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# Do Sexually Oriented Massage Parlors Cluster in Specific Neighborhoods? A Spatial Analysis of Indoor Sex Work in Los Angeles and Orange Counties, California

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## ABSTRACT

**Objective.** Social determinants of health may be substantially affected by spatial factors, which together may explain the persistence of health inequities. Clustering of possible sources of negative health and social outcomes points to a spatial focus for future interventions. We analyzed the spatial clustering of sex work businesses in Southern California to examine where and why they cluster. We explored economic and legal factors as possible explanations of clustering.

**Methods.** We manually coded data from a website used by paying members to post reviews of female massage parlor workers. We identified clusters of sexually oriented massage parlor businesses using spatial autocorrelation tests. We conducted spatial regression using census tract data to identify predictors of clustering.

**Results.** A total of 889 venues were identified. Clusters of tracts having higher-than-expected numbers of sexually oriented massage parlors (“hot spots”) were located outside downtowns. These hot spots were characterized by a higher proportion of adult males, a higher proportion of households below the federal poverty level, and a smaller average household size.

**Conclusion.** Sexually oriented massage parlors in Los Angeles and Orange counties cluster in particular neighborhoods. More research is needed to ascertain the causal factors of such clusters and how interventions can be designed to leverage these spatial factors.

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Social determinants are recognized as important for population health, especially for the most vulnerable populations. The public health field is increasingly aware that social determinants are intertwined with place (i.e., the spatial determinants of health).<sup>1</sup> In developing new, more “upstream” interventions,<sup>2</sup> which target earlier points in the causal chain, it is necessary to develop a greater understanding of the intersection between social determinants and the places in which inequities persist.

One important spatial aspect is clustering. Recent studies have investigated causal factors associated with clustering (e.g., the clustering of liquor stores associated with poverty<sup>3,4</sup> and child maltreatment).<sup>5,6</sup> What is less clear, however, is why such businesses cluster in specific locations.

We examined the spatial clustering of sexually oriented massage parlors, a business type associated with negative health outcomes, in Southern California. Sex workers in these businesses are at risk for sexually transmitted infections, physical violence, and emotional abuse.<sup>7</sup> Sexually oriented massage parlors in the United States tend to employ mostly immigrant Asian as well as Latina/Hispanic women,<sup>8</sup> populations experiencing substantial health disparities.<sup>9</sup> Lower condom use rates in this population are associated with lack of support for condom use at venues and financial incentives from clients (e.g., a client offering money to not use a condom).<sup>10</sup>

Sexually oriented massage parlors are categorized as “indoor sex work”<sup>11</sup> because, unlike street-based sex work, transactions occur indoors. Although some studies suggest that indoor sex work has become the most prevalent form of sex work in the United States,<sup>12,13</sup> constituting up to 85% of all sex work activity,<sup>14</sup> most research has focused on street or “outdoor” sex work.<sup>15</sup> In studying spatial aspects of outdoor sex work, researchers have focused on “red-light” districts, where street-based sex workers congregate and “adult use” businesses (e.g., porn shops, strip clubs) cluster.<sup>16–18</sup> Few studies have focused on indoor sex work businesses outside of red-light districts, leaving gaps in knowledge about health for female sex workers and their male clients.<sup>15,19</sup> One study has suggested, for example, that sex work outside of red-light districts is associated with increased pressure on female sex workers to not use condoms.<sup>20</sup>

## BACKGROUND

The indoor sex industry in the United States ranges from individual workers providing services in their homes to associated businesses where workers provide

a combination of legitimate massage services and illegal sex services.<sup>21</sup> The apparent growth in the indoor sex work industry has been traced in part to more aggressive policing of street-based sex workers, driving sex work into indoor venues, and use of the Internet to connect clients and sex workers.<sup>19</sup> We briefly summarize the literature that provides two possible conceptual explanations for clustering: (1) cost-reduction advantages associated with localization and urbanization economies and (2) lower levels of law enforcement monitoring associated with moderate- and higher-income neighborhoods.

Indoor sex work industry firms may cluster for economic advantages. Although clustering can induce a price-cutting effect, agglomeration theory and empirical evidence suggest that the economic advantages of clustering often outweigh the costs.<sup>22</sup> Agglomeration theory posits that businesses reduce their costs by taking advantage of external effects or spillovers that result from colocation with other allied businesses.<sup>23</sup> Specialized businesses may at first locate near each other, forming what are described as localization economies (specialization and colocation) to take advantage of preexisting specialized labor pools, supplier input, and customers. The cluster begins to attract and support new labor, producers of supplier inputs, and customers, resulting in further cost reductions and increases in market size. Scaling up from the neighborhood to the urban region, a larger number and higher density of businesses in urban areas allows for multiple clusters of businesses specializing in different but related activities. These clusters of clusters further drive down costs associated with supplier input and access to labor pools, and are described as urbanization economies.

With respect to sexually oriented massage parlors, research suggests that such businesses locate in areas with high rates of male employment,<sup>24</sup> hotels, and active nighttime and adult entertainment.<sup>18</sup> Lower costs (e.g., proximate male clients leading to lower advertising and other costs, and immigrant female workers with massage and sex work skills leading to lower costs of finding new employees) may make delivering sex services less expensive than if these businesses were located elsewhere.<sup>25</sup> Additionally, in California, proximity to approved massage therapy schools may enable massage parlors to reduce their operational risk by making it easier for workers to get professional massage certification.

Sexually oriented massage parlors may also locate in specific neighborhoods because of lower law enforcement monitoring. Researchers have long argued that law enforcement activity limits sex work businesses to areas where such activity might be better tolerated.<sup>18</sup>

However, the relationship between illicit activity and neighborhood context is complex. For example, a study of sex work in Brussels found sex work to be highly tolerated in a traditional upper-class neighborhood but not in a recently gentrified area.<sup>26</sup>

In the United States, sexually oriented massage parlors exist in a gray area of the law, largely because they are often assumed to be sexually oriented even though they purport not to be. State and local laws, such as massage therapy licensing requirements, attempt to curtail illegal sexual activity without having to prove that it is occurring. In an attempt to systematize massage parlor regulation across the state, California created the California Massage Therapy Council (CAMTC), which is authorized by a 2009 state law.<sup>27</sup> CAMTC required at least 250 hours of training at approved schools for professional massage certification. If all individuals in a massage parlor were certified, the business would not be subject to restrictive zoning and high license fees that some cities had imposed; however, local laws prevailed when not all of the practitioners in an establishment were certified through CAMTC. Some cities complained that CAMTC had usurped local authority and led to a proliferation of illicit massage parlor activity.

Their complaints led to passage of the California Massage Therapy Reform Act in September 2014, which reinstated much of localities' regulatory authority.<sup>28</sup> Local policies within California vary greatly, with many cities and counties maintaining stricter rules after experiencing upticks in massage parlor activity. The City of Los Angeles, for example, requires a massage parlor worker to obtain both a massage therapy license and a police permit to practice massage.<sup>29</sup> Los Angeles County requires that the business and the massage parlor workers have business licenses to operate.<sup>30</sup> The City of Rancho Santa Margarita in Orange County enacted an ordinance in 2000 that requires background investigations and fingerprint checks for massage parlor employees.<sup>31</sup>

## METHODS

### Data

Data were manually coded from a massage parlor and escort review website (mreviews.com)<sup>32</sup> with ratings of more than 22,000 sex workers in the United States. To access the reviews on the website, users register using an e-mail address. Only members who pay a monthly fee are able to use all of the search functions available on the website and view photos. Each female massage parlor worker rated on the site has a member-provided description of her physical appearance, race/ethnicity,

age, location, cost for services, types of services offered, and reviews and ratings from members. All reviews for female massage parlor workers in Los Angeles and Orange counties listed on the site in April 2011 were analyzed, and race/ethnicity, age, services provided, and location of massage parlor were manually coded.

Because all data are member-reported, they may not accurately represent worker characteristics. The website provides review guidelines, asking users to list accurate, detailed descriptions of their experiences within 30 days of the encounter, and purports to vet reviews for accuracy and compliance with the site's guidelines "in order to keep the value of [the] site high."<sup>32</sup> Reviews are not posted automatically but, rather, are vetted first and then posted if approved. When users submit reviews for massage parlor workers already listed in the system, address information is prefilled, but the user has the opportunity to change the address. Given the website's interest in maintaining its value (and thereby profitability) by providing accurate information to users, it is likely that conflicting address information from users would be reconciled by the site managers during the vetting process.

We were not able to determine if the massage parlor listings on the website were comprehensive or representative of all massage parlors in Los Angeles and Orange counties. However, the Polaris Project, a prominent anti-human trafficking organization, estimated in 2011, contemporaneous with our research, that there were more than 4,000 sexually oriented Asian massage parlors in the United States.<sup>33</sup> The 889 massage parlors that we identified in Southern California consequently seemed a reasonable estimate, as Los Angeles and Orange counties have some of the largest Asian immigrant populations in the United States.

### Analysis

Using the number of massage parlors in each tract as the variable of interest, a global test of spatial autocorrelation, Moran's *I*-statistic, was calculated to test the null hypothesis that massage parlors were distributed randomly across tracts. We used Moran's *I*-statistic to gauge whether there was systematic rather than random distribution of massage parlors in the study area. A Local Indicator of Spatial Autocorrelation (LISA) statistic was calculated to identify the locations where massage parlors were clustering.<sup>34</sup> We used an empirical Bayes adjustment for the LISA statistic (using road miles in each Census tract as the denominator), which identified more low cluster tracts than without the adjustment. Otherwise, the cluster patterns were similar.

The clustering analyses employed an inverse

distance-weighted (IDW) measure of distance as the method to compare each tract with all other tracts in the study area and down-weight the influence of each tract on the index tract based on the distance between the two tracts. We also ran the analysis using inverse distance squared for the IDW measure, achieving very similar results. We used the IDW method rather than contiguity of tracts to determine the influence of tracts on each other, because it accounts for proximity of tracts to each other in a context where there is a diversity of tracts in scale and size.

We identified four categories of clustering: high-high (i.e., tracts with more than the expected number of massage parlors surrounded by tracts with more than the expected number of massage parlors); high-low (i.e., tracts with more than the expected number of massage parlors surrounded by tracts with fewer than the expected number of massage parlors); low-high (tracts with fewer than expected massage parlors surrounded by tracts with more than the expected number of massage parlors); and low-low (tracts with fewer than expected massage parlors surrounded by tracts with fewer than expected massage parlors).

To designate clusters, we created a new variable in which high-high census tracts were classified as 1 and other census tracts were classified as 0. This dichotomous hot spot variable was used as the dependent variable in logistic regression modeling to identify characteristics of census tracts associated with clusters. Using neighborhood data from the 2010 U.S. Census, we examined 22 census tract characteristics, including proportion male, proportion Asian, commute time, median household income, and number of employees in the census tract. We initially conducted a logistic regression analysis for each census tract characteristic of interest, analyzed without adjustment for covariates (i.e., unadjusted simple regression). Subsequently, all of the census tract characteristics were included in a single multivariate model to adjust for covariates, and variables were retained using backward stepwise regression, with  $p < 0.20$  as the cutoff. Prior to modeling, each census tract variable was converted to a  $z$ -score, which had a mean of 0 and standard deviation (SD) of 1 so that in the logistic regression results, each coefficient could be interpreted as the odds ratio (OR) associated with a 1 SD unit increase in the independent variable. Given the geographic nature of the data, the logistic regression modeling was conducted while including in each model a variable equal to the lag of the dependent variable (calculated using IDW). Conventional diagnostics were conducted for each model, including testing residuals for the presence of spatial autocorrelation, using variance inflation factors to test for multicol-

linearity, and generating plots of deviance vs. leverage statistics to test for outliers.<sup>35</sup> The multivariate model goodness-of-fit metrics indicated a parsimonious model.

The data representing the focus of this study (i.e., the number of massage parlors in census tracts) were not normally distributed and, thus, were not ideal for the cluster analyses that we employed. As such, we repeated the local cluster analysis using massage parlor rate per 100,000 population and the log of this rate. The resulting census tract cluster classifications (e.g., high-high, high-low) remained very similar to the original classifications derived from counts, as indicated by kappa statistics of 0.85 and 0.93, respectively.

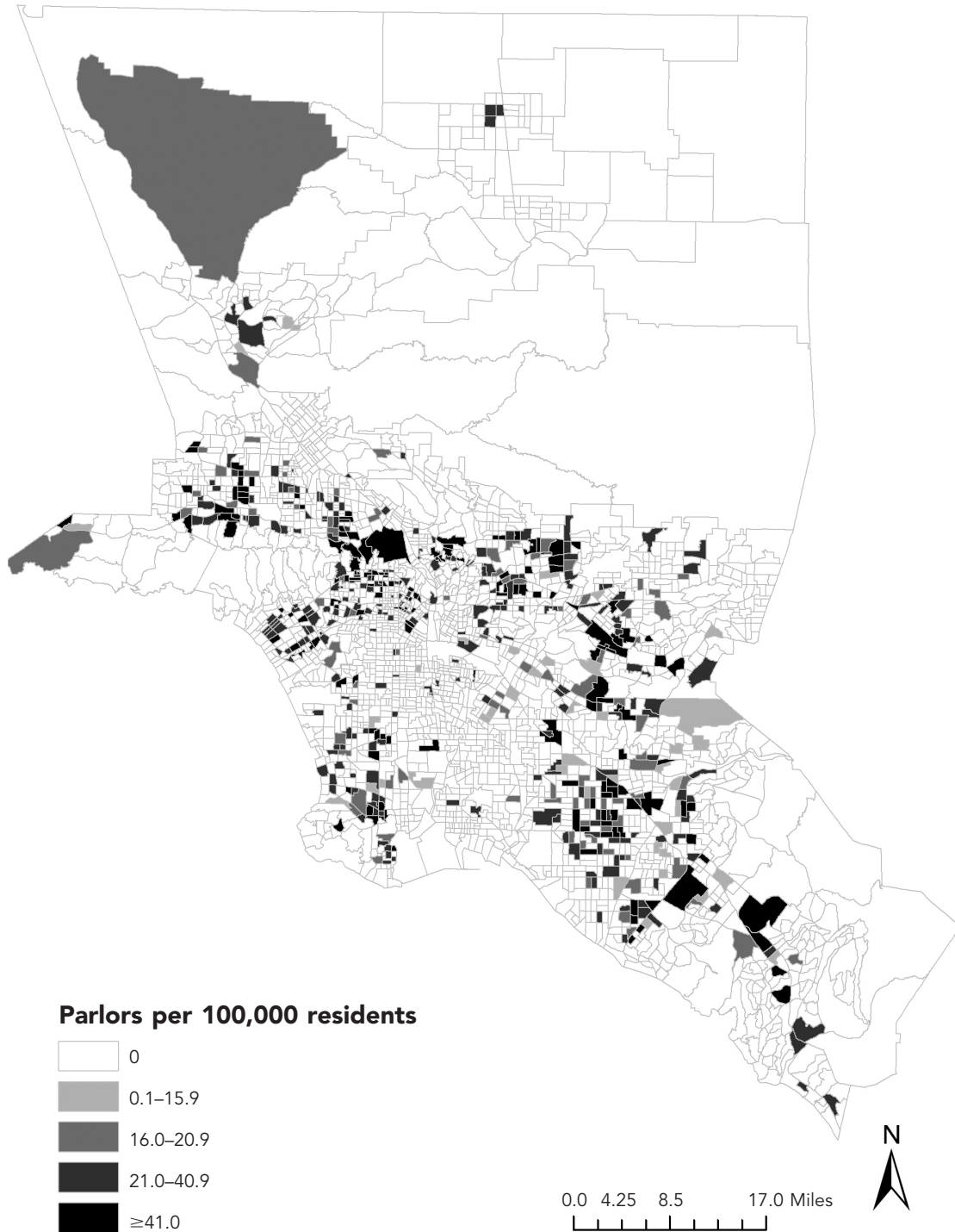
## RESULTS

We found 3,882 rated massage parlor workers and 889 unique massage parlors in Los Angeles and Orange counties. The largest ethnic group of sex workers was Chinese ( $n=1,698$ , 44%), followed by Koreans ( $n=1,434$ , 37%), with fewer Vietnamese ( $n=396$ , 10%) and Hispanic/Latina ( $n=354$ , 9%) sex workers. The largest age group was 30–37 years ( $n=1,380$ , 36%), followed by 25–29 years ( $n=1,174$ , 30%), 38–49 years ( $n=706$ , 18%), and 21–24 years ( $n=497$ , 13%) (age categories were defined by the website). The most common sexual service was hand job (83%), followed by blowjob (47%), vaginal intercourse (44%), and anal sex (1%) (data not shown in a table).

### Massage parlor clusters

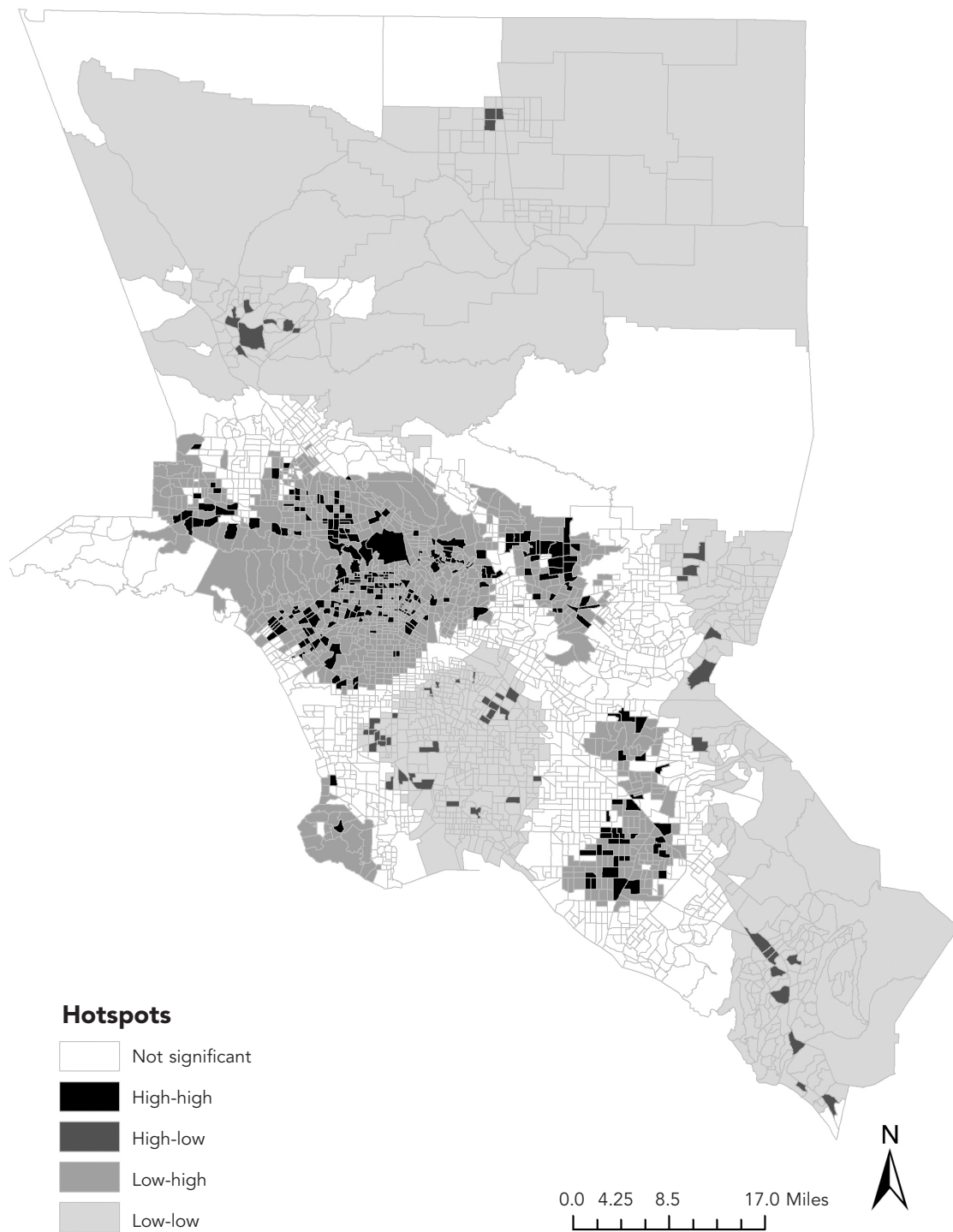
The global test of spatial autocorrelation, calculated on the number of massage parlors per capita, found evidence that massage parlors cluster in Los Angeles and Orange counties (Moran's  $I=0.005$ ,  $z$ -score=4.28,  $p < 0.001$ ) (Figure 1). The local test of spatial autocorrelation (Figure 2) revealed low-low tracts (i.e., “cold spots”) in the northern and eastern portions of Los Angeles County, the industrial core of Los Angeles County, and the eastern and southern portions of Orange County. Hot spots were located to the north, west, and southeast of the central industrial core of Los Angeles County and formed essentially a ring of tracts through Los Angeles County and the northern part of Orange County. The northwestern hot spots included wealthier communities, such as Santa Monica, Beverly Hills, and West Hollywood; northern hot spots were located through the working-class neighborhoods in the San Fernando Valley; eastern hot spots were located through the eastern suburban areas of Los Angeles County and moving south into the northern half of Orange County; and the westernmost hot spot was located near Rancho Palos Verdes.

**Figure 1. Spatial distribution of sexually oriented massage parlors (per 100,000 residents) in Los Angeles and Orange counties, California, by census tract, 2011**





**Figure 2. Results of local test of spatial autocorrelation to identify clusters of sexually oriented massage parlors in census tracts<sup>a</sup> in Los Angeles and Orange counties, California, 2011**



<sup>a</sup>High-high clusters were tracts with more than the expected number of massage parlors surrounded by tracts with more than the expected number of massage parlors. High-low tracts were tracts with more than the expected number of massage parlors surrounded by tracts with fewer than the expected number of massage parlors. Low-high tracts were tracts with fewer than the expected number of massage parlors surrounded by tracts with more than the expected number of massage parlors. Low-low tracts were tracts with fewer than the expected number of massage parlors surrounded by tracts with fewer than the expected number of massage parlors.

### Neighborhood characteristics associated with sexually oriented massage parlor clusters

Some interesting patterns at the census-tract level included a higher proportion of Asian sex workers, a lower proportion of Hispanic sex workers, and the lowest median household and family sizes in the high-high census tracts. High-high tracts also had the highest number of employees and employees per capita, while low-low tracts had the lowest values for these two measures. High-high tracts and low-high tracts had the lowest median incomes and the highest rates of poverty (Table 1).

The results of the unadjusted and adjusted multivariate logistic regression models are reported as ORs, where an OR that is significantly  $>1$  indicates that the probability of a census tract having a massage parlor cluster (i.e., a high-high tract) increases as the census tract characteristic being analyzed increases. Conversely, an OR that is significantly  $<1$  indicates that the probability of a census tract having a massage parlor cluster decreases as the census tract characteristic of interest increases (Table 2).

In the unadjusted regression analyses, 17 of the 22 variables were associated either positively or inversely with clustering of sexually oriented massage parlors. The nine variables associated positively with clustering in tracts were having a higher proportion of males overall, males 20–64 years of age, Asians, residents of two or more races, vacant housing, unemployed people, residents who walk to work, number of employees working in the census tract as compared with other census tracts, and households below the federal poverty level (FPL). The eight variables associated inversely with clustering were having a higher proportion of young adult male residents (15–24 years of age), females, residents identifying with only one race, Hispanic residents, female-headed households, and a higher average household size, family size, and median household income (Table 2).

In the adjusted multivariate regression model, six variables remained statistically significant. The three variables associated positively with clustering were having a higher proportion of males 20–64 years of age, a higher average family size, and a higher proportion of households below the FPL. The three variables associated inversely with clustering were having a higher average household size, a higher proportion of residents who walk to work, and a higher median household income (Table 2).

### DISCUSSION

The spatial analysis showed that massage parlors did cluster and that these clusters were not typically in downtown Los Angeles; rather, they formed a ring through working-class and upper-income (in some cases) census tracts. In the unadjusted regression analyses, the proportion of adult males overall and those aged 20–64 years (client supply), the proportion unemployed (client supply), the number of employees (client supply), and the proportion of Asian residents (labor supply) were positively associated with clustering. Unemployed people have unstructured time that may increase their likelihood of visiting sex workers, while having more employees in a census tract may also increase the client supply of individuals who may visit sex workers during lunch breaks and after work. Although the proportions of males overall and males 20–64 years of age were positively associated with clustering, the proportion of males aged 15–24 years was negatively associated with clustering, as teenage boys may be unlikely to visit sex workers in massage parlors because of their young age and lack of income. The positive associations with the proportion of vacant housing and the proportion of households below the FPL may indicate that massage parlors cluster in census tracts with lower rents. The association of clusters with poverty may also be related to greater labor supply (e.g., those with fewer alternative options for earning income).

In the adjusted multivariate regression analysis, the positive associations with proportion male (20–64 years of age) and proportion of households below the FPL were maintained, and the negative associations with average household size and median family income were also maintained. These results indicate that massage parlor clustering may be driven mostly by client supply and lower rents. The negative association of clustering with average household size may indicate that areas that have larger households with children may be less receptive to massage parlors. Labor supply appears to be less of a factor, suggesting that massage parlors can count on workers to travel longer distances, an interpretation that is consistent with the relatively low socioeconomic position of massage parlor workers. Two variables, average family size and proportion of residents who walk to work, flipped direction when moving from the unadjusted to the adjusted multivariate regression, possibly because their effects on the dependent variable are accounted for by other variables in the multivariate model. In the multivariate model, massage parlor clustering was not associated with characteristics typically associated with spatial facets



**Table 1. Census tract-level characteristics of the population, households, and housing stock by type<sup>a</sup> of clustering of 889 massage parlors in Los Angeles and Orange counties, California, 2011**

Census tract characteristic	High-high clusters <sup>b</sup> Median (p25, p75) <sup>c</sup>	High-low outliers <sup>b</sup> Median (p25, p75) <sup>c</sup>	Low-high outliers <sup>b</sup> Median (p25, p75) <sup>c</sup>	Low-low clusters <sup>b</sup> Median (p25, p75) <sup>c</sup>	Not significant census tracts Median (p25, p75) <sup>c</sup>
<b>Sex</b>					
Proportion male	0.50 (0.48, 0.51)	0.49 (0.48, 0.50)	0.49 (0.48, 0.51)	0.49 (0.48, 0.50)	0.49 (0.48, 0.50)
Proportion male (15–24 years of age)	0.07 (0.05, 0.08)	0.08 (0.07, 0.09)	0.07 (0.06, 0.09)	0.08 (0.07, 0.09)	0.08 (0.07, 0.09)
Proportion male (20–64 years of age)	0.32 (0.30, 0.36)	0.29 (0.28, 0.30)	0.31 (0.29, 0.33)	0.29 (0.28, 0.31)	0.30 (0.28, 0.31)
Proportion female	0.50 (0.49, 0.52)	0.51 (0.50, 0.52)	0.51 (0.49, 0.52)	0.51 (0.50, 0.52)	0.51 (0.50, 0.52)
<b>Race/ethnicity</b>					
Proportion one race	0.95 (0.95, 0.96)	0.95 (0.95, 0.96)	0.96 (0.95, 0.96)	0.96 (0.95, 0.96)	0.96 (0.95, 0.96)
Proportion white	0.53 (0.37, 0.70)	0.55 (0.36, 0.67)	0.49 (0.35, 0.69)	0.53 (0.39, 0.73)	0.53 (0.42, 0.67)
Proportion black	0.03 (0.02, 0.05)	0.03 (0.02, 0.12)	0.03 (0.01, 0.06)	0.05 (0.02, 0.14)	0.02 (0.01, 0.04)
Proportion Asian	0.13 (0.07, 0.25)	0.08 (0.04, 0.17)	0.10 (0.05, 0.19)	0.07 (0.02, 0.12)	0.10 (0.04, 0.22)
Proportion ≥2 races/ethnicities	0.05 (0.03, 0.05)	0.05 (0.04, 0.05)	0.04 (0.04, 0.05)	0.05 (0.04, 0.05)	0.04 (0.04, 0.05)
Proportion Hispanic	0.33 (0.14, 0.60)	0.40 (0.23, 0.68)	0.42 (0.15, 0.72)	0.39 (0.19, 0.68)	0.40 (0.18, 0.71)
<b>Household</b>					
Proportion female-headed household	0.13 (0.09, 0.17)	0.16 (0.11, 0.20)	0.15 (0.10, 0.20)	0.16 (0.10, 0.22)	0.15 (0.11, 0.19)
Average household size	2.66 (2.08, 3.13)	3.11 (2.81, 3.41)	2.84 (2.44, 3.56)	3.18 (2.72, 3.84)	3.12 (2.71, 3.73)
Average family size	3.26 (2.92, 3.62)	3.49 (3.25, 3.79)	3.39 (3.03, 3.96)	3.55 (3.19, 4.14)	3.51 (3.18, 4.03)
<b>Housing stock</b>					
Proportion vacant housing	0.06 (0.05, 0.07)	0.05 (0.03, 0.06)	0.05 (0.04, 0.07)	0.04 (0.03, 0.07)	0.04 (0.03, 0.06)
<b>Employment</b>					
Proportion unemployed	0.09 (0.06, 0.11)	0.08 (0.06, 0.11)	0.08 (0.06, 0.11)	0.08 (0.06, 0.12)	0.07 (0.06, 0.10)
Proportion walk to work	0.02 (0.01, 0.05)	0.02 (0.01, 0.03)	0.02 (0.01, 0.05)	0.01 (0.00, 0.03)	0.02 (0.00, 0.03)
Proportion work from home	0.04 (0.02, 0.07)	0.04 (0.02, 0.05)	0.04 (0.02, 0.06)	0.03 (0.02, 0.06)	0.03 (0.02, 0.06)
Commute time (minutes)	27.9 (25.4, 30.4)	27.8 (25.1, 30.7)	28.2 (25.5, 31.2)	28.3 (26.0, 31.6)	27.7 (24.9, 30.6)
Number of employees	1,307 (699, 2,538)	1,233 (543, 3,616)	677 (340, 1,538)	667 (321, 1,630)	783 (370, 1,655)
Number of employees per capita (residents)	0.34 (0.16, 0.71)	0.23 (0.11, 0.97)	0.18 (0.09, 0.39)	0.15 (0.08, 0.35)	0.18 (0.09, 0.38)
<b>Income</b>					
Median annual household income	\$52,933 (\$38,170, \$68,838)	\$62,723 (\$47,424, \$77,379)	\$51,620 (\$36,071, \$73,393)	\$60,453 (\$42,349, \$86,542)	\$62,665 (\$46,934, \$81,931)
Proportion below federal poverty level last 12 months	0.11 (0.05, 0.20)	0.07 (0.02, 0.16)	0.11 (0.05, 0.21)	0.07 (0.03, 0.18)	0.07 (0.03, 0.15)

<sup>a</sup>Using 2010 U.S. Census data

<sup>b</sup>High-high clusters were tracts with more than the expected number of massage parlors surrounded by tracts with more than the expected number of massage parlors. High-low tracts were tracts with more than the expected number of massage parlors surrounded by tracts with fewer than the expected number of massage parlors. Low-high tracts were tracts with fewer than the expected number of massage parlors surrounded by tracts with more than the expected number of massage parlors. Low-low tracts were tracts with fewer than the expected number of massage parlors surrounded by tracts with fewer than the expected number of massage parlors.

<sup>c</sup>p25 = 25th percentile and p75 = 75th percentile

**Table 2. Results of unadjusted and adjusted logistic regression analyses to identify census tract characteristics associated with clustering of 889 sexually oriented massage parlors in Los Angeles and Orange counties, California, 2011<sup>a</sup>**

Census tract characteristic	Unadjusted analysis		Adjusted analysis	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Sex (age)				
Proportion male	1.14 (1.02, 1.27)	<0.001		
Proportion male (15–24 years of age)	0.63 (0.50, 0.79)	<0.001		
Proportion male (20–64 years of age)	1.50 (1.35, 1.67)	<0.001	1.33 (1.08, 1.64)	0.007
Proportion female	0.88 (0.79, 0.98)	0.024		
Race/ethnicity				
Proportion one race	0.87 (0.76, 0.98)	0.024		
Proportion white	0.93 (0.81, 1.06)	0.272		
Proportion black	1.01 (0.86, 1.19)	0.879	0.81 (0.64, 1.02)	0.078
Proportion Asian	1.16 (1.04, 1.31)	0.010	1.15 (0.99, 1.34)	0.069
Proportion ≥2 races/ethnicities	1.15 (1.02, 1.31)	0.024		
Proportion Hispanic	0.85 (0.74, 0.98)	0.021		
Household				
Proportion female-headed household	0.74 (0.63, 0.87)	<0.001		
Average household size	0.56 (0.49, 0.65)	<0.001	0.12 (0.05, 0.28)	<0.001
Average family size	0.70 (0.62, 0.80)	<0.001	4.42 (1.69, 11.59)	0.002
Proportion vacant housing	1.19 (1.09, 1.31)	<0.001		
Employment				
Proportion unemployed	1.25 (1.09, 1.42)	0.001		
Proportion walk to work	1.11 (1.01, 1.23)	0.037	0.73 (0.60, 0.89)	0.002
Proportion work from home	1.07 (0.96, 1.20)	0.204		
Commute time (minutes)	1.12 (0.97, 0.68)	0.133		
Number of employees	1.17 (1.06, 1.29)	0.002	1.11 (0.98, 1.25)	0.115
Number of employees per capita (residents)	0.97 (0.69, 1.37)	0.873		
Income				
Median annual household income	0.57 (0.47, 0.68)	<0.001	0.67 (0.50, 0.91)	0.009
Proportion below federal poverty level, last 12 months	1.32 (1.16, 1.50)	<0.001	1.34 (1.08, 1.67)	0.009

<sup>a</sup>Logistic regression conducted with spatial lag to account for spatial autocorrelation.

Adjusted analysis conducted with backward stepwise regression to retain covariates with  $p < 0.20$ .

Each predictor variable was transformed to a z-score with a mean of 0 and standard deviation of 1. The area under the curve for the adjusted model is 0.84 (95% CI 0.82, 0.86).

OR = odds ratio

CI = confidence interval

of urban disadvantage (i.e., central downtown areas). Sexually oriented massage parlor clusters were not associated with proportion black, proportion Hispanic, proportion of female-headed households, proportion of vacant housing, and proportion unemployed.

**Limitations**

This study was subject to several limitations. Although based in a large, diverse geographic region, the study area was unique. Thus, the results may not be generalizable to the United States. Also, the data source was from a ratings site where users posted most of the information. However, there was some vetting of posted information by the website managers to maintain accuracy and the website’s value to paying users.

**CONCLUSION**

The gaps in this study point to several topics that require further investigation. Although the model results suggest that neighborhood characteristics significantly explain the variation in clusters, the mechanisms and causes of clustering need further clarification. For example, as intolerance rises, do sexually oriented massage parlors close and open elsewhere? The choice of sexually oriented massage parlor location also varied. High-high tracts suggest clusters while high-low tracts are more akin to massage parlor islands. Further research might explore an explanation for parlor location behavior and to what degree regulatory requirements (e.g., licensing)

and enforcement practices and patterns (e.g., arrests, incarceration, and diversion programs) come into play. Additional research may help health researchers, practitioners, and policy makers devise more effective approaches to reducing health disparities for indoor sex workers and their clients.

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