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Georgiana Bostean
Chapman University, gbostean@chapman.edu

Luis A. Sánchez
California State University, Channel Islands

Jason A. Douglas
Chapman University, jadouglas@chapman.edu

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Georgiana Bostean[a] (Corresponding author)

Luis A. Sánchez[b]

Jason A. Douglas[c]

[a] Sociology Department & Environmental Science & Policy Program, Chapman University, One University Drive, Orange, CA 92866, gbostean@chapman.edu, Tel: 714-519-5610, Fax: 714-532-6048

[b] Sociology Department, California State University, Channel Islands

[c] Department of Health Sciences, Crean College of Health and Behavioral Sciences, Chapman University, One University Drive, Orange, CA 92866

Running Head: Nativity and Neighborhood Alcohol & Tobacco Retailer Density

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Abstract

Background: Studies of retail environment, one of the social determinants of health, document racial/ethnic disparities in exposure to alcohol and tobacco (A&T) retailers, but have largely overlooked nativity.

Methods: We examined associations between A&T retailer density and rates of foreign-born Latinx and foreign-born Asian residents in California census tracts (N = 7,888), using spatial regressions and controlling for population and ecological confounders (e.g., population density, zoning, residential instability, urbanicity). Socio-demographic data came from the American Community Survey (2012-2016); census tract density of A&T retailers came from geocoded addresses from state license data for off-sale alcohol distributors and purchased data on tobacco retailers from a commercial provider.

Results: Models predicting A&T tract retailer density showed that the rate of foreign-born Latinx residents was associated with higher tobacco retailer density but lower alcohol retailer density, and demonstrate no significant associations between rate of foreign-born Asian residents tobacco and alcohol retail density.

Discussion: Retail environment could contribute to observed declines in immigrant health over time in the US and across generations.

Keywords: immigrant health; contextual risk factors; retail environment; social determinants of health; neighborhoods

Introduction

In many Western countries, foreign-born residents exhibit worsening health outcomes and behaviors the longer they live in their host countries, within and across generations [1]. For example, US studies find that health risk behaviors, including smoking and drinking, are more common among second generation Latinx and Asians compared with their immigrant counterparts [2-4]. Most studies examine immigrant health from individual acculturation perspectives, focusing on how individual changes in socio-cultural orientation affect health and health behaviors. However, critics point out that this approach has largely overlooked the role of structural factors, including neighborhood environments, in immigrant health [5, 6]. Some scholars find that immigrant neighborhoods have been targeted by industries such as Big Tobacco [7]. Yet few retail environment studies examine disparities in retailer exposure by both race-ethnicity and nativity. Considering retail environment influences alcohol and tobacco (A&T) use [for review, see 8, 9], investigating nativity associations with retail environment may provide critical insights into the social determinants that contribute to immigrants' declining health.

Theoretical Framework

We draw on a social determinants of health framework to examine nativity and racial/ethnic disparities in exposure to A&T retailers. Social determinants of health are the "conditions in which people are born, grow, live, work, and age," and the socioeconomic and broader social factors that shape these conditions [10]. For example, despite comparable tobacco use prevalence among Black and White adults, Black adults experience disproportionately high second-hand smoke exposure [11, 12]. This second-hand smoke exposure disparity has been attributed to (1) health compromising living and working conditions, and (2) inequitable smoke-

free policy coverage in the US [13, 11]. The social determinants of health lens accordingly provides a framework for contextualizing associations between social factors (e.g., race-ethnicity, nativity) and exposure to health-compromising conditions (e.g., unequal exposure to A&T retailers) that may contribute to health disparities.

Background

Communities with large racial/ethnic minority populations have a higher density of A&T retailers [14-16]. This is a concerning public health and equity issue considering that A&T retail environment—e.g., retailer density and proximity to residential areas—is associated with tobacco use initiation, frequency of use, and cessation [17-19], particularly among youths and young adults [20-23]. For example, neighborhood retailer count is associated with lower intention to quit among smokers [24]. Beyond impacting health behaviors, presence of A&T retailers may also influence residents' perceptions of neighborhood safety and even increase crime [25]. Thus, research is needed to identify retail environment exposure inequities in order to understand implications for both population health disparities and policy [26].

However, studies have largely overlooked retail environment associations with foreign-born composition, despite large disparities in smoking and drinking behaviors by race/ethnicity and nativity. Many studies document associations between time in the US and increased health risk behaviors, such as smoking and drinking, particularly for second generation Asian and Latinx residents [2-4, 27, 28]. For example, although the foreign-born Latinx population has among the lowest smoking prevalence in the US [29], second and third generation Latinx youth have greater increases in cigarette use compared with first generation youth [30]. By contrast, some foreign-born Asians, particularly Korean and Vietnamese men [31], are more likely to smoke tobacco and have higher prevalence of lung cancer than their US-born counterparts [32-

34]. Examining the association between percent foreign-born Asian and tobacco retailer density could shed light on the retail environment as a potential factor facilitating smoking in these groups. Regarding alcohol use, Latinxs are more likely than non-Hispanic Whites to abstain from alcohol, but Latinx men who do drink alcohol consume more and are more likely to binge [35, 36]. Foreign-born Asians report lower rates of alcohol use and abuse compared with other groups [37-39].

The few studies that have investigated nativity associations with A&T retailer density report conflicting results. One Canadian study found that in rural areas tobacco retailers were more likely to be located in areas with greater concentrations of foreign-born populations, but in urban areas, tobacco retailers were less likely to be located in areas with large foreign-born populations [40]. By contrast, a US study in the city of Chicago, IL, found greater tobacco retailer density in areas with large concentrations of foreign-born residents [22]. Because of these mixed results across varied and small geographic areas (e.g., city or metropolitan area), it remains unclear whether A&T retail environments are more widespread in areas with higher concentrations of foreign-born residents compared with areas with larger US-born populations. This information could advance scholars' understanding of why immigrants' substance use often increases with time in the US and across immigrant generations. Thus, place-based studies of larger geographic areas are needed.

Considering evidence of targeted marketing in the US in immigrant neighborhoods by industries such as Big Tobacco [7], we argue that immigrant neighborhoods may have more health-deleterious retail environments than areas with larger US-born populations. We go beyond existing studies in several ways. First, we examine data from a larger geographic area—the state of California (CA), which has the largest foreign-born population in the US [41]. Second, we

control for confounders known to be associated with tobacco and alcohol retailer density, most of which are common to both retailer types. Both A&T retailers tend to be located in areas that are urban, more densely populated [42], socioeconomically disadvantaged (e.g., have lower income [43] and higher levels of residential instability). Moreover, unhealthy retailers tend to co-locate [44], and some retailers (e.g., convenience stores) sell both alcohol and tobacco. Thus, this study controls for not only racial/ethnic composition and socioeconomic composition (income, education, residential instability), but also ecological factors including population density, zoning, urbanicity, and density of other types of retailers associated with substance use. Third, we use spatial analyses to account for the fact that retailers tend to cluster spatially. As such, in many cases retail environments tend to be more similar in neighboring areas, which often leads to the violation of assumptions of traditional statistical analyses (e.g., independent errors) and consequently to biased models. Thus, retail environment studies should examine whether spatial regression approaches, which account for spatial dependence, are warranted. Findings have implications for understanding structural influences on immigrant health.

Methods

Data

We examine census tracts, the most common geographic unit of analysis in retail environment studies, for comparability with the bulk of US studies [45, 14, 16, 22]. Surveys show that the retail environment around respondents' homes is associated with health behaviors, particularly among youth [for review, 46]. Residential census tracts are therefore commonly used in US studies because they capture the characteristics of residential environments. Census tract sociodemographic data came from the 2016 American Community Survey 5-year estimates [47].

We excluded 90 "isolated" tracts having population density < 5 persons per square mile (the definition set forth by [48]) because they tend to be geographically very large and therefore "exposure" is different (because the average distance to retailers is much larger) than more populous tracts (which may have similar retailer density). US Census Bureau TIGER files (2017) contained road data [49]. The National Land Use Dataset (NLUD), described elsewhere [50], estimated commercial zoning.

Of California census tracts, we excluded coastal waters tracts (n = 21), "islands" (n = 15; six real islands, and nine neighborless tracts based on the spatial weight matrix described below), isolated tracts with population density of less than 5 persons per sq. mile (n = 90), and those missing data on study variables (n =43). The final analytic sample size was N = 7,888 census tracts (2% of tracts excluded). This study was deemed exempt from human subjects review by the (anonymized) University Institutional Review Board.

Dependent measures

Alcohol distributor density by roadway. Premises with active, off-sale alcohol distributor licenses (Type 20 and 21) as of 4/18/2018 were downloaded from CA Department of Alcoholic Beverage Control. A total of *N* = 22,306 (100% of locations) premises licensed to sell off-site alcohol were successfully geocoded. We calculated the density of licensed distributors per 10 miles of roadway, following prior studies [16].

Tobacco retailer density. Retailer data on verified locations operating in 2018 of tobacco retailers including gas stations, convenience stores, liquor stores, tobacco shops (excluding supermarkets and drug stores) (primary SIC codes: 541103, 554101, 554103, 554105, 554106, 554107, 554110, 554111, 554112, 592101, 592102, 592103, 592104, 592107, 599301, 599302, 599304, 599305, 599306) were purchased from a leading commercial data provider (DataAxle;

formerly InfoUSA), used in previous retailer studies [51, 52]. A total of $N = 20{,}990$ locations (100%) were successfully geocoded. We calculated the density of licensed tobacco retailers per 10 miles of roadway in the census tract.

Key Independent Measures

Rate of foreign-born Latinx is the percent of those reporting Latinx ethnicity in the tract who are foreign-born (born outside the US); *Rate of foreign-born Asian* is the percent of non-Latinx Asians (excludes Native Hawaiian, Pacific Islanders) in the tract who reported being foreign-born.

Control variables

Sociodemographic controls. We include several control variables, based on past research showing an association between these factors and both retail environment and racial/ethnic composition [45, 42, 14]: Percentage White is the percent of population that reported being non-Latinx/Hispanic White only; Percentage Latinx and percentage Asian is the percent of the total tract population that reported being Latinx and Asian, respectively; Percent of population that was under age 18; Percent that was ages 18-24; Percent that was ages 55 or over; Percent of the tract population that had a less than a high school diploma; Median household income.

