Published in final edited form as:
*Soc Sci Med*. 2006 June ; 62(12): 3062–3071.

# Alcohol outlets, gonorrhea, and the Los Angeles civil unrest: A longitudinal analysis

**Deborah A. Cohen**[a,*], **Bonnie Ghosh-Dastidar**[a], **Richard Scribner**[b], **Angela Miu**[a], **Molly Scott**[c], **Paul Robinson**[d], **Thomas A. Farley**[e], **Ricky N. Bluthenthal**[a,d], and **Didra Brown-Taylor**[f]

a*RAND Corp., 1776 Main Street, Santa Monica, CA 90407, USA*

b*LSUHSC, Louisiana State University Health Sciences Center, School of Public Health, New Orleans, LA, USA*

c*UCLA Center for Adolescent Health Promotion, Los Angeles, CA, USA*

d*Charles Drew University, Los Angeles, CA, USA*

e*Tulane School of Public Health and Tropical Medicine, New Orleans, LA, USA*

f*UCLA Integrated Substance Abuse Programs, Los Angeles, CA, USA*

## Abstract

This study tests the effect of neighