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Original investigation

# Is There a Relationship Between the Concentration of Same-Sex Couples and Tobacco Retailer Density?

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## Abstract

**Background:** Tobacco use is markedly higher among lesbian, gay, and bisexual populations than heterosexuals. Higher density of tobacco retailers is found in neighborhoods with lower income and more racial/ethnic minorities. Same-sex couples tend to live in similar neighborhoods, but the association of this demographic with tobacco retailer density has not been examined.

**Methods:** For a national sample of 97 US counties, we calculated the number of tobacco retailers per 1000 persons and rates of same-sex couples per 1000 households in each census tract ( $n = 17\,941$ ). Using spatial regression, we examined the association of these variables in sex-stratified models, including neighborhood demographics and other environmental characteristics to examine confounding.

**Results:** Results from spatial regression show that higher rates of both female and male same-sex couples were associated with a higher density of tobacco retailers. However the magnitude of this association was small. For female couples, the association was not significant after controlling for area-level characteristics, such as percent black, percent Hispanic, median household income, the presence of interstate highways, and urbanicity, which are neighborhood correlates of higher tobacco retailer density. For male couples, the association persisted after control for these characteristics.

**Conclusion:** Same-sex couples reside in areas with higher tobacco retailer density, and for men, this association was not explained by neighborhood confounders, such as racial/ethnic composition and income. While lesbian, gay, and bisexual disparities in tobacco use may be influenced by neighborhood environment, the magnitude of the association suggests other explanations of these disparities remain important areas of research.

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## Introduction

The lesbian, gay, and bisexual (LGB) population is routinely found to have a large, persistent disparity in tobacco use.<sup>1</sup> In the 2012–2013 US Adult Tobacco Survey, the prevalence of any tobacco use among

LGB adults was 36% compared to 24% for heterosexual adults.<sup>2</sup> Transgender adults also have high tobacco use prevalence<sup>3</sup> but given the lack of neighborhood-level data are not discussed further here. Explanations for LGB tobacco use disparities typically focus on

discrimination, structural stigma, and resulting stress.<sup>4</sup> Media influence is another prominent explanation: LGB populations report high exposure<sup>5,6</sup> and receptivity<sup>7</sup> to targeted tobacco industry marketing.<sup>8</sup> Tobacco use is also normative in LGB print<sup>9</sup> and entertainment<sup>10</sup> media. Other environmental influences have received too little attention, including the retail environment and concentration of stores that sell tobacco products (“tobacco retailers”) in neighborhoods. Emerging evidence shows that LGB people have unique patterns of migration and neighborhood selection.<sup>11–13</sup> Yet, a systematic review of the literature reveals no research examining whether tobacco retailers are more or less present in places where LGB people are more likely to live.<sup>4</sup>

Theories of neighborhood health disparities applied to tobacco retailer density suggest that tobacco retailers represent a physical presence that can hinder health by promoting ready access to tobacco products. Additionally these physical locations provide a channel for tobacco industry marketing and decrease search costs for tobacco products.<sup>14,15</sup> Tobacco retailers provide ubiquitous cues to smoke.<sup>16–19</sup> Proximity to tobacco retailers is associated with decreased success in tobacco use cessation,<sup>20,21</sup> although this may be true only in lower socioeconomic status neighborhoods.<sup>22</sup> Tobacco retailer density has been associated with smoking behaviors<sup>23–25</sup> and with youth initiation,<sup>26</sup> however, some findings are mixed.<sup>21,25,27</sup>

There are both regional and local patterns of same-sex couple migration and neighborhood selection in the United States.<sup>11</sup> (We use the term same-sex couple to discuss migration and other aspects of research using census data, as individual sexual orientation is not ascertained in the US Census. In discussing broader literature regarding sexual orientation identity, we use LGB.) Indeed, similar levels of neighborhood segregation exist for same-sex couple households as for household income, although less than exist for race.<sup>12</sup> Same-sex couples, like other couples, tend to migrate toward regions with better jobs, more temperate weather, lower crime, and cultural amenities.<sup>28,29</sup> Yet, the political environment also matters for same-sex couples, with greater concentrations of same-sex couples in less conservative places<sup>30,31</sup> and in regions with higher concentrations of other same-sex couples.<sup>29</sup> Within these regions, however, neighborhood selection can be influenced by several factors: Qualitative research finds strong evidence of the importance of other same-sex couples in neighborhood selection.<sup>32,33</sup> These patterns of neighborhood selection differ somewhat by sex, with greater concentrations of same-sex male couples into fewer, more dense neighborhoods than for female same-sex couples.<sup>13</sup> Same-sex couples, and male couples in particular, were more likely than opposite-sex couples to live in urban area zip codes, and in more racially/ethnically diverse zip codes with lower median household income.<sup>11</sup>