Ecological controls. Residential instability was measured by percent of households that moved within the past 12 months. *Population density*, commonly used in the tobacco and alcohol literatures [45], measured persons per square mile of tract and was included based on evidence that retailers are disproportionately located in densely populated urban areas [53]. *Commercial land use* was a continuous variable indicating the percent of the tract area that was commercial, industrial, or urban use; this has been used in previous studies to account for the fact that some

census tracts have more commercial zones, and are therefore likely to have more commercial retailers [22, 54]. *Rural/small town* was included due to differences in sociodemographic composition and retail environments [42]. It was coded as a dichotomous variable (ref = not rural or small town) created using Rural-Urban Commuting Area (RUCA) 2010 codes to determine urban/rural tract classifications [55]. This definition uses measures of population density, urbanicity, and commuting patterns. We used the classification proposed in previous work [48] to identify rural and small town tracts (from scheme 1) and large rural, suburban, or urban core tracts (reference group). *Other retailers* are included as controls since unhealthy retailers co-locate—alcohol models controlled for tobacco retailer density (by roadway) and vape store (e-cigarette) density (by roadway), and tobacco models controlled for alcohol and vape retailer density. Vape store data (primary SIC code: 599306) was purchased from DataAxle.

Analyses

Geospatial processes (e.g., geocoding, overlay analyses to calculate retailer density) were conducted in ArcMap 10.3, and statistical analyses were conducted in Stata 15.1, GeoDa, and GeoDaSpace. We first examined the characteristics of CA non-isolated census tracts. Bivariate analyses (ANOVA) tested for differences in retail environment and sociodemographics across tertiles of rate of foreign-born Latinx and Asian. Pearson correlations examined bivariate correlations between all study variables.

The regressions predicted the log of density for each outcome due to the highly skewed distributions of alcohol and tobacco retailer density; diagnostics showed better fit of models using the transformed variables. Multicollinearity diagnostics showed a mean VIF of 3.1, with no VIFs above 10. We first examined global spatial autocorrelation in the dependent variables with Moran's *I* statistics. This was followed by estimating local Moran's *I* statistics which were

further visualized using a Local Indicators of Spatial Association (LISA) map to indicate hot and cold spots as well as spatial outliers [56]. The spatial analyses necessitate a formal definition of spatial weight, which specifies whether two census tracts are neighbors. We adopted the widely used Queen-contiguity criterion and defined neighbors as those with common vertices or edges/borders. This yielded a mean of 6.2 (median= 6) neighbors. We then compared Ordinary Least Squares (OLS) regressions with the two main spatial models in the spatial econometric literature: the spatial lag models and spatial error models. These models explicitly account for spatial dependence. The spatial lag model included a spatially lagged dependent variable, defined using the weighted average of values of the dependent variable in the neighboring tracts, while the spatial error model introduces a spatially correlated error term. We followed the forward specification analysis and diagnostics (with Lagrange Multiplier and Robust Lagrange Multiplier) favoured the spatial lag specification for both outcomes [57]. The spatial lag models were estimated using the two-stage least squares (TSLS) approach, which allow us to estimate robust standard errors to deal with heteroskedasticity. We present the coefficients (along with robust standard errors) from the fully adjusted models predicting tobacco and alcohol retailer density.

Results

Table 1 presents the characteristics of non-isolated census tracts (N = 7,888) in CA. The median number of tobacco retailers per tract was 2 (mean = 2.6) and 2 alcohol retailers (mean = 2.8). The count of retailers varied substantially, ranging from zero to 54 for tobacco retailers and zero to 20 for alcohol retailers. The median density of retailers was 0.9 tobacco retailers (mean =1.5) per 10 miles of roadway in a tract, and a median of 1.1 alcohol retailers (mean = 1.8). Across non-isolated tracts in the state, 78% had at least one tobacco retailer and 82% had at least

one alcohol retailer. In terms of racial/ethnic and nativity composition, the mean percentage of Latinx in a tract who were foreign-born was 31.6%, while the mean percentage FB among Asians was 60.2%.

Bivariate correlations (Supplemental Figure 1) revealed weak positive associations between A&T retailer density and rate of FB Latinx and Asian, as well as overall percentages of Latinx and Asian, but a negative correlation with percent non-Latinx White. Comparing across tertiles of FB composition (Table 2), tracts with larger rates of foreign-born (FB) Latinx and FB Asian populations had statistically significantly higher alcohol and tobacco retailer density compared with areas with low percentages of these populations. For example, areas with the highest rate of FB Latinx (as a percentage of overall Latinx population) had 2.1 tobacco retailers per 10 miles of road, compared with 1.0 tobacco retailers in tracts with the lowest rate of FB Latinx ($p < .001$). For both tobacco and alcohol retailer density, differences between tracts with low, medium, and high (tertiles) rates of FB Latinx and FB Asian were statistically significant at the 0.001 alpha level. There were also substantial and statistically significant differences across these areas in terms of sociodemographic and ecological characteristics. Compared with areas with low rates of FB Latinx, tracts with high rates of FB Latinx had fewer non-White residents, larger percentages of under age 18 population and smaller populations of adults ages 55 and over, larger percentages of lower education population, lower median income, lower residential instability, more commercial land zoning, and higher population density. Compared to tracts with low rates of FB Asian, those with high rates of FB Asian have lower median income, lower residential instability, greater commercial land zoning, and higher population density. However, unlike for Latinx, tracts with high rates of FB Asian have smaller percentages under 18

population, and no significant differences in young adult population (% ages 18-24) or educational composition compared with low FB Asian tracts.

We found significant and positive global spatial autocorrelation for both alcohol and tobacco retailer density (Moran's $I = 0.463$ and 0.497 for tobacco and alcohol, respectively; $p < .01$), suggesting diffusion of retail environment in neighboring census tracts. To demonstrate this clustering, Supplemental Figure 2 displays the LISA cluster maps for alcohol and tobacco retailer density. Due to the large study area (the whole state) and very small geographic size of urban census tracts, it was not possible to show the entire state, therefore we visualized the two most populous geographic regions of the state, encompassing the counties where half the state's population lives. The figure reflects the pattern observed across the state—tracts with higher retailer density tend to be near other tracts with high retailer density (high-high tracts in dark red), and those with low density are often surrounded by other low density tracts. This violates the linear regression assumption of independence, and suggests that spatial models may be needed. Further, diagnostics from Ordinary Least Squares regressions controlling for population sociodemographic characteristics and ecological context confirmed that spatial models were needed based on a statistically significant Moran's I on the regression residuals for both alcohol (MI = 0.066) and tobacco (MI = 0.071) (both p's < 0.001), which reveals significant spatial autocorrelation and violation of the linear regression assumption of independence of errors.

Table 3 presents the results from the spatial lag models, which account for spatial dependence by including the spatial lag of the dependent variable. For tobacco retailer density, the statistically significant spatially lagged variable ($b = 0.317$, $p <.001$) indicated that density in one tract is positively associated with density in neighboring tracts due to the spatial spillover effect. Accounting for such spatial spillover effect, there was a positive and statistically

significant association between tobacco retailer density and the percentage of the Latinx population that is foreign-born, even controlling for racial/ethnic composition (e.g., percentages Latinx, Asian, non-Latinx White) and other sociodemographic and ecological characteristics. Specifically, a one standard deviation increase in the rate of FB Latinx was associated with a 3.7% increase in tobacco retailer density ($b = 0.037$, $p < .001$). This effect was even larger after accounting for the spatial multiplier effect from the spatial lag specification. The spatial multiplier effect arose because the increase in the tobacco retailer density in a focal tract from the increased rate of FB Latinx spilled over to neighbours, which in turn, increased the density of the tract. The total effect would be 0.054 after accounting for such spatial multiplier effect. Tobacco retailer density was lower in tracts with higher percentage Latinx population ($b = - 0.08$, $p < .001$). Tobacco retailer density was also positively associated with residential instability (i.e., a greater % of households that moved within the past year), commercial zoning, and alcohol retailer density. Conversely, tobacco retailer density was negatively associated with percentage of the population under age 18 ($b = - 0.05$, $p < .001$) and ages 55 and older ($b = - 0.08$, $p < .001$), and vape retailer density ($b = - 0.07$, $p < .01$). These effects were stronger after accounting for the spatial multiplier effect. This model explained over 61% of the variation in tobacco retailer density. In other words, even when accounting for the fact that areas with higher rates of FB Latinx also tend to be more densely populated, lower income and education, with more commercial zoning—characteristics associated with more tobacco retail (see Supplementary Figure 1)—greater rates of FB Latinx in census tracts are associated with greater tobacco retailer density.

As with tobacco retailer density, alcohol retailer density is spatially dependent, indicated by the statistically significant spatially lagged dependent variable ($b = 0.292$, $p <.001$). However,

the association between foreign-born composition and alcohol retailer density was opposite that for tobacco retailer density. A higher percentage of the Latinx population being foreign-born was *negatively* associated with alcohol retailer density, net of controls (b = - 0.026, p <.001). The total effect would be -0.037 after taking the spatial multiplier effect into account. Higher percentages of overall Latinx, Asian, and non-Latinx White residents were associated with higher alcohol retailer density. Similarly, higher alcohol retailer density was associated with a higher percentage of under age 18, higher residential instability (% of households that moved within the past year), more commercial zoning, higher population density, and higher density of other (vape, tobacco) retailers. In other words, for alcohol retailer density, higher percentages of all three racial/ethnic groups (Latinx, Asian, non-Latinx White) are positively associated with density but higher rates of FB as a percentage of the Latinx population is associated with lower alcohol retailer density. This model explained 63.7% of the variation in alcohol retailer density.

Discussion

This study extends the immigrant health literature by examining associations between A&T retailer density and residential concentrations of foreign-born Latinx and Asian populations. Bivariate analyses showed higher tobacco & alcohol retailer density in census tracts with larger rates of foreign-born Latinxs and foreign-born Asians. After accounting for spatial dependence in retail environment and confounding factors associated with both retail environment and foreign-born composition, significant racial/ethnic and nativity differences in retailer density remained. Our novel findings suggest that in some cases, racial/ethnic disparities in retailer density may vary by foreign-born composition. We discuss implications for immigrant health research and public health policy.

Our major finding is that areas with larger concentrations of foreign-born Latinx residents have higher densities of tobacco retailers and lower densities of alcohol retailers (the effect of FB Asian composition was not statistically significant for either alcohol or tobacco density). Our results partially support those of Chaiton and colleagues [40]. Their study in Ontario, Canada, found a positive association between immigrant concentration and A&T outlets in rural, but not urban, areas, while our study found a positive association in non-isolated areas, including both rural and urban. It is worth noting that the studies are not comparable considering the very different contexts in which they were conducted. First, the US and Canada have substantially different histories of immigration and immigrant incorporation, and varying federal, state, and local policies regarding alcohol and tobacco retail environments, thus we might not expect the same nativity associations. Second, the definitions of urban/rural are not comparable across the studies; in this study, we examined non-isolated census tracts (including both rural and urban areas). Because "exposure" to retailer density may vary in sparsely populated, geographically large census tracts (which also likely have substantially different sociodemographic characteristics compared with more urban, populous tracts), future studies should examine whether these associations vary across the urban-rural spectrum. Thus, our finding provides novel evidence about foreign-born concentrations and retail environment in the US context.

Although the overall percentage Latinx (regardless of foreign-born composition) is associated with lower tobacco retailer density, it is particularly notable that areas with greater foreign-born Latinx rates have higher tobacco retailer density considering that approximately one-third of CA Latinos are foreign-born [58]. Moreover, the smoking rate among foreign-born Latinxs is among the lowest of US race-ethnic groups [29]; however, second generation Latinx residents have higher rates of substance use, including smoking and binge drinking, than their

immigrant counterparts [59, 60]. Considering that most US daily smokers initiate smoking before young adulthood [61], and that the risk of smoking initiation among immigrants is lower after migrating compared with before migration [62], the tobacco retail environment may be less important for the health behaviors (e.g., smoking) of first generation immigrants, but particularly important for the children of immigrants (i.e., second generation), especially those living in areas with large foreign-born populations. Moreover, retailers in areas with larger minority populations have more exterior advertisements [63], which is associated with youth smoking uptake. Taken together, these findings suggest that the retail environment could play a role in the substance use patterns observed among second generation youth. That tobacco retailer density is positively associated with the percent foreign-born Latinx—despite this group having among the lowest smoking rates—may be line with evidence that immigrants have been targeted by industries including Big Tobacco [7], although we are not able to test unequal targeting in this study. It may also reflect patterns of small business ownership (including convenience stores, etc.) in immigrant communities. Regardless, this information may help identify the populations (and neighborhoods) at-risk of deleterious health impacts of unhealthy retail environments.

Interestingly, there was no association between retail environment and percentages Asian (or FB Asian). We included a term for Asian population because this is a relatively understudied group in this literature, perhaps due to their higher average socioeconomic status compared with other non-White groups. Another possibility is that our methodological approach of examining average effects across all of California did not allow us to tease out effects for Asian populations. It is plausible that there are areas where there is a statistically significant association between percentage Asian residents (and/or percentage FB Asian) and retailer density. Future studies may

further explore this question by using geostatistical approaches that account for potential geographic variation in these associations.

Our findings also highlight that the correlates of unhealthy retail environments are not always the same for alcohol and tobacco retail. As previously mentioned, the association between foreign-born composition is opposite for alcohol and tobacco retailer density. In addition, racial/ethnic composition has opposite associations for alcohol versus tobacco. Other factors that are differentially associated with tobacco versus alcohol retail are the youth population (percentage under age 18 is negatively associated with tobacco density and positively with alcohol density), income (negatively associated with alcohol density). By contrast, residential instability and ecological factors have similar associations with both tobacco and alcohol retailer density. Population density and commercial zoning are positively associated with density, while rural and small town tracts have lower retailer density than tracts that are not rural or small towns.

This study is not without limitations. As with other spatial studies using areal data, the results are subject to the Modifiable Areal Unit problem, a theoretical problem having to do with the scale and choice of boundaries [64]. We used the most commonly used unit of analysis in US studies, the census tract, for several reasons: (1) for comparability with studies in other geographic areas; (2) it is a small enough geography to capture variation in retail environments but large enough that the estimates are more stable than smaller geographies such as block groups; and (3) it makes sense as a measure of exposure since residents of census tracts likely pass through their tracts, at a minimum, as they go about their day in their activity spaces. However, the associations observed here at the tract level may differ at other scales (e.g., county) or aggregated to different boundaries (e.g., cities). This study examined retailer density cross-

sectionally, and therefore cannot address whether there is causal association between neighborhood sociodemographic composition and retailer density, nor whether this pattern reflects targeting of immigrant areas by these industries. Future studies might explore this question by examining longitudinal data on new licenses, for example.

These findings have important implications. Methodologically, our study confirms the need for spatial methods in neighborhood studies [65, 66], many of which to-date have used non-spatial methods. Theoretically, our findings evidence the need to move beyond individual acculturation explanations of immigrant health toward structural factors, as others have argued [5]. Our results suggest that immigrant neighborhoods do not necessarily have fewer "risks" than other neighborhoods [67], as we find higher tobacco retailer density in areas with larger rates of foreign-born populations (although alcohol retailer density is negatively associated with rate of FB Latinx). Considering the wide-ranging impact of retailer density on health behaviors—including tobacco behaviors [46] such as initiation and cessation [24]—future research should examine the extent to which the retail environment disparities documented here contribute to the observed health declines across immigrant generations. Some studies find health-protective effects of immigrant neighborhoods for certain groups [68]— should those protective elements of immigrant neighborhoods erode, residents might be particularly vulnerable to retail environment influences on health behaviors. Taken in the context of social determinants of health literature, these findings highlight nativity as an important social factor to consider in place-based health disparities research.

New Contribution to the Literature

This study is among the few to document greater densities of unhealthy retailers in neighborhoods with greater rates of foreign-born residents. Findings point to the need to reduce inequities in neighborhood retail environments. Policies that reduce the density of such retailers, such as zoning and permit caps, are one way to improve retail environments [69]. Such structural changes could help maintain immigrant health advantages (in cases in which there are advantages) and potentially mitigate health declines across generations.

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Table 1. California non-isolated census tract (*N* = 7,888) characteristics

	Median	Mean	SD	Min	Max
Outcome measures					
Tobacco retailer count	2.0	2.6	3.0	0.0	54.0
Alcohol retailer count	2.0	2.8	2.6	0.0	20.0
Tobacco density (per 10 mi road)	0.9	1.5	2.2	0.0	38.1
Alcohol retailer density (per 10 mi road)	1.1	1.8	2.6	0.0	48.9
Key independent variables					
% of Latinx who are foreign-born	31.9	31.6	14.1	0.0	100.0
% of Asian who are foreign-born	62.7	60.2	21.0	0.0	100.0
Sociodemographic and ecological controls					
% Latinx	30.5	37.7	26.5	0.0	100.0
% Asian	7.9	13.3	15.2	0.0	91.1
% non-Latinx White	38.6	39.7	26.4	0.0	100.0
% Under age 18	23.1	23.0	7.1	0.0	53.4
% Ages 18-24	9.3	10.0	6.6	0.0	97.3
% Ages 55+	27.6	29.0	10.8	0.0	99.4
% Less than high school	13.7	18.7	15.7	0.0	80.0
Median household income ($1,000s)	62.5	69.7	34.2	4.8	250.0
% HH Moved in past 12 months	11.9	13.3	7.3	0.0	80.3
% Commercial land use	1.0	5.0	8.8	0.0	72.0
Population density (per sq. mile)	6,458	8,759	9,657	5.2	151,527
Rural/small town	0	0.0	0.1	0.0	1.0

Notes: Tobacco retailers include (verified retailers in 2018 purchased from commercial data provider). Alcohol retailer locations obtained from state license listings (2018). Sociodemographic data from American Community Survey, 5-year estimates (2012-2016). Non-isolated tracts defined as those with population density of 5 or more persons/sq mile.

Table 2. Retail environment and socio-demographics by race/ethnic and nativity composition of CA non-isolated census tracts (*N*= 7,888)

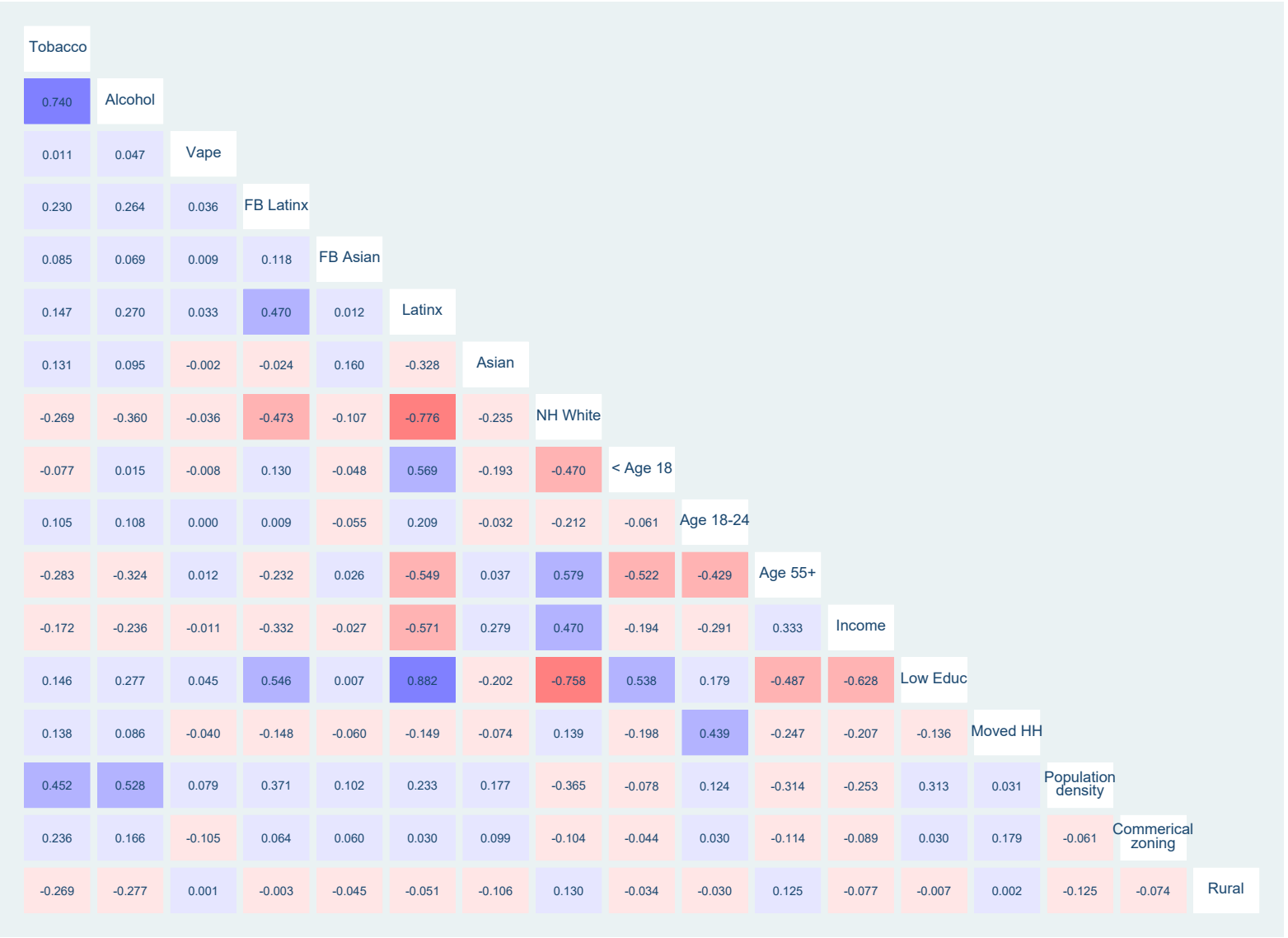
	Rate of Foreign-born (FB) Latinx				Rate of Foreign-born (FB) Asian			
	Low	Medium	High	F-stat	Low	Medium	High	F-stat
Dependent variables								
Tobacco retailer density	1.0	1.4	2.1	***	1.4	1.4	1.8	***
Alcohol retailer density	1.1	1.6	2.6	***	1.6	1.5	2.1	***
Independent variables								
% non-Latinx White	56.0	37.7	25.7	***	45.4	40.6	33.0	***
% Under age 18	21.6	23.1	24.1	***	23.2	22.8	22.9	***
% Ages 18-24	9.8	10.0	10.2	†	10.8	9.4	9.8	ns
% Ages 55+	32.4	28.7	25.9	***	28.9	29.3	28.8	***
% Less than high school	8.3	17.9	29.6	***	18.2	15.0	22.9	ns
Median HH income ($)	83,872	69,503	56,254	***	69,750	79,724	59,726	***
% HH moved, past 12 months	14.5	13.5	11.9	***	14.4	13.0	12.6	***
% Commercial land use	4.2	5.2	5.4	***	4.3	5.1	5.4	***
Population density (per sq. mile)	5,673	7,216	13,299	***	7,458	7,952	10,844	***

