Examining Latinos' Exposure to California's Vice Retail Environment

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(Abstract on Pampa has been updated to reflect changes since submission. This draft does not reflect those changes.)

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Background

Some studies suggest that minority neighborhoods, particularly those with greater proportions of Latino residents, have disproportionately more vice stores such as tobacco and alcohol retailers compared with other neighborhoods [1 ,2]. However, previous studies' findings are difficult to synthesize due to the inconsistent methods used to examine the association between race/ethnicity and vice retail environment, with many studies inadequately accounting for spatial dependencies in retailer distribution. Further, although many studies examine the extent to which the percentage youth and young adult populations are associated with retail environment [3 ,4], few also include older adults. Yet environmental theories of aging suggest that the neighborhood environment may be particularly important among older adults under certain conditions, such as when they experience decreased mobility. For example, a study of breast cancer survivors found a greater likelihood of excessive alcohol use among those who lived within a closer distance to an alcohol retailer [5]. It is therefore important to understand the extent to which all age groups, including older adults, are exposed to vice retailers.

This study examines the extent to which the Latinos in California (CA) census tracts are exposed to the vice retailer environment. Specifically, we examine whether the percentage Latino in census tracts is associated with greater density of alcohol and tobacco retailers, and whether in tracts with predominantly Latino residents, the age structure of the Latino population is associated with retailer density. We extend the literature in several ways. Substantively, we contribute by considering how the nativity composition of tracts can modify the association between percentage Latino and retailer density. Considering the large proportion of California Latinos who are foreign-born, this is an important yet understudied area. We are among the few

studies to also examine whether the percentage older adults in tracts is associated with retail environment, an important issue if retail environment influences certain health behaviors at older ages. Methodologically, we contribute to the literature by comparing results from traditional, non-spatial analyses with those from analyses that account for spatial structure in the outcome variables. We go beyond previous studies by controlling for other vice retailers (tobacco, alcohol, and vape stores) in our analyses to assess the extent to which retailers co-locate.

Our results indicate that spatial modelling provides a better model fit versus traditional non-spatial regression approaches. Findings have implications for the study of the geographic distribution of vice retailers and for understanding how racial/ethnic groups differ in exposure to vice retailers, which may ultimately be associated with population disparities in behaviors and outcomes.

Methods

Data

Data on census tract sociodemographic characteristics came from the American Community Survey 5-year estimates (2012-2016). We used Rural-Urban Commuting Area (RUCA) 2010 data to identify urban tracts (coded 1-9 as urban, 10 and 99 as not urban). Road data, used for normalization, was downloaded for 2017 from the US Census Bureau TIGER files. Of the 8,057 census tracts in California, we excluded tracts if they had less than 500 population, were not urban, and were missing data on any of the variables. The final analytic sample size was N = 7,814.

Dependent measures

The dependent variables were density of alcohol and tobacco retailers (by 10 kilometers of roadway in tract) within each census tract. After geocoding the locations of retailers using Geographic Information Systems (GIS), we counted the number of retailers that fall within each census tract and normalized per 10 kilometers of roadway in the tract, following prior studies [3].

Alcohol distributor density by roadway. Data on premises with valid alcohol distributor licenses as of 4/18/2018 were downloaded from the California Department of Alcoholic Beverage Control and geocoded. A total of N = 69,045 alcohol licensed premises in CA were included.

Tobacco retailer density. Data on valid tobacco distributor licenses in CA as of 2/2/2018 were downloaded from the state of California on March 1, 2018 and geocoded**.** There were a total of 22,438 licensed premises in CA. A limitation of this data is that the state does not release information on individual license holders. We calculated the density per 10 kilometers of roadway in the census tract of licensed tobacco retailers, following prior studies (Giovenco et al., 2016b; Yu et al., 2010).

Key Independent Measures

Percentage Latino is the percent of tract that reported being *Latino (Hispanic)* ethnicity (regardless of race).

Percentage foreign-born is the percent of tract that reported being born outside the United States.

Covariates. We included the following sociodemographic covariates at the census tract level: *percentage Black* is the percent of tract that reported being non-Hispanic Black only; p*ercentage Asian* is the percent of tract that reported being non-Hispanic Asian only (does not include Native Hawaiian or Pacific Islanders); percent of tract 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;* percent of households that *moved within the past 12 months.*

We also included the following covariates to control for tracts' ecological characteristics: *population density* for each census tract, measured in thousands of persons per square mile, commonly used in the tobacco retailer literature (Duncan et al., 2014), was included based on evidence that tobacco retailers are disproportionately located in urban areas [6]; *commercial land use* was a continuous variable indicating the percent of the tract area that was commercial, industrial, or urban use (coded as "built up—commercial (office, retail, or entertainment)"); the dataset is described elsewhere [7], and was obtained from the author [8]. Commercial land use 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 [9 ,10].

Analyses

Geographic analyses (e.g., geocoding, overlay analyses) were conducted in ArcMap 10.3, and statistical analyses were conducted in Stata 15.1 and GeoDa. We first examined the characteristics of CA census tracts. Next, Spearman correlations examined the associations between all study variables, and bivariate analyses compared the mean alcohol and tobacco retailer density per 10 kilometers of roadway in tract, comparing tertiles of percentage Latino using ANOVA to test for differences.

Lastly, we conducted regression analyses, using the log of density for both dependent variables due to the highly skewed distributions. We compared Ordinary Least Squares (OLS) regressions with spatial lag models and spatial error models predicting alcohol and tobacco

retailer density. Diagnostics showed better fit of the spatial lag models based on R^2, *AIC*, and Lagrange Multiplier. Models controlled for socio-demographic characteristics, population density, percent of tract classified as commercial land use, and density of other vice stores (e.g., models predicting alcohol retailer density controlled for tobacco and vape store density). To examine whether nativity modified the effect of percentage Latino, in separate models (because of a high degree of collinearity between Latino and FB), we include percent FB Latino. The sub-group analysis of predominantly Latino tracts (n = 1,833) used OLS regressions because spatial lag and error models are inappropriate given that those tracts are not completely contiguous and form islands across the state.

Results

For California census tracts overall, the mean alcohol retailer density was 0.5 retailers, and tobacco retailer density was 0.2 retailers, per 10 km of roadway in a tract (Table 1). The mean percentage Latino, Black, and Asian within census tracts was 37.8%, 5.6%, and 13.4%, respectively. Across all CA tracts, on average, 27% of the census tract residents were foreign-born, 23% were under age 18, 10% were ages 18-24, 18.8% had less than a high school education. On average, the median household income was $68,815 and 13% of households had moved within the past 12 months, 5% of the tract was commercial land use, and the population density was 8,845 persons per square mile.

Turning to the bivariate association between percentage Latino and vice retailer density (Table 2), alcohol retailer density was lower in tracts with greater Latino population (0.62 in 1st tertile, 0.51 in 2nd tertile, and 0.47 in 3rd tertile; $\chi^2 = 109.9$, $p < .001$). For tobacco, greater percentages of Latino residents were statistically significantly associated with higher retailer

density. The Figure reveals associations between retailer density, % minority, and other sociodemographic and ecological characteristics, suggesting the need to control for these potential confounders in the association between retailer density and race/ethnicity.

To examine whether these racial/ethnic disparities remain when accounting for confounding factors, we conducted regressions predicting retailer density (logged) while controlling for sociodemographic and ecological controls (Table 3). We first examined potential spatial dependencies in the data to determine whether spatial or non-spatial approaches should be used. Both alcohol density and tobacco retailer density showed evidence of spatial autocorrelation, suggesting that tracts with greater retailer density were likely to be surrounded by neighboring tracts with similarly high retailer density (Moran's $I = 0.41$ and 0.27, respectively, $p < .01$). Such spatial dependence violates the independence assumption of linear regression and suggests that spatial models are more appropriate; diagnostics confirmed that the spatial lag models were more appropriate than OLS regressions.

For alcohol retailer density, there was moderate evidence of spatial autocorrelation of the residuals (Moran's $I = 0.125$, $p < .001$) in the OLS models, and in the spatial lag models the lagged dependent variable was statistically significant ($b = 0.30$, $p < 0.05$), indicating that alcohol retailer density is affected by the characteristics of neighboring census tracts (violating the OLS assumption of independence of observations). The spatial lag models showed an interaction between percent Latino and percent foreign-born. Net of controls, the percentage Latino in census tracts was significantly associated with lower alcohol retailer density in tracts with mean levels of foreign-born ($b = -0.06$, $p < 0.05$), but with higher retailer density in tracts with low levels of foreign-born ($b = -.05$, $p < .01$). Greater percentages of Black residents, under age 18 and age 18-24 residents, a lower median household income, and greater percentage

residents with less than a high school education were associated with lower alcohol retailer density.

For tobacco retailer density, there was also some evidence of spatial autocorrelation of the residuals (Moran's $I = 0.051$, $p < .001$) in the OLS models, and in the spatial lag models the lagged dependent variable was statistically significant ($b = 0.16$, $p < 0.001$). There was no effect modification of percent foreign-born on percent Latino, indicated by the lack of statistically significant interaction. Thus, a greater percentage Latino in tracts is associated with greater tobacco retailer density ($b = 0.15$, $p < 0.001$). A greater percentage foreign-born, Black, greater percentage youth, young adults, and older adults, higher median household income, higher population density, and higher density of vape and alcohol retailers were associated with higher tobacco retailer density.

In predominantly Latino tracts (60% or more Latino), the age structure of the Latino population was statistically significantly associated with retailer density. After controlling for confounders, the percentage of the tract that is middle age adults and the percentage older adults were associated with greater alcohol retailer density. Although there were bivariate associations between age groups and tobacco retailer density, those were not statistically significant after accounting for confounding factors.

Discussion

This study found that, in CA, the greater the percentage of Latino and foreign-born residents in census tract, the higher the tobacco retailer density, even accounting for sociodemographic and other differences between tracts with greater density of retailers and those with lower density. We extend the literature by showing that percent foreign-born modifies the association between

percentage Latino and alcohol retailer density such that retailer density is lower in areas with mean and higher levels of foreign-born population, and higher in areas with low percentage foreign-born population. Our findings on age are also novel, showing that in predominantly Latino tracts, a greater percentage older adult is associated with higher alcohol retailer density. Finally, results suggest that studies of retail environment should use spatial analyses that account for the distribution of retailers being spatially dependent.

This study's findings are troubling considering that neighborhood vice retail environment influences health behaviors and other social characteristics. Beyond simply affecting health behaviors, vice retail environment can also shape the social environment in neighborhoods. For instance, some studies find an association between alcohol retailer density and neighborhood crime. More vice retailers could plausibly affect neighborhood perceptions of safety, which are associated with residents' mental health. Future research should examine how disproportionate exposure to vice retailers impacts the health behaviors and outcomes among groups including Latinos, especially youth and older adult Latinos.

References

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Table 1. California census tract characteristics (n = 7, 814)

	All tracts			
	% or Mean	SD	Min	Max
Alcohol retailer density (per 10km road)	0.5	1.1	0.0	28.4
Tobacco density (per 10km road)	0.2	0.3	0.0	4.2
Key independent variables				
% Latino	37.8	26.5	0.0	100.0
% Foreign-born	27.0	14.1	0.3	81.5
Covariates				
% Black	5.6	8.9	0.0	87.3
% Asian	13.4	15.3	0.0	91.1
% Under age 18	23.0	7.0	0.0	53.4
% Ages 18-24	10.0	6.6	0.0	97.3
% Ages 55+	28.8	10.7	0.0	99.4
% Less than high school	18.8	15.7	0.0	80.0
Median household income ($)	69,815	34,275	4,774	250,001
% HH Moved in past 12 months	13.3	7.3	0.4	80.3
% Commercial land use	5.0	8.8	0.0	72.0
Population density (per sq. mile)	8,845	9,664	0.4	151,527

Table 2. Vice store density in census tracts by race/ethnicity

		Alcohol density (roadway)		Tobacco density (roadway)	
		Mean	SD	Mean	SD
% Minority within tract (tertiles)					
% Latino					
1st		0.62	1.43	0.13	0.25
2nd		0.51	1.15	0.17	0.26
3rd		0.47	0.58	0.23	0.26
	chi^2 (p-value)	109.9 (.001)		515.2 (.001)	
% Black					
1st		0.42	0.81	0.13	0.19
2nd		0.59	1.21	0.18	0.25
3rd		0.58	1.23	0.22	0.32
	chi^2 (p-value)	93.7 (.001)		219.9 (.001)	
% Asian					
1st		0.39	0.53	0.16	0.20
2nd		0.49	0.83	0.17	0.24
3rd		0.70	1.62	0.20	0.32
	chi^2 (p-value)	26.0 (.001)		1.0 (0.60)	

Notes: two-tailed tests. Kruskill Wallis (without ties) used to test tertile differences. Density by roadway (per 10km).

Table 3. Regressions predicting log of alcohol and tobacco retailer density (per 10 km of roadway) in CA census tracts

	Alcohol retailer density (log)						Tobacco retailer density (log)					
	OLS Regression			Spatial Lag Model			OLS Regression			Spatial Lag Model		
	b	SE	p-value	b	SE	p-value	b	SE	p-value	b	SE	p-value
lagged dependent variable				0.30	0.01	0.000				0.16	0.02	0.000
Key independent variables												
% Latino	-0.04	0.03	0.190	-0.06	0.03	0.023	0.18	0.03	0.000	0.15	0.03	0.000
% Foreign-born	0.07	0.02	0.007	0.03	0.02	0.193	0.15	0.03	0.000	0.12	0.03	0.000
Latino*foreign-born	-0.07	0.02	0.000	-0.05	0.02	0.002	0.00	0.02	0.883	0.00	0.02	0.966
% Black	-0.07	0.01	0.000	-0.07	0.01	0.000	0.14	0.01	0.000	0.12	0.01	0.000
% Asian	-0.05	0.02	0.008	-0.04	0.02	0.025	0.00	0.02	0.892	0.01	0.02	0.773
Control variables												
% Less than HS	0.00	0.03	0.872	0.02	0.03	0.405	-0.17	0.03	0.000	-0.14	0.03	0.000
Median HH income	-0.03	0.02	0.055	-0.06	0.02	0.000	0.15	0.02	0.000	0.13	0.02	0.000
% Ages 18-24	-0.09	0.02	0.000	-0.07	0.02	0.000	0.09	0.02	0.000	0.09	0.02	0.000
% Under age 18	-0.17	0.02	0.000	-0.09	0.02	0.000	0.02	0.02	0.290	0.04	0.02	0.039
% Ages 55+	-0.18	0.02	0.000	-0.13	0.02	0.000	0.07	0.02	0.000	0.08	0.02	0.000
% Moved in past 12 months	0.07	0.01	0.000	0.07	0.01	0.000	0.00	0.02	0.860	0.01	0.02	0.570
% Commercial land use	0.03	0.00	0.000	0.02	0.00	0.000	-0.01	0.00	0.000	-0.01	0.00	0.000
Population density	0.04	0.00	0.000	0.03	0.00	0.000	0.02	0.00	0.000	0.01	0.00	0.000
Vape density (log)	-0.07	0.01	0.000	-0.07	0.01	0.000	0.04	0.02	0.003	0.04	0.01	0.008
Tobacco density (log)	0.37	0.01	0.000	0.33	0.01	0.000						
Alcohol density (log)							0.48	0.01	0.000	0.46	0.01	0.000
Intercept	-0.97	0.03	0.000	-0.56	0.03	0.000	-1.24	0.03	0.000	-0.96	0.04	0.000
n	7,814			7,814			7,814			7,814		
R^2	0.43			0.48			0.33			0.34		
AIC	21337.60			20856.30			23387.90			23284.60		
Moran's *I* (residuals)	0.1247 ($p < .001$)						0.052 ($p < .001$)					

Note: All variables except controls are mean-centered. Models control for % commercial land use, population density, and density of other retailers (alcohol models include tobacco and vape density by roadway as controls; alcohol models include tobacco and vape density as controls).