Existing evidence suggests racial minority and lower income neighborhoods have a disproportionately higher density of tobacco retailers. The first report of a disparity in tobacco retailer density found greater density of tobacco retailers in lower socioeconomic status and higher proportion black census tracts by quartile in a single New York county.<sup>34</sup> Similar findings have been identified in Iowa;<sup>35</sup> New Jersey with added disparities for tracts with more Hispanic residents;<sup>36–39</sup> New York state;<sup>40</sup> for poverty and Hispanic residents in Chicago, Illinois;<sup>41</sup> and, for Hispanic residents and lower income, Omaha, Nebraska.<sup>42</sup> In one national study, tobacco retailer density was related to Hispanic ethnicity, poverty, and other indicators of lower socioeconomic status.<sup>43</sup>

In this national study, we sought to identify if same-sex couples live in areas with higher tobacco retailer density and to assess if the association is independent from other neighborhood characteristics.

## Methods

### Data Sources: Tobacco Retailers

This is a secondary analysis of data from Advancing Science and Policy in the Retail Environment, funded by the National Cancer Institute’s State and Community Tobacco Control Research Initiative. Advancing Science and Policy in the Retail Environment is a consortium of the Center for Public Health Systems Science at Washington University in St. Louis, the Stanford Prevention Research Center, and the University of North Carolina Gillings School of Global Public Health. The selection of counties for a nationally representative sample of US tobacco retailers was based on all counties in the contiguous 48 states. The sample of counties was selected using a probability proportionate to size method developed by Chromy.<sup>44</sup> This resulted in 97 unique counties (Figure 1) in which 26% of the US population (79 million people) resides.<sup>45</sup>

Retailer address and phone data were purchased in 2012 from two sources: North American Industry Classification System (NAICS) Association and ReferenceUSA. We requested lists of stores with primary or secondary classification as one of the following: supermarkets and other grocery (except convenience) stores; convenience stores; tobacco stores; gasoline stations with convenience stores; warehouse clubs and supercenters; news dealers and newsstands; beer, wine, and liquor stores; pharmacies and drug stores; discount department stores; and other gasoline stations. Vape shops and e-cigarette retailers are classified in multiple different NAICS codes, often as tobacco stores; where they were identified in the store types above they were included in this study.

Data cleaning removed stores without addresses, removed punctuation and spaces, removed suite numbers, replaced PO boxes, and removed non-street address (eg, airport) stores. The cleaning process eliminated discount department stores other than Walmart, separate stores within Walmarts (eg, Walmart Bakery), retained only the top 50 pharmacy chains, and removed stores known to not sell tobacco (eg, state-controlled liquor stores, Aldi, Trader Joe’s, Whole Foods). This was conducted separately for NAICS Association and ReferenceUSA lists. Lists were then merged by zip code and address and de-duplicated. We retained approximately 58% of the initial address lists for the 97 counties after de-duplicating addresses within and between lists.

A national review of food stores found that commercial lists like those used in this study are a viable data source for large-scale studies<sup>46</sup> and the use of these commercial databases has been validated using ground truthing in a state without tobacco retail licensing.<sup>47</sup> Previous research has also validated the use of commercial lists to measure tobacco retailer density, finding that commercial lists did not show disproportionate under- or over-reporting of state-licensed tobacco retailers by area demographics in Washington State.<sup>43</sup>

### Data Sources: Same-Sex Couples

Data on same-sex couples came from the 2010 US Census, which included a question on relationship to the owner or renter of the household (“How is this person related to Person 1?”). By aggregating responses of “Husband or wife” and “Unmarried partner” and comparing to the sex of each person, same-sex couples were computed by the Census Bureau as a subcategory of unmarried partner households, where “an adult who is unrelated to the householder, but shares living quarters and has a close personal relationship with the householder” is present.<sup>48</sup> Census 2010 includes same-sex couples

