Department of Public Health Sciences, University of California, Davis, Davis, CA, USA; Geraghty is with the Department of Internal Medicine, University of California, Davis, Sacramento, CA, USA.

Correspondence: Thomas J. Stopka, Graduate Group in Epidemiology, Department of Public Health Sciences, University of California, Davis, Davis, CA, USA. (E-mail: tjstopka@ucdavis.edu)

Electronic supplementary material The online version of this article (doi:10.1007/s11524-013-9798-7) contains supplementary material, which is available to authorized users.

with the presence of pharmacies and pharmacies that sell syringes over-the-counter (OTC).

Since the beginning of the HIV/AIDS epidemic in the USA, pharmacies have played an increasing role in HIV/AIDS prevention.[4] Pharmacies have served as key locations for structural interventions to enhance access to OTC syringes[5] and as a nexus for treatment, care, and other needed services in places such as New York City.[6] A number of states have introduced legislation to permit OTC sales of syringes within pharmacies.[5,7–16] Pharmacy syringe sales have been associated with reduced injection-mediated risks, including rates of syringe sharing,[5,17–19] and reduced rates of HIV infection among injection drug users (IDUs).[20,21] HIV infection levels were twice as high among IDUs in cities across the USA that did not permit OTC syringe sales compared to IDUs in cities that did.[20,21] Because pharmacies are distributed throughout most regions of North America and have extended hours of operation, they can potentially increase access to clean syringes.[18,22] IDUs generally consider pharmacies as stable, safe, and affordable sources of sterile syringes.[11,23] In Connecticut, where legislation permitted the sale of OTC syringes, a large percentage of pharmacists agreed to sell syringes.[8,10,12] In Baltimore, Maryland, some pharmacists ran syringe exchange programs in their stores.[24]

In January 2005, California Senate Bill 1159 allowed local health jurisdictions (LHJs) to authorize OTC syringe sales in registered pharmacies.[25] By 2007, approximately one quarter (27.9 %, 17 of 61) of LHJs and 532 of 2,987 (17.8 %) pharmacies allowed OTC syringe sales.[26] Nearly four in ten (39 %) IDUs reported syringe purchases at participating pharmacies in San Francisco, California[27]

In the City of Los Angeles (LA), pharmacy-based OTC syringe sales were authorized by the City Council in June 2005. Pharmacies began to register to sell OTC syringes with the LA County Department of Public Health in 2007. By the end of 2007, 183 (11 %) pharmacies in LA County were registered to sell OTC syringes.[26]

Little is known, however, about the prevalence of pharmacies in general and OTC syringe-selling pharmacies, specifically. Also, little research has been directed toward the factors associated with pharmacy presence. In Pittsburgh, Pennsylvania, and Omaha, Nebraska, total population size was the only factor associated with the spatial distribution of pharmacies.[28] In Minnesota counties, population density was associated with entry and exit of community pharmacies.[29] In a larger study that conducted county-level analyses of the market factors that were associated with the availability of community pharmacies in the USA, the percent of the population living below the poverty level, the percent of elderly people in the population, the average income of residents, the percent of the population living in a rural setting, the percent of the population that was unemployed, and the percent of the population receiving public assistance were significantly associated with pharmacy availability.[30]

Demographic factors have also been associated with the presence of pharmacies that sold OTC syringes. In New York, Cooper and colleagues conducted kernel density estimates to detect that neighborhoods with a high proportion of African American residents between 2001 and 2006 had fewer OTC syringe-selling outlets than neighborhoods with a high proportion of white residents.[31] However, little research has been conducted on the demographic and socioeconomic status (SES) factors associated with pharmacy availability and OTC syringe availability on the local level in the Western USA.

The goal of the current study was to characterize the syringe-mediated disease risk environment in LA County related to pharmacy availability and local community characteristics. Specifically, we aimed: (1) to characterize *availability of*

all pharmacies across space in LA census tracts, (2) to characterize *availability of OTC syringe-selling pharmacies* in LA census tracts, and (3) to determine the factors that were associated with the presence of all pharmacies and OTC syringe-selling pharmacies. We tested the following null hypotheses: (1) Pharmacies, OTC syringe-selling pharmacies, and other population characteristics (i.e., demographics, SES) were randomly distributed in space; (2) The odds of the presence of all pharmacies and OTC syringe-selling pharmacies were equal in census tracts of diverse demographic and SES characteristics.

METHODS

Study Design

We conducted secondary analyses of existing pharmacy and sociodemographic data in California for 2008, using a cross-sectional and ecological study design. LA County census tracts (N=2,054) were the geographical unit of analysis. Census tracts, as defined by the U.S. Census Bureau, are small, relatively permanent statistical subdivisions of a county and usually are comprised of between 2,500 and 8,000 persons. They were designed to be homogenous with respect to population characteristics, economic status, and living conditions.[32]

Data

We compiled publically available data from several sources for analyses to test the aforementioned hypotheses. We acquired names and addresses for all licensed LA County pharmacies (N=1,623) from the California State Board of Pharmacy for the year 2007. We obtained the names and addresses of all pharmacies registered to sell syringes OTC (N=269) within LA County by 2008 from the LA County Department of Public Health. We used 5-year estimates of U.S. Census demographic information,[33] comprised of 2005–2009 American Community Survey data, believed to be representative for 2008, our year of focus.

Measures

Outcome Variables First, we focused on the presence of all pharmacies (i.e., yes or no) as the outcome of interest to assess factors associated with pharmacy availability in LA County census tracts. Next, we determined the prevalence of OTC syringe-selling pharmacies (i.e., counts per census tract) as our outcome to assess factors associated with presence of pharmacies selling syringes OTC.

Explanatory Variables Based on the previous studies in Pittsburgh and Omaha, population size (i.e., total population per census tract) was the primary independent variable.[28] Previous research findings in Minnesota,[29] U.S. counties,[30] and New York informed our inclusion of the following census tract level data points as explanatory variables: population density per square mile, percent of population that was Latino, percent African American, percent White, percent Asian, percent of population with less than a high school education, percent unemployed, median income, median age, percent of population under 18 years of age, percent single-parent households, percent living in poverty, and percent of households that received public assistance. All of these variables were included as continuous explanatory variables.

Geocoding and Spatial Variable Creation Addresses for all 1,623 registered LA County pharmacies were standardized and geocoded using the browser-based geocoding system available at the Environmental Health Investigations Branch of the California Department of Public Health.[34] This approach allowed subsequent mapping and spatial analysis of pharmacies in a geographic information system (GIS) [ArcGIS 10.0, ESRI, Redlands, CA, USA].

"Point in polygon spatial joins" were conducted within the GIS to determine the number of pharmacies and the number of OTC syringe-selling pharmacies (the points) within LA County census tracts (the polygons). We used the presence of pharmacies (yes or no) and the aggregate count of pharmacies at the census tract level as the outcome variables in statistical analyses.

Statistical Analyses

To characterize pharmacy availability and SES characteristics across LA County census tracts, we conducted univariate analyses to obtain descriptive statistics (mean, standard deviation, median, interquartile range) and assessed the normality and distribution of the data. We used graphics (boxplots, histograms) and maps (thematic) to assess distributions and natural cut points for the outcome and explanatory variables and to determine whether to transform or categorize variables. We transformed total population per census tract by dividing by 1,000, and we divided median annual household income by 1,000. Thus, we estimated odds ratios for the prevalence of pharmacies and OTC syringe-selling pharmacies for each 1,000 person increase in population and each $1,000 increase in annual household income.

We conducted unadjusted logistic regression analyses to identify univariate associations between explanatory variables and the outcome (pharmacy presence [yes vs. no]). To assess colinearity, we compared explanatory variables in bivariate analyses. If variables were correlated (Pearson correlation coefficient >0.8), we included only the variable with the most significant contribution in subsequent multivariable models.

We conducted multivariable logistic regression analyses to determine which factors were independently associated with pharmacy presence within LA County census tracts. We included all variables that were significant at the $p<0.05$ level in unadjusted analyses in multivariate model 1. Next, for model 2, we assessed potential confounding for all sociodemographic variables in bivariate analyses. Covariates that produced a 5 % change in effect for the association between total population and pharmacy presence (i.e., confounded the total population—pharmacy presence relationship) were included in multivariable model 2.

Next, we performed simple and multivariable Poisson regression analyses to determine whether explanatory variables were associated with counts of OTC syringe-selling pharmacies within the 915 LA County census tracts that had a least one pharmacy. Statistical analyses were conducted in SAS version 9.3 (SAS Corporation, Cary, NC, USA).

Spatial Analyses

Descriptive Mapping We used descriptive GIS mapping techniques to assess the spatial distribution of all pharmacies and OTC syringe-selling pharmacies in LA County. We visualized the distributions of outcome and explanatory variables across LA County census tracts using thematic maps (data not shown).

Cluster Analyses To determine an appropriate spatial scale for hot-spot analysis in LA County census tracts, we tested the spatial autocorrelation for each variable over 30 distance measurements, beginning at 4,000 m and increasing in increments of 500 m. This analysis produced three important statistical results for each distance tested: (1) a Moran's *I* statistic, to test the null hypothesis that spatial autocorrelation of a variable is zero;[35] (2) a *Z* score, the highest value of which indicated the distance at which spatial autocorrelation or clustering was most intense for the variable; and (3) a *p* value, which confirmed the statistical significance of the spatial autocorrelation. From these results, we determined the distance at which clustering was most intense and statistically significant and entered this distance as a parameter in subsequent hot-spot analyses.

We used hot-spot analyses (Getis-Ord Gi*) to determine the location of statistically significant clusters of census tracts with higher (or lower) values for pharmacies, OTC syringe-selling pharmacies, and relevant explanatory variables.[36] The local statistic, Gi*, allowed us to detect pockets of spatial association that may not have been evident using traditional statistics alone.[35]

A tri-colored map layer portrayed the relationship of each census tract's tested variable value or local mean (i.e., variable value for census tract and its neighbors within a specified distance) to the global variable value or global mean (i.e., variable value of all census tracts in LA County). "Hot-spots" were defined as clusters of census tracts that had values (e.g., pharmacy counts) that were significantly higher than the global mean value (e.g., mean number of pharmacies) for all census tracts within LA County. "Cold-spots" were defined as clusters of census tracts that had significantly lower values than the global mean value for all census tracts within LA County. Census tracts that were not portrayed as hot-spots or cold-spots contained variable values that were not statistically different from the global mean value for all census tracts.

Ethical Considerations

This study was reviewed by the institutional review board at the University of California, Davis and was deemed exempt.

RESULTS

Descriptive Statistics

As of 2008, 915 of 2,054 (45 %) census tracts in Los Angeles County had at least one community pharmacy. OTC syringe-selling pharmacies were present within 247 of these 915 census tracts (27 %) or 12 % of all LA County census tracts (247/2,054). Fifty-one percent of the population within all LA County census tracts was White, 46.3 % Hispanic, 13.0 % Asian, and 8.7 % African American. One quarter of the population was less than 18 years of age (25.6 %), and 26.2 % had less than a high school education. The median age of residents in LA census tracts was 34.5 years. The median annual household income was $59,635, and 3.9 % of households received public assistance (Table 1).

Unadjusted Regression

In unadjusted logistic regression analyses, the total population size of the census tract residents, median age, percent of each race/ethnicity, percent under 18 years of age, percent foreign born, percent with less than a high school education, percent living in poverty, percent of households that received public assistance, and percent

TABLE 1 Sociodemographic composition of Los Angeles County census tracts, 2005–2009 (*N*=2,054)

Characteristic of census tract residents	Mean (SD)	Median (IQR)
Percent African American	8.7 (14.38)	3.3 (7.84)
Percent White	51.1 (21.47)	51.0 (32.65)
Percent Hispanic/Latino	46.3 (30.08)	43.6 (54.90)
Percent Asian	13.0 (15.47)	7.99 (13.25)
Percent foreign born	35.14 (15.24)	35.25 (23.16)
Percent <18 years of age	25.6 (8.04)	25.81 (9.84)
Percent single-parent household	29.1 (16.38)	27.65 (23.76)
Percent with less than high school education	26.2 (19.24)	23.17 (33.02)
Percent Spanish language in household	38.3 (27.86)	31.64 (47.25)
Percent living in poverty	15.2 (11.69)	11.92 (15.87)
Median annual household income (USD)	59,635 (30,210.6)	53,431 (36,494)
Annual income per capita (USD)	27,706 (19,556.8)	21,383 (20,285)
Percent of households that received public assistance	3.9 (4.14)	2.57 (4.67)
Percent unemployed	7.9 (4.16)	7.31 (4.89)
Total population	4,764 (1,854.85)	4,583.5 (2,365)
Median age (years)	34.5 (7.09)	34.0 (10.0)
Population density per square mile	12,588 (10,652.33)	9,984.14 (10,325)

SD standard deviation, *IQR* interquartile range, *USD* United States Dollars

unemployed were significantly associated with the presence of a community pharmacy within LA County census tracts (Table 2).

Using Poisson regression analyses, the percent of residents who were Latino, percent foreign born, percent with less than a high school education, percent of households that received public assistance, percent single-parent households, and population density were significantly negatively associated with the number of OTC syringe-selling pharmacies within LA County census tracts (Supplemental Table).

Multivariable Regression

In model 1, total population size, percent of population under 18 years of age, percent of households that received public assistance, and median age were associated with the probability that a community pharmacy was present in LA County census tracts (Table 2). For each 1,000-person increase in the total population of a census tract, the odds were 23 % higher that a community pharmacy was present (adjusted odds ratio (AOR) 1.23; 95 % confidence interval (CI), 1.17, 1.29). For each one percentage point increase in the percent of the population that was under 18 years of age, the odds were 4 % lower that a pharmacy was present within LA County census tracts (AOR, 0.96; 95 % CI, 0.95, 0.98) (Table 2, model 1). In model 2, total population size, median age, and percent of households that received public assistance were associated with the presence of community pharmacy. For each 1-year increase in median age, the odds were 3 % higher that a pharmacy was present within LA census tracts (AOR, 1.03; 95 % CI, 1.01, 1.05). For each one percentage point increase in the percent of households that received public assistance, the odds were 3 % lower that a community pharmacy was present within census tracts (AOR, 0.97, 95 % CI, 0.94, 0.99).

Using multivariable Poisson regression analyses, none of the sociodemographic variables were independently associated with the number of OTC syringe-selling pharmacies (Supplemental Table).

TABLE 2 Factors associated with presence of a community pharmacy within Los Angeles County census tracts (*N*=2,054), 2008

Characteristic of census tract residents	Unadjusted odds ratio (95 % CI)	Model 1[a] adjusted odds ratio (95 % CI)	Model 2[b] adjusted odds ratio (95 % CI)
Total population (by 1,000s)	1.19 (1.13, 1.25)	1.23 (1.17, 1.29)	1.22 (1.16, 1.28)
Percent African American	0.99 (0.986, 0.998)	0.99 (0.98, 1.00)	
Percent White	1.005 (1.001, 1.009)	0.99 (0.99, 1.00)	
Percent Latino	0.99 (0.989, 0.995)		
Percent Asian	1.01 (1.01, 1.02)	0.99 (0.99, 1.01)	
Percent foreign born	1.00 (1.00, 1.01)		
Percent <18 years old	0.96 (0.95, 0.97)	0.96 (0.95, 0.98)	
Percent less than high school education	0.99 (0.98, 0.99)	0.99 (0.98, 1.00)	
Percent living in poverty	0.987 (0.979, 0.995)	1.01 (1.00, 1.02)	
Percent unemployed	0.974 (0.953, 0.995)	1.00 (0.98, 1.03)	
Median annual household income ($1,000)	0.98 (0.95, 1.01)		
Percent of households that received public assistance	0.95 (0.93, 0.97)	0.99 (0.96, 1.03)	0.97 (0.94, 0.99)
Single-parent household	1.0 (0.99, 1.00)		
Population density per square mile	1.0 (0.99, 1.01)		
Median age	1.03 (1.02, 1.04)	1.00 (0.98, 1.03)	1.03 (1.01, 1.05)

CI confidence interval

[a]Model 1 includes all covariates that were significant in unadjusted analyses, with the exception of percent Latino, which was highly correlated with percent of residents with less than a high school education.

[b]For model 2, based on the literature, we assessed potential confounding for all sociodemographic variables in bivariate analyses. Covariates that produced a 5 % change in effect for the association between total population and pharmacy presence (i.e., confounded the total population—pharmacy presence relationship) were included in multivariable model 2. The percent of population under 18 years was also a confounder but was dropped since it was correlated with median age

Spatial Analysis Results

Descriptive Map We developed a reference basemap of LA County Service Planning Areas (SPAs) that displays the spatial distribution of community pharmacies not registered to sell syringes OTC (*N*=1,354) and pharmacies registered to sell syringes OTC (*N*=269) in 2008 (Figure 1).

Incremental Spatial Autocorrelation The local distance at which spatial clustering was most intense for the total population in a census tract was 11,000 m (6.8 miles) (*Z* score, 12.9; $p<0.001$). The distances at which clustering was most intense were similar for percent of population that received public assistance (11,500 m; *Z* score 79.0; $p<0.001$), median age (10,000 m; *Z* score, 70.4; $p<0.001$), and percent <18 years of age (12,000 m; *Z* score, 97.4; $p<0.001$). We obtained comparable distances for the outcome variable (pharmacy presence) and the remaining explanatory variables (data not shown). To conduct hot-spot analyses at the same spatial scale across variables, we used 11,000 m as the distance parameter (statistical significance remained at $p<0.05$ for all outcomes and explanatory variables at this distance).

Hot-Spot Analyses Hot-spot analyses revealed statistically significant clusters of community pharmacies in the West, Metro, San Fernando, and San Gabriel SPAs of

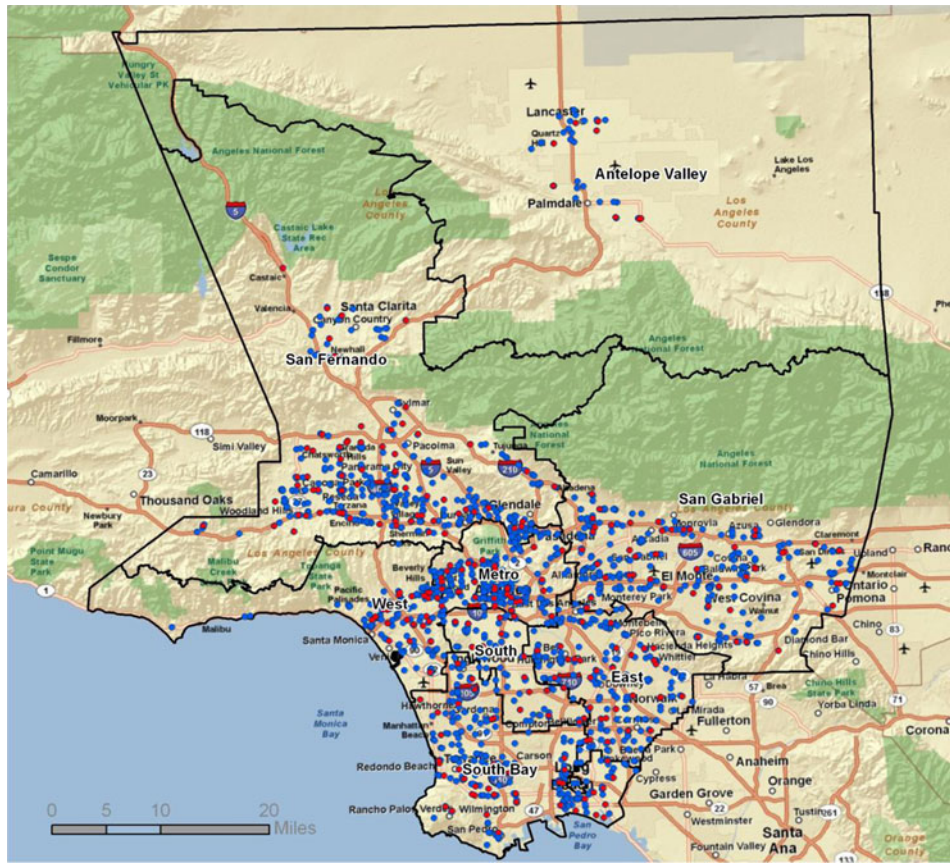

FIGURE 1. Basemap of Los Angeles County, California, 2008. Sub-county boundaries represent Service Planning Areas (*named with white halos*). *Blue points* represent all pharmacies not registered to sell syringes over-the-counter (N=1,354). *Red points* represent all pharmacies registered to sell syringes over-the-counter (N=269).

LA County. There were clusters of OTC syringe-selling pharmacies in the West, San Fernando, and South Bay SPAs (Figure 2a, b). Hot-spot clusters for total population, percent of the residents who were <18 years of age, percent that received public assistance, and median age are portrayed in Figure 2c–f. Hot-spot clusters for community pharmacies were located in close proximity to hot-spot clusters for older populations and were distant from hot-spot clusters that had higher percentages of households that received public assistance. Cold-spot clusters for OTC syringe-selling pharmacies were located in the Metro, South, South Bay, and East SPAs.

DISCUSSION

Several sociodemographic factors were independently associated with the presence of community pharmacies in LA County census tracts. Census tracts with larger population sizes and older populations had *higher* odds that community pharmacies were present within their boundaries, findings which concurred with earlier studies.[28,29] Additionally, census tracts that had higher percentages of households on public assistance had *lower* odds of having pharmacies within their boundaries. The associations of larger and older populations with pharmacy presence likely reflected market trends to place pharmacies

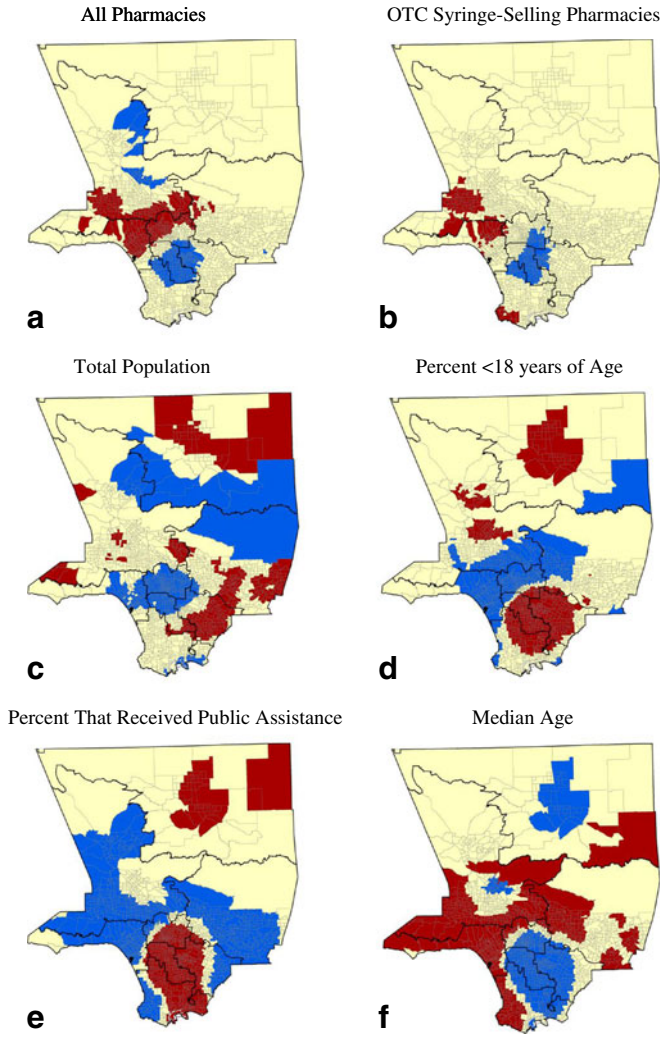

FIGURE 2. Statistically significant clusters of all pharmacies (**a**), pharmacies that sold syringes over-the-counter (**b**), and sociodemographic variables (**c**–**f**) within Los Angeles County census tracts in 2008. Locations with *red shading* denote hot-spot clusters that had significantly higher values than the global mean value for all census tracts in LA County ($p<0.05$). *Yellow polygons* denote census tracts that had values that were not statistically different from the global mean value. Polygons with *blue shading* denote cold-spots that had significantly lower values than the global mean ($p<0.05$). Threshold distance 11,000 m (6.8 miles). Geographic coordinate system: NAD 1983, Projection: California Teale Albers.

in locations that were likely to have a larger customer base (i.e., higher demand) for pharmacies.[29] Most businesses, including pharmacies, conduct market analyses of neighborhoods to determine potential new store locations. The website of a leading pharmacy chain indicated that the key local characteristics for new pharmacy sites include busy intersections, drive-through access, and a population base of at least 20,000 residents.[37] Lower availability of community pharmacies in areas with higher percentages of households that received public assistance may reflect an important disparity. Households that received public assistance are likely poorer and have individuals who are in poorer health and therefore also have higher demand for pharmacies.

Using multivariable Poisson regression analyses, none of the sociodemographic variables we tested were significantly associated with the number of OTC syringe-selling pharmacies within LA County census tracts. Decisions surrounding the initial construction and opening of pharmacies may well have been influenced by sociodemographic factors within census tracts. However, legislation that authorized OTC syringe sales within LA pharmacies in 2005 came years after initial market entry for most pharmacies. Thus, political and social factors, and the personal perspectives of pharmacy directors, were more likely to affect the decision to register pharmacies in the OTC syringe sales program than the sociodemographic factors that originally influenced the opening of pharmacies as a potentially good business.

We determined that communities in LA with diverse racial/ethnic and sociodemographic characteristics had similar levels of availability of OTC syringe-selling pharmacies. HIV transmission occurs in a diverse array of communities; access to OTC syringe sales is needed in all of the communities. The fact that only 12 % of census tracts in LA County had pharmacies registered to sell OTC syringes in 2008 indicates there is room for improvement. New legislation in California enacted in January 2012, which states that local approval of an OTC syringe sales program is no longer required, might encourage more pharmacies to participate in this important intervention to prevent HIV and other bloodborne pathogens.

Through spatial analysis, we identified locations within LA County with statistically significant clusters of pharmacies. While community pharmacies are available in nearly half of all LA County census tracts, there were clusters of significantly higher numbers of pharmacies and OTC syringe-selling pharmacies in Western, Central, and Southern LA County. Hot-spot clusters for higher median age (Figure 2f) overlapped a similar region of West Central LA County where clusters of pharmacies were prevalent. In contrast, clusters of pharmacies were distant from clusters of residents with a high percentage of lower SES (e.g., percent that received public assistance). The clustering patterns help explain the geographic component of the statistical associations between median age, SES, and pharmacy presence in regression analyses. Cold-spot clusters of OTC syringe-selling pharmacies (i.e., significantly lower counts) within Central LA County may be of particular concern when considering access to sterile syringes and prevention of syringe-mediated transmission of HIV and other bloodborne pathogens. Figure 2 could be used by public health decision makers in LA to target areas in need of additional pharmacy access and OTC syringe-selling pharmacies.