Table 4. Predictors of retail density in predominantly Latino tracts: Latinos by age (exponentiated coefficients)

	Alcohol retailer density by roadway (log)			Tobacco retailer density by roadway (log)		
% Latino under age 25	0.89***	1.01	1.01	0.87***	1.01	1.00
	(0.83 - 0.94)	(0.94 - 1.08)	(0.95 - 1.07)	(0.82 - 0.92)	(0.93 - 1.09)	(0.94 - 1.07)
% Latino ages 25 to 54	1.28***	1.07+	1.08*	1.30***	0.99	0.96
	(1.20 - 1.36)	(0.99 - 1.16)	(1.01 - 1.15)	(1.22 - 1.39)	(0.91 - 1.08)	(0.89 - 1.02)
% Latino ages 55+	0.93**	1.04+	1.04*	0.92**	1.00	0.98
	(0.89 - 0.98)	(0.99 - 1.10)	(1.00 - 1.09)	(0.87 - 0.97)	(0.95 - 1.06)	(0.94 - 1.03)
% Black		0.93*	0.93**		1.02	1.06+
		(0.88 - 0.98)	(0.88 - 0.97)		(0.95 - 1.08)	(1.00 - 1.12)
% Asian		1.04	1.04		1.02	0.99
		(0.97 - 1.12)	(0.98 - 1.10)		(0.94 - 1.10)	(0.94 - 1.06)
% Foreign-born		1.04	1.02		1.03	1.01
		(0.96 - 1.13)	(0.96 - 1.09)		(0.95 - 1.13)	(0.95 - 1.08)
% Less than HS		0.87***	0.88***		0.98	1.06
		(0.80 - 0.94)	(0.82 - 0.94)		(0.90 - 1.07)	(0.99 - 1.13)
Median HH income		0.84***	0.85***		0.96	1.06+
		(0.79 - 0.89)	(0.81 - 0.90)		(0.90 - 1.03)	(0.99 - 1.12)
% Moved in past 12 months		1.09***	1.08***		1.00	0.96+
		(1.04 - 1.14)	(1.04 - 1.13)		(0.96 - 1.05)	(0.92 - 1.00)
SJ-SF-Oak CSA (LA ref)		1.35***	1.46***		0.86+	0.73***
		(1.18 - 1.56)	(1.28 - 1.66)		(0.74 - 1.01)	(0.63 - 0.85)
Fresno-Madera		0.65**	0.91		0.49***	0.61***
		(0.50 - 0.86)	(0.75 - 1.10)		(0.36 - 0.66)	(0.49 - 0.77)
Sacramento-Roseville		2.08*	2.14***		0.97	0.66
		(1.07 - 4.01)	(1.67 - 2.75)		(0.26 - 3.60)	(0.24 - 1.77)
Modesto-Merced		0.86	1.04		0.68*	0.73*
		(0.64 - 1.15)	(0.81 - 1.33)		(0.48 - 0.96)	(0.55 - 0.99)
San Diego County not CSA		1.04	0.99		1.10	1.08
		(0.89 - 1.22)	(0.86 - 1.13)		(0.93 - 1.30)	(0.94 - 1.24)

Other		0.61***	0.82**		0.52***	0.67***
		(0.53 - 0.70)	(0.72 - 0.94)		(0.44 - 0.60)	(0.59 - 0.76)
% Commercial land use		1.23***	1.17***		1.10***	0.99
		(1.19 - 1.28)	(1.13 - 1.22)		(1.06 - 1.15)	(0.95 - 1.03)
Population density (per 1,000)		1.48***	1.22***		1.53***	1.24***
		(1.37 - 1.59)	(1.14 - 1.30)		(1.42 - 1.65)	(1.18 - 1.31)
logTobdensRd			1.57***			
			(1.48 - 1.67)			
logVapedensRd			0.93**			1.01
			(0.89 - 0.98)			(0.97 - 1.06)
logAlcdensRd						1.71***
						(1.59 - 1.83)
Constant	0.35***	0.38***	0.69***	0.23***	0.26***	0.44***
	(0.34 - 0.37)	(0.36 - 0.40)	(0.63 - 0.76)	(0.22 - 0.24)	(0.25 - 0.28)	(0.41 - 0.47)
Observations	1,833	1,833	1,833	1,833	1,833	1,833
R-squared	0.04	0.32	0.48	0.04	0.29	0.46