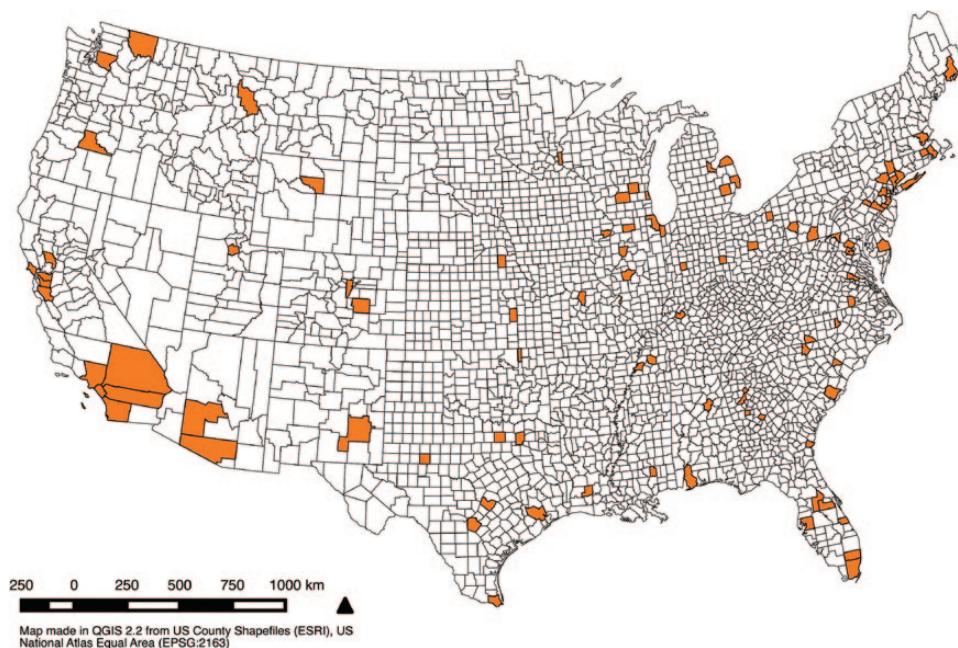


Figure 1. Counties included in sampling frame,  $n = 97$ .

as unmarried partners even when they are legally married and live in states with provisions for same-sex marriage or other legal recognition. An important questionnaire design issue has been identified in Census 2010 that caused misclassification of sex in door-to-door data collection by census workers, thereby causing some estimates of same-sex couples to exceed the total possible number.<sup>49,50</sup> To correct for this error, we applied a state-level error-rate correction developed and recommended by Gates.<sup>51</sup>

#### Data Sources: Census Tract Characteristics

Census tract demographic variables on race/ethnicity and total population were available from Census 2010.<sup>52</sup> We used the Census Bureau's American Community Survey, 5-Year Estimates, 2008–2012, for income.<sup>53</sup> American Community Survey data were unavailable for eight census tracts.

#### Measures

Following earlier research,<sup>34,37,39,40,42</sup> we conducted all analyses at the census tract level. Census tracts represent the best available area unit to reflect neighborhood processes for our purposes, having been designed to define homogenous community areas,<sup>54</sup> and provide a large enough population to also analyze small subgroups (ie, same-sex couples). Measure definitions are reported in Table 1 by their role as dependent variable, independent variables, and explanatory variables. Percentages were divided by 10 (eg, 12% = 1.2) for scaling purposes.

Tobacco retailer density was computed as the number of tobacco retailers divided by 1000 population in a given census tract. Because of non-normality in the distribution of tobacco retailer density (skew: 7.9,  $P = .02$ ; kurtosis: 139.3,  $P = .04$ ), we tested various transformations with an offset of 0.3 to see which transformation's Pearson correlation with same-sex couple rates best approximated a nonparametric correlation coefficient between the female and male same-sex couple household rates with tobacco retailer density, respectively,  $r_{s(n=17,675)} = 0.09$  ( $P < .001$ ) and  $0.14$  ( $P < .001$ ). Of

these, a square-root transformation provided the best option (skew: 1.8,  $P = .02$ ; kurtosis: 9.5,  $P = .04$ ). We then ran analyses using both transformed and untransformed dependent variables. As patterns of significance and direction were not sensitive to the transformation, like Loomis and colleagues,<sup>40</sup> we left our dependent variable untransformed so as to facilitate interpretation.

There are multiple ways to calculate the density of same-sex couples, and they are very highly correlated.<sup>30</sup> We choose to follow an approach used by Walther *et al.*,<sup>31</sup> that calculates a same-sex couple rate per 1000 coupled households, shown for male couples:

$$\left( \frac{\text{Number of male same sex couple households}}{\text{Number of same sex couple households} + \text{Number of opposite sex unmarried couple households} + \text{Number of married couple households}} \right) \times 1000$$

Data from an earlier study<sup>55</sup> showed that, particularly in suburban and rural areas, retailers clustered at exits along interstate highways. Thus we created a dichotomous measure of presence of an interstate highway within a tract.<sup>56</sup> We used US Department of Agriculture's 2013 Rural–Urban Continuum Codes for county urbanicity.<sup>57</sup> Data management was conducted in SPSS v. 22 (IBM, Chicago, Illinois) and QGIS v. 2.2 ([www.qgis.org](http://www.qgis.org)). Data analysis was conducted with GeoDa v. 1.6.0 (Arizona State University, Tempe, Arizona).

#### Analysis Strategy

Because some census tracts are not residential or have very few people, rates of demographic characteristics can be unstable. We thus excluded census tracts with fewer than 250 households ( $n = 266$  tracts) and retained 17 675 tracts (or 98.5% of the original sample). We then excluded eight tracts for which no economic data were available. All model results are reported using  $n = 17 667$  tracts.

**Table 1.** Key Measures and Definitions

| Variable  | Item details  |
|---|---|
| <b>Dependent variable</b>                                       |   |
| Tobacco retailer density  | Total number of tobacco retailers in a census tract divided by total population and multiplied by 1000                              |
| <b>Block 1: independent variable</b>                            |   |
| Same-sex couple households, female, per 1000 coupled households | Number of female householders with female partner divided by total married and unmarried coupled households and multiplied by 1000  |
| Same-sex couple households, male, per 1000 coupled households   | Number of male householders with male partner divided by total married and unmarried coupled households and multiplied by 1000      |
| <b>Block 2: explanatory variables</b>                           |   |
| Percentage black population in 10-point increments              | Percentage of the total population reporting black or African-American race alone or in combination with another race divided by 10 |
| Percentage hispanic ethnicity in 10-point increments            | Percentage of the total population reporting Hispanic or Latino origin divided by ten   |
| Median annual household income, adjusted to 2012 USD            | Median household income in the past 12 months, in 2012 inflation-adjusted dollars divided by 1000                                   |
| <b>Block 3: explanatory variables</b>                           |   |
| Presence of interstate highway                                  | Dichotomous (0 = No, 1 = Yes)   |
| Rurality  | County-level ordinal US Department of Agriculture urban–rural continuum codes (range 1–9, from most to least urban)                 |

Given gendered differences in spatial patterns of same-sex couple migration, we stratified all analyses by sex of same-sex couple. When statistically modeling phenomena with a spatial component, key tenets of linear regression are violated by nonindependence of observations based on shared characteristics due to their proximity.<sup>58</sup> We identified spatial clustering of the dependent variable (Moran's  $I = 0.10$ ,  $P = .001$ ). Indeed, ordinary least squares regression residuals showed significant spatial clustering (Female: Moran's  $I = 0.08$ ,  $P = .001$ ; Male: Moran's  $I = 0.07$ ,  $P = .001$ ). Therefore, we used spatial regression models to account for spatial dependence in our data. We examined models with multiple contiguity weights matrices, selecting a second order queen weights matrix. Two common approaches to spatial dependence include spatial lag and spatial error models. Spatial lag models address the influence of the dependent variable in one location on nearby locations. Spatial error models address the influence of omitted independent variables over space. Past tobacco retailer density analyses have used a spatial lag approach.<sup>39,40</sup> Lagrange Multiplier Tests indicated the spatial error model was more appropriate for our data. We set all critical values at  $\alpha = 0.05$  and used two-tailed tests. Finally, we graphically displayed results using a dot and 95% confident interval plot, using Jenks natural breaks in the data.<sup>59</sup>

### Modeling Approach

We selected variables for model building based on the existing literature of tobacco retailer density and same-sex couple demography discussed above. We approached modeling in three blocks, stratifying by sex. First, we entered the same-sex couple household rates, defined as same-sex coupled households per 1000 coupled households. We then added tract-level characteristics for income and racial/ethnic composition. Lastly, we added variables for the presence of interstates and rurality, as indicated by US Department of Agriculture Rura–Urban Continuum Codes (Table 1). We compared models using changes in  $R^2$  and likelihood ratio tests. Lastly, we conducted sensitivity analyses for edge effects (ie, a boundary problem in spatial analysis), where the lack of data on neighboring units at the borders of the area under study can influence results.<sup>60</sup>

As there were no human subjects, the UNC Office of Human Research Ethics exempted this research from further review (#13–2602).

## Results

### Same-Sex Couples and Tobacco Retailer Density

At the census tract level, the average density was 1.27 tobacco retailers per 1000 population (range 0 to 50.96,  $SD = 1.55$ , median = 0.96). The average rate of same-sex households per 1000 coupled households was 6.66 for same-sex female couples (range 0 to 68.74,  $SD = 5.96$ , median = 5.21) and 10.07 for same-sex male couples (range 0 to 562.35,  $SD = 23.77$ , median = 3.26).

Results from spatial regression show that higher rates of both female and male same-sex couple were associated with a higher density of tobacco retailers (Table 2). However, the magnitude of this association was small: For each additional same-sex household per 1000 households, the number of tobacco retailers per 1000 people increased by one one-hundredth. For both sexes, the first model explained only 6% of variance. Figure 2 illustrates the bivariate relationship in natural breaks of same-sex couple rates, showing an increase in density with greater rates of female same-sex couples. Male same-sex couples showed a similar pattern albeit with greater overall density and a possible plateau in density starting with >43 couples per 1000 coupled households. It is of note that the rates of same-sex male couples are much higher than for same-sex female couples as shown in the x-axis.

We examined whether including area-level demographic characteristics of race, ethnicity, and income explained the bivariate association in model 1. For female same-sex couples, the addition of other neighborhood indicators explained the relationship between same-sex couple households and tobacco retailer density. For male same-sex couples, however, a significant positive association of same-sex households and tobacco retailer density was independent of other neighborhood demographics.

A third block of variables looked at if physical area-level characteristics would offer additional explanation of this association. Thus, in this third model, we included variables for the presence of



**Table 2.** Same-Sex Couple Household Rate per 1000 Coupled Households Predicting Tobacco Retailer Density per 1000 Population in Census Tracts (n = 17 667), 97 Counties, United States, Respectively, Stratified by Sex of Couple

| Model         | Variable                            | Female                              |       |                                     | Male                                |       |       |
|---------------|-------------------------------------|-------------------------------------|-------|-------------------------------------|-------------------------------------|-------|-------|
|               |                                     | Estimate                            | SE    | P                                   | Estimate                            | SE    | P     |
| 1             | Constant                            | 1.18                                | 0.03  | <.001                               | 1.17                                | 0.02  | <.001 |
|               | Same-sex couple rate                | 0.01                                | <0.01 | <.001                               | 0.01                                | <0.01 | <.001 |
|               | Lag coefficient, lambda             | 0.44                                | 0.02  | <.001                               | 0.40                                | 0.02  | <.001 |
|               | Overall model                       | R <sup>2</sup> = 0.06; AIC = 64 849 |       |                                     | R <sup>2</sup> = 0.06; AIC = 64 714 |       |       |
| 2             | Constant                            | 1.83                                | 0.06  | <.001                               | 1.71                                | 0.05  | <.001 |
|               | Same-sex couple rate                | <0.01                               | <0.01 | .19                                 | 0.01                                | <0.01 | <.001 |
|               | % Black race (10 points)            | <0.01                               | 0.01  | .82                                 | 0.01                                | 0.01  | .35   |
|               | % Hispanic ethnicity (10 points)    | -0.04                               | 0.01  | <.001                               | -0.03                               | 0.01  | <.001 |
|               | Median household income (1000s)     | -0.01                               | <0.01 | <.001                               | -0.01                               | <0.01 | <.001 |
|               | Lag coefficient, lambda             | 0.43                                | 0.02  | <.001                               | 0.39                                | 0.02  | <.001 |
|               | Overall model                       | R <sup>2</sup> = 0.07; AIC = 64 613 |       |                                     | R <sup>2</sup> = 0.08; AIC = 64 448 |       |       |
| 3             | Constant                            | 1.73                                | 0.08  | <.001                               | 1.57                                | 0.07  | <.001 |
|               | Same-sex couple rate                | <0.01                               | <0.01 | .15                                 | 0.01                                | <0.01 | <.001 |
|               | % Black race (10s)                  | <0.01                               | 0.01  | .83                                 | 0.01                                | 0.01  | .30   |
|               | % Hispanic ethnicity (10s)          | -0.04                               | 0.01  | <.001                               | -0.03                               | 0.01  | <.001 |
|               | Median household income (1000s)     | -0.01                               | <0.01 | <.001                               | -0.01                               | <0.01 | <.001 |
|               | Presence of interstate highway      | 0.26                                | 0.03  | <.001                               | 0.27                                | 0.03  | <.001 |
|               | Rurality level                      | 0.01                                | 0.04  | .70                                 | 0.04                                | 0.03  | .22   |
|               | Lag coefficient, lambda             | 0.43                                | 0.02  | <.001                               | 0.38                                | 0.02  | <.001 |
| Overall model | R <sup>2</sup> = 0.08; AIC = 64 483 |                                     |       | R <sup>2</sup> = 0.08; AIC = 64 348 |                                     |       |       |

AIC = Akaike information criterion, SE = standard error. Using a row-standardized second order (including lower orders) queen weights matrix and a spatial error model.

an interstate and rurality level. These did not fully explain the relationship between male same-sex couples and tobacco retailer density but did offer significant improvements in both models.

The addition of each block of variables significantly improved model fit based on likelihood ratio tests,  $P < .001$ . Nonetheless, our final models explained only a modest amount of variance in the tobacco retailer density, 8%.

### Sensitivity Analysis

To assess the sensitivity of our findings to edge effects, which can influence results in spatial analysis,<sup>60</sup> we re-ran all analyses in a subset of 15 085 tracts, after removing all census tracts at the edges of counties. Our findings were sensitive to the removal of edge tracts. For female same-sex couples, excluding edge tracts, there was a negative association with tobacco retailer density, which is in the opposite direction of our main findings. Estimates became more pronounced: -0.05 in model 1 and -0.07 in models 2 and 3. Significance was maintained between female same-sex couples and tobacco retailer density in each model ( $P < .01$ ). For men, estimates were similar for each model (0.01), but control for tract demographics and physical characteristics resulted in a marginally significant relationship between male same-sex couple rate and tobacco retailer density in models 2 ( $P = .07$ ) and 3 ( $P = .08$ ). Thus, our findings for female same-sex couples show substantive differences when edge tracts are removed while the removal of edge tracts has less influence on our findings for male same-sex couples.

Further examination revealed quantitative differences in edge versus non-edge tracts, all  $P < .01$ : Edge tracts have fewer black residents ( $M = 11\%$  vs.  $15\%$ ), fewer Hispanic residents ( $M = 15\%$  vs.  $29\%$ ), higher median income ( $\$74\ 379$  vs.  $\$63\ 489$ ), lower population density per square mile ( $M = 4737$  vs.  $8895$ ), and a lower same-sex couple household rate than non-edge tracts ( $M = 6.05$

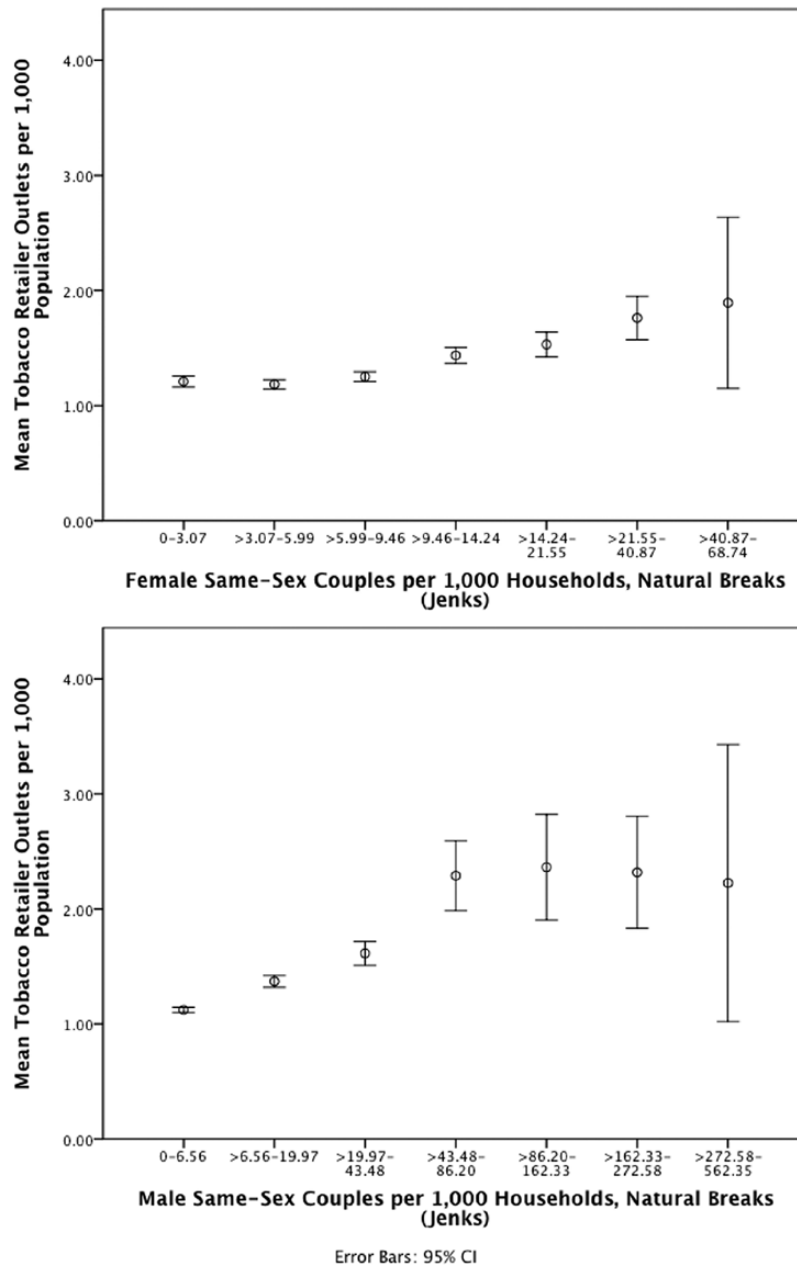
vs.  $6.75$  female and  $8.64$  vs.  $10.53$  male couples per 1000 coupled households). These findings appear to be consistent with historical patterns of residential segregation in urban areas.<sup>61</sup> These sensitivity analyses indicate that we cannot rule out the possibility of edge effects, but differences from the main model may be driven by patterns of residential segregation. Future research using areas with fewer edges (eg, an entire state instead of a sample of noncontiguous counties) is indicated.

## Discussion

### Principal Findings

Same-sex couples tend to live in neighborhoods where tobacco retailer density is greater, and for male same-sex couples this association persists even after adjustments for other neighborhood income, race/ethnicity and other correlates of higher retailer density. An increase of 100 same-sex couple households in the rate of same-sex households was associated with an additional tobacco retailer for every 1000 residents in census tracts. Although the association between the density of same-sex households and tobacco retailers was relatively small, such findings matter to our understanding of population-level influences on health.<sup>62</sup> This study is the first to suggest a role for neighborhoods in understanding the etiology of LGB tobacco-related health disparities.

That the relationship between same-sex couples and tobacco retailer density can be explained by area demographics for female same-sex couples but not for male same-sex couples suggests differences by sex in the mechanisms by which same-sex couple households come to be associated with tobacco retailer density. Two processes may be involved in this. First, retailer density can be explained by theories of organizational ecology,<sup>63</sup> which consider available resources to promote the founding, evolution, and closing



**Figure 2.** Same-sex couples per 1000 partnered households classified by natural breaks (Jenks) and mean number of tobacco retailers per 1000 population, census tracts ( $n = 17\,667$ ), 97 counties, United States, in 2010 and 2012, respectively, by sex of couples.