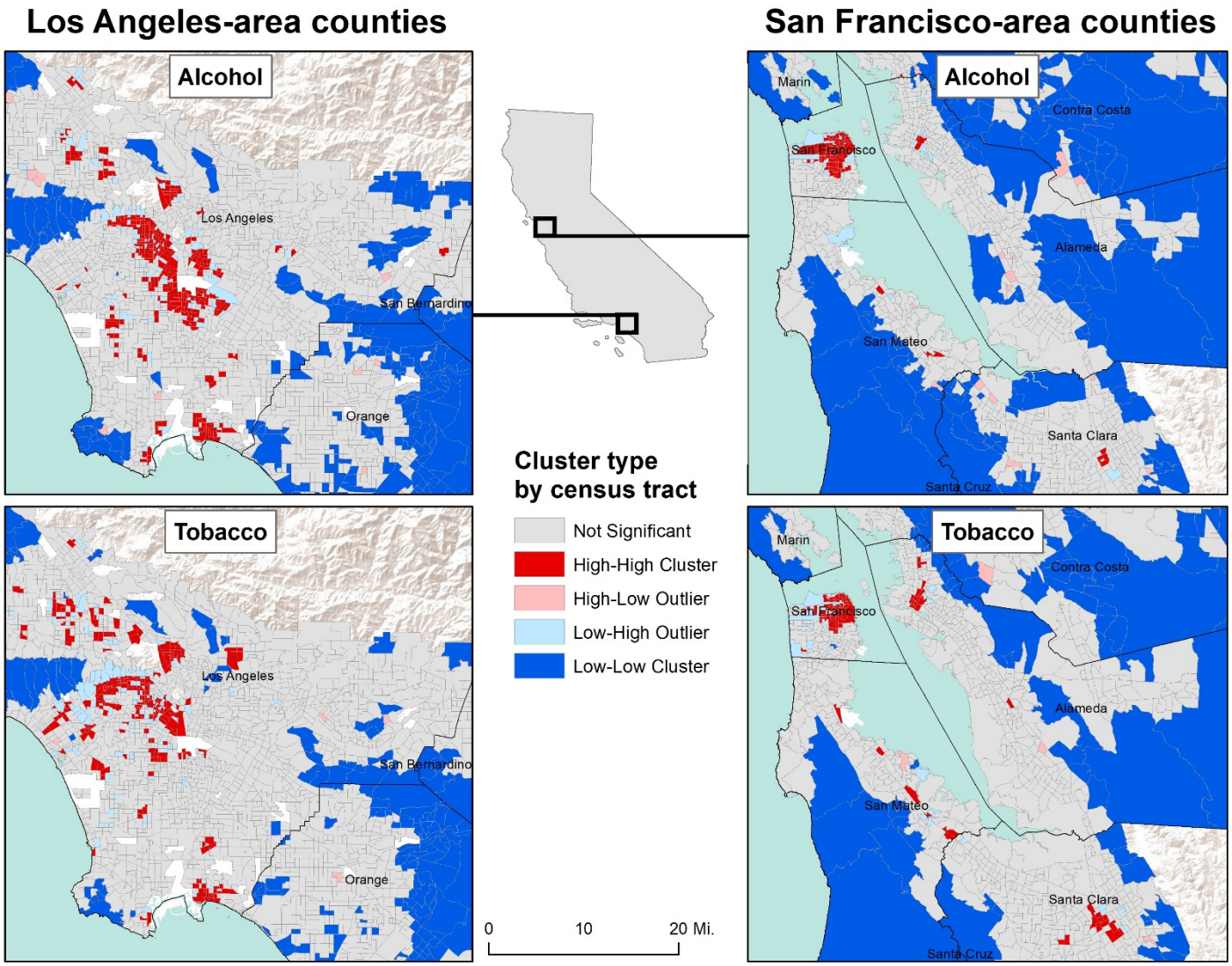
Notes: Alcohol and tobacco retailer density is per 10 km of roadway in tract. Standard errors italicized. F-statistic from ANOVA. ***p < .001 **p < .01 * p < .05 † p< 0.10 (two-tailed test). Low, medium, and high indicate first tertile, second tertile, third tertile, respectively. Non-isolated tracts defined as those with population density > 5 persons/sq mile.

Table 3. Spatial lag (two-stage least squares) regression models predicting retailer density[a] in CA non-isolated[b] census tracts (*N* = 7,888)

	Tobacco Retailer Density			Alcohol Retailer Density		
	b	*SE*	*p*-value	*b*	*SE*	*p*-value
Spatially lagged dependent variable[e]	0.317	0.021	*<0.0001*	0.292	0.022	*<0.0001*
Key independent variables						
% of Latinx who are foreign-born[c]	0.037	0.010	*<0.0001*	-0.026	0.010	*0.010*
% of Asian who are foreign-born[c]	0.013	0.009	0.126	-0.010	0.008	0.242
Control variables						
% Latinx	-0.080	0.020	*<0.0001*	0.140	0.020	*<0.0001*
% Asian	-0.014	0.012	0.259	0.036	0.013	*0.004*
% non-Latinx White	-0.023	0.020	0.257	0.051	0.020	*0.012*
% Under age 18	-0.051	0.013	*<0.0001*	0.029	0.013	*0.034*
% Age 18-24	-0.021	0.011	0.065	-0.026	0.011	*0.016*
% Age 55+	-0.083	0.014	*<0.0001*	0.001	0.014	0.944
% Less than high school diploma (ref = low)						
medium	-0.041	0.023	0.074	0.029	0.022	0.192
high	-0.061	0.036	0.087	-0.015	0.036	0.683
Median household income tertiles (ref = low)						
medium	0.021	0.021	0.329	-0.114	0.021	*<0.0001*
high	-0.050	0.028	0.074	-0.122	0.027	*<0.0001*
% of households moved past year	0.033	0.010	*0.001*	0.025	0.010	*0.017*
% Commercial zoning	0.089	0.008	*<0.0001*	0.018	0.008	*0.018*
Population density	0.005	0.012	0.695	0.141	0.015	*<0.0001*
Rural/Small town (ref = not small town or rural)	-0.178	0.102	0.082	-0.289	0.098	*0.003*
Alcohol or tobacco retailer density[d] (log)	0.533	0.014	*<0.0001*	0.537	0.013	*<0.0001*
Vape retailer density (log)	-0.068	0.026	*0.009*	0.072	0.031	*0.020*
Intercept	0.042	0.028	0.134	0.167	0.028	*<0.0001*
Pseudo-R^2	0.612			0.637		

Notes: [a]Retailer densities (tobacco, vape, alcohol) measured as density per mile of roadway, and logged. [b]Isolated tracts (those with population density < 5 persons per square mile) were excluded. [c]Rate FB Latinx and FB Asian are defined as the FB Latinx or Asian population divided by the total Latinx or Asian population. [d]Alcohol model controls for tobacco, and tobacco model controls for alcohol. [e]Spatial lag variable created using the weighted average of neighbors, defined using Queen's contiguity (first order), which yielded a mean of six neighbors. All continuous independent variables are standardized except vape density and tobacco density. Income and education coded in tertiles-- low, medium, and high indicate first tertile, second tertile, third tertile, respectively. White standard errors reported. Italicized p-values indicate statistical significance below alpha level of 0.05.


Tobacco
0.740 Alcohol
0.011 0.047 Vape
0.230 0.264 0.036 FB Latinx
0.085 0.069 0.009 0.118 FB Asian
0.147 0.270 0.033 0.470 0.012 Latinx
0.131 0.095 -0.002 -0.024 0.160 -0.328 Asian
-0.269 -0.360 -0.036 -0.473 -0.107 -0.776 -0.235 NH White
-0.077 0.015 -0.008 0.130 -0.048 0.569 -0.193 -0.470 < Age 18
0.105 0.108 0.000 0.009 -0.055 0.209 -0.032 -0.212 -0.061 Age 18-24
-0.283 -0.324 0.012 -0.232 0.026 -0.549 0.037 0.579 -0.522 -0.429 Age 55+
-0.172 -0.236 -0.011 -0.332 -0.027 -0.571 0.279 0.470 -0.194 -0.291 0.333 Income
0.146 0.277 0.045 0.546 0.007 0.882 -0.202 -0.758 0.538 0.179 -0.487 -0.628 Low Educ
0.138 0.086 -0.040 -0.148 -0.060 -0.149 -0.074 0.139 -0.198 0.439 -0.247 -0.207 -0.136 Moved HH
0.452 0.528 0.079 0.371 0.102 0.233 0.177 -0.365 -0.078 0.124 -0.314 -0.253 0.313 0.031 Population density
0.236 0.166 -0.105 0.064 0.060 0.030 0.099 -0.104 -0.044 0.030 -0.114 -0.089 0.030 0.179 -0.061 Commerical zoning
-0.269 -0.277 0.001 -0.003 -0.045 -0.051 -0.106 0.130 -0.034 -0.030 0.125 -0.077 -0.007 0.002 -0.125 -0.074 Rural



Supplemental Figure 2. Local Indicators of Spatial Autocorrelation (LISA) map showing tracts with statistically significant clustering of retailer density in selected (most populous) regions of California