Robust cieform in parentheses

*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

All continuous variables centered at the mean for predominantly Latino tracts (defined as >60% Latino)

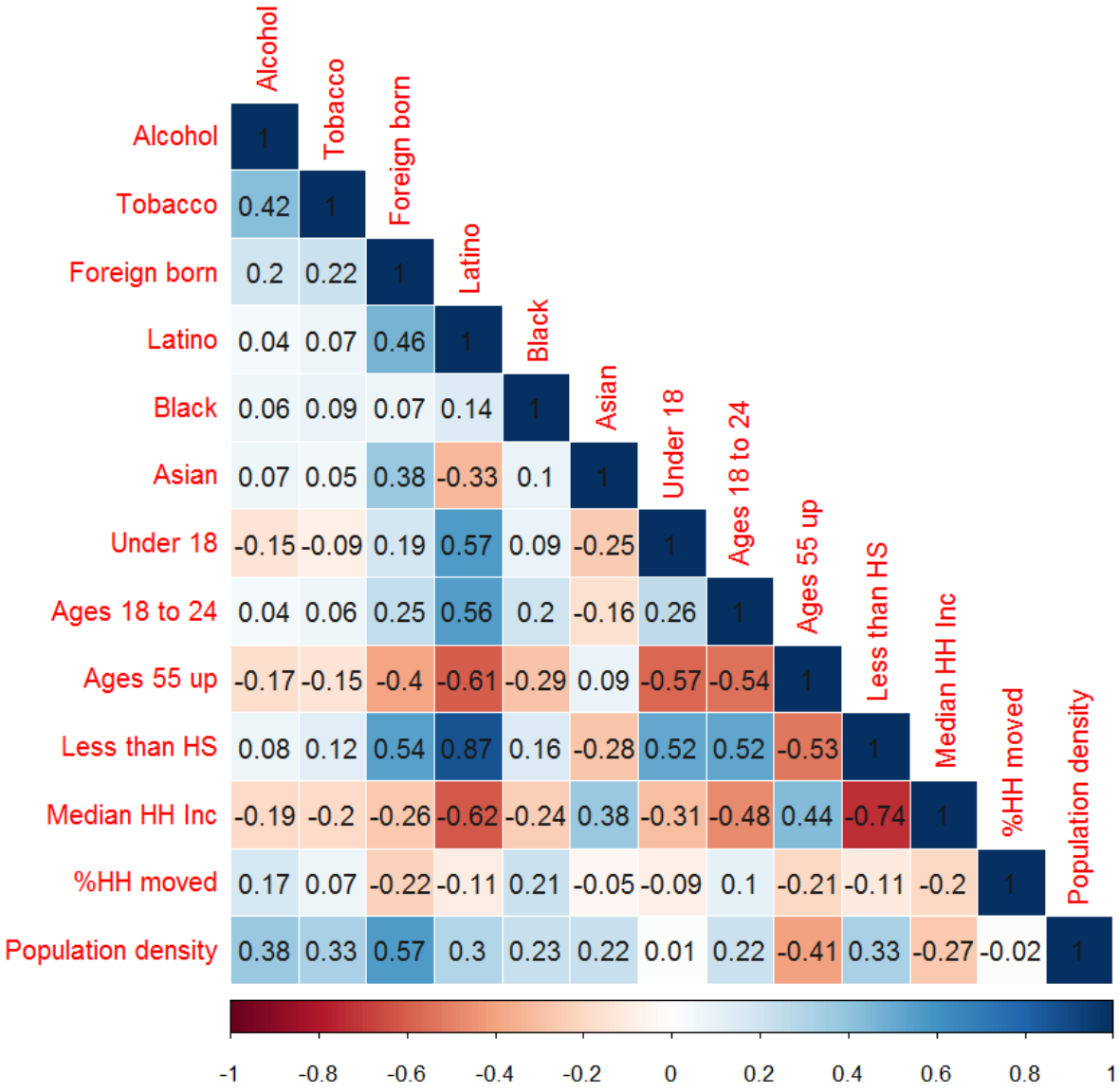

Figure. Spearman correlations between study variables