The present study had several limitations. First, the cross-sectional design of the study precluded assessment of temporal and causal relationships. Second, the ecological design precluded assessment of individual level associations. Estimates for explanatory variables obtained from the American Community Survey data (U.S. Census Bureau) represented data from a 5-year span. Fluctuations during this time frame were possible, especially for economic indicators. While such fluctuations may have influenced the true estimate for any 1 year, the 5 years of data collection bolstered the sample size and stability of estimates on the census tract level across LA County, even in census tracts that had smaller populations.

CONCLUSION

Our combined statistical and spatial analyses provided an innovative approach to assess the sociodemographic and geographic factors associated with the presence of community pharmacies and pharmacies that participated in OTC syringe sales. Such an approach can inform public health officials and policymakers to better understand the factors that are

associated with the prevalence of pharmacies and to identify locations where pharmacy access may be particularly low. While only 12 % of LA County census tracts had pharmacies that were registered to sell syringes OTC in 2008, new syringe access legislation in California could foster participation by larger numbers of pharmacies.

ACKNOWLEDGMENTS

The authors would like to thank Lauren Scott and Lauren Rosenhein Bennett for technical assistance with the hot-spot cluster analysis methodology. This study was supported by doctoral studies fellowship funding (Stopka) through the Graduate Group in Epidemiology, University of California, Davis.

REFERENCES

1. Negru DS, Diaconescu M, Petculescu AM, Bild V. Community pharmacy—ideal location to screen and monitor hypertensive patients. *Rev Med Chir Soc Med Nat Iasi*. 2010; 114(3): 904–909.
2. Skiles MP, Cai J, English A, Ford CA. Retail pharmacies and adolescent vaccination—an exploration of current issues. *J Adolesc Health*. 2011; 48(6): 630–632.
3. Fitzgerald N, Watson H, McCaig D, Stewart D. Developing and evaluating training for community pharmacists to deliver interventions on alcohol issues. *Pharm World Sci*. 2009; 31(2): 149–153.
4. Deas C, McCree DH. Pharmacists and HIV/AIDS prevention: review of the literature. *J Am Pharm Assoc*. 2003; 50(3): 411–415.
5. Fuller C, Galea S, Caceres W, Blaney S, Sisco S, Vlahov D. Multilevel community-based intervention to increase access to sterile syringes among injection drug users through pharmacy sales in New York City. *Am J Public Health*. 2007; 97(1): 117–124.
6. Rudolph AE, Standish K, Amesty S, et al. A community-based approach to linking injection drug users with needed services through pharmacies: an evaluation of a pilot intervention in New York City. *AIDS Educ Prev*. 2010; 22(3): 238–251.
7. Deibert R, Goldbaum G, Parker T, et al. Increased access to unrestricted pharmacy sales of syringes in Seattle-King County, Washington: structural and individual-level changes, 1996 versus 2003. *Am J Public Health*. 2006; 96(8): 1347–1353.
8. Valleroy L, Weinstein B, Jones T, Groseclose S, Rolfs R, Kassler W. Impact of increased legal access to needles and syringes on community pharmacies' needle and syringe sales—Connecticut, 1992–1993. *J Acquir Immune Defic Syndr Hum Retrovirol*. 1995; 10(1): 73–81.
9. Burris S, Welsh J, Ng M, Li M, Ditzler A. State syringe and drug possession laws potentially influencing safe syringe disposal by injection drug users. *J Am Pharm Assoc (Wash)*. 2002; 42(6 Suppl 2): S94–S98.
10. Singer M, Baer H, Scott G, Horowitz S, Weinstein B. Pharmacy access to syringes among injecting drug users: follow-up findings from Hartford, Connecticut. *Public Health Rep*. 1998; 113(Suppl 1): 81–89.
11. Junge B, Vlahov D, Riley E, Huettner S, Brown M, Beilenson P. Pharmacy access to sterile syringes for injection drug users: attitudes of participants in a syringe exchange program. *J Am Pharm Assoc (Wash)*. 1999; 39(1): 17–22.
12. Compton W, Horton J, Cottler L, et al. A multistate trial of pharmacy syringe purchase. *J Urban Health*. 2004; 81(4): 661–670.
13. Fuller C, Ahern J, Vadnai L, et al. Impact of increased syringe access: preliminary findings on injection drug user syringe source, disposal, and pharmacy sales in Harlem, New York. *J Am Pharm Assoc (Wash)*. 2002; 42(6 Suppl 2): S77–S82.
14. Bluthenthal R, Kral A, Gee L, Erringer E, Edlin B. The effect of syringe exchange use on high-risk injection drug users: a cohort study. *AIDS*. 2000; 14(5): 605–611.