of retail locations. Neighborhood resources for retailers may be influenced by historical underinvestment in more urban, more black neighborhoods.<sup>64</sup> With fewer large and chain stores, more smaller corner stores may be present.<sup>65,66</sup> Second, neighborhood selection choices of same-sex couples may be related to selection into neighborhoods that, for other reasons, have more tobacco retailer density. Mechanisms could include differences in childrearing (less for male couples)<sup>67</sup> and interest in school quality; in perceived safety of neighborhoods, which may differ by gender,<sup>68</sup> although some studies find no differences for lesbian women and gay men;<sup>69</sup> and, in income (lower for women).<sup>70</sup> There is evidence that LGB people are subject to wage and hiring discrimination, the latter of which may differ by state.<sup>71-73</sup> Same-sex couples are not as wealthy as the popular

imagination holds.<sup>74</sup> Lesbian couples are also affected by gender-based inequity in pay compared to heterosexual couples and gay male couples.<sup>70</sup>

Early research on gay neighborhoods described a process of territorialization, rooted in masculine behavior and need to create gay (male) space.<sup>75</sup> Others describe a process by which gay male neighborhoods were created out of red light districts.<sup>76,77</sup> In qualitative research, these patterns of neighborhood formation do not parallel the formation of lesbian neighborhoods.<sup>32,33,78,79</sup> Alternatively, declining residential segregation for same-sex couples<sup>12</sup> and rural and suburban neighborhood selection<sup>80-82</sup> as well as the feasibility of returning to communities of origin with growing social acceptance<sup>83</sup> could be different by gender and result differences in our models.

Regardless of the different mechanisms, our findings show both the rate of male and female same-sex couples are associated with greater tobacco retailer density.

In sensitivity analyses to assess edge effects, our results differ, particularly for female same-sex couple models. However, because the counties included in our study are more urban than the typical county, edge tracts appear to be qualitatively different than core tracts. Thus, we cannot rule out the possibility of edge effects. For many included counties, a central city occupies the center of the tract and many edge tracts are larger and suburban in nature. Future research should explore this more fully.

### Strengths and Weaknesses of the Study

There are several strengths and limitations to this research. We selected an area unit we viewed to be most conceptually appropriate for neighborhoods and selected variables for model building *a priori* based on the existing literature. The statistical approach explicitly modeled spatial dependence. We note two important limitations: First, census data only provide information on same-sex couples; were data on individual sexual orientation available they might provide different results. Individuals who are partnered may be quite different in their neighborhood selection and health behaviors, and this research is not generalizable to individual LGB people. However, the limited data available show similar disparities in smoking prevalence for same-sex couples compared to opposite-sex couples (53% and 35% higher for same-sex female and male couples than their opposite-sex counterparts, respectively).<sup>84</sup> Although the census undercounts some racial/ethnic minorities,<sup>85</sup> census data represent a high quality data source. Second, there is no national licensing of tobacco retailers. While we used a unique, high quality list of tobacco retailers that has been validated in similar studies,<sup>43,47</sup> there is an unknown amount of error in identifying current tobacco retailers. Additionally, we did not have information on retailer type.

Future research should examine (1) differences in tobacco retailer density where people live, work, and play (ie, activity space)<sup>86</sup> as we only had data on rates of households based on where people live, (2) the potential role of edge effects as we were unable to rule them out, (3) the role of tobacco retailer policy interventions on density for neighborhoods with more same-sex couples, and (4) changes in gay and lesbian neighborhoods<sup>12,87</sup> in relation to tobacco retailer density.

### Conclusion

This is the first study to examine tobacco retailer density in relation to same-sex couples, thus providing new information to our understanding of LGB disparities in tobacco use. Much of the literature on tobacco dependence disparities for LGB populations is based on a minority stress model.<sup>4</sup> Our work suggests a small role for an environmental factor that may also contribute to disparities, differences in neighborhood tobacco retailer density. The positive relationship between tobacco retailer density and same-sex couples at the tract level suggests that this may play a part in population-level disparities in tobacco use for LGB adults. The extent and quantification of that role requires further research. Given the lack of tobacco control interventions that reduce disparities,<sup>88</sup> identifying pro-equity interventions is an important area of future research. Policy interventions<sup>89-91</sup> to limit the density of tobacco retailers should be assessed for their impact on LGB tobacco use disparities.

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### Declaration of Interests

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