15. Hurley S, Jolley D, Kaldor J. Effectiveness of needle-exchange programmes for prevention of HIV infection. *Lancet*. 1997; 349(9068): 1797–1800.
16. MacDonald M, Law M, Kaldor J, Hales JGD. Effectiveness of needle and syringe programs for preventing HIV transmission. *Int J Drug Policy*. 2003; 14(5/6): 353–357.
17. Pouget E, Deren S, Fuller C, et al. Receptive syringe sharing among injection drug users in Harlem and the Bronx during the New York State Expanded Syringe Access Demonstration Program. *J Acquir Immune Defic Syndr*. 2005; 39(4): 471–477.
18. Wodak A, Cooney A. Do needle syringe programs reduce HIV infection among injecting drug users: a comprehensive review of the international evidence. *Subst Use Misuse*. 2006; 41(6–7): 777–813.
19. Neaigus A, Zhao M, Gyarmathy V, Cisek L, Friedman S, Baxter R. Greater drug injecting risk for HIV, HBV, and HCV infection in a city where syringe exchange and pharmacy syringe distribution are illegal. *J Urban Health*. 2008; 85(3): 309–322.
20. Friedman S, Perlis T, Des Jarlais D. Laws prohibiting over-the-counter syringe sales to injection drug users: relations to population density, HIV prevalence, and HIV incidence. *Am J Public Health*. 2001; 91(5): 791–793.
21. Holmberg SD. The estimated prevalence and incidence of HIV in 96 large US metropolitan areas. *Am J Public Health*. 1996; 86(5): 642–654.
22. Jones T, Coffin P. Preventing blood-borne infections through pharmacy syringe sales and safe community syringe disposal. *J Am Pharm Assoc (Wash)*. 2002; 42(6 Suppl 2): S6–S9.
23. Reich W, Compton W, Horton J, et al. Injection drug users report good access to pharmacy sale of syringes. *J Am Pharm Assoc (Wash)*. 2002; 42(6 Suppl 2): S68–S72.
24. Riley E, Safaeian M, Strathdee S, et al. Comparing new participants of a mobile versus a pharmacy-based needle exchange program. *J Acquir Immune Defic Syndr*. 2000; 24(1): 57–61.
25. Stopka T, Garfein R, Ross A, Truax S. Increasing syringe access and HIV prevention in California: findings from a survey of local health jurisdiction key personnel. *J Urban Health*. 2007; 84(1): 116–125.
26. Garfein RS, Stopka TJ, Pavlinac PB, et al. Three years after legalization of nonprescription pharmacy syringe sales in California: where are we now? *J Urban Health*. 2010; 87(4): 576–585.
27. Riley ED, Kral AH, Stopka TJ, Garfein RS, Reuckhaus P, Bluthenthal RN. Access to sterile syringes through San Francisco pharmacies and the association with HIV risk behavior among injection drug users. *J Urban Health*. 2010; 87(4): 534–542.
28. Kaplan RS, Leinhardt S. The spatial distribution of urban pharmacies. *Med Care*. 1975; 13(1): 37–46.
29. Schommer JC, Singh RL, Cline RR, Hadsall RS. Market dynamics of community pharmacies in Minnesota. *Res Soc Adm Pharm*. 2006; 2(3): 347–358.
30. Doucette WR, Brooks JM, Sorofman BA, Wong H. Market factors and the availability of community pharmacies. *Clin Ther*. 1999; 21(7): 1267–1279. discussion 1266.
31. Cooper HL, Bossak BH, Tempalski B, Friedman SR, Des Jarlais DC. Temporal trends in spatial access to pharmacies that sell over-the-counter syringes in New York City health districts: relationship to local racial/ethnic composition and need. *J Urban Health*. 2009; 86(6): 929–945.
32. United States Census Bureau. Census Tracts and Block Numbering Areas. Available at: http://www.census.gov/geo/www/cen_tract.html. Accessed November 28, 2011.
33. United States Census Bureau. American FactFinder. Available at: http://factfinder.census.gov. Accessed August 3, 2011.
34. California Department of Public Health. Environmental Health Investigations Branch. Available at: http://www.ehib.org/page.jsp?page_key=137. Accessed August 5, 2011.
35. Ord J, Getis A. Local spatial autocorrelation statistics: distributional issues and an application. *Geogr Anal*. 1995; 27: 286–306.
36. Mitchell A. *The ESRI Guide to GIS Analysis Volume 2: Spatial Measurements and Statistics*, vol. 2. Redlands, CA: ESRI Press; 2005.
37. Walgreen Drug Store Location Information. Available at: http://www.walgreens.com/marketing/contactus/corporate.jsp. Accessed November 23, 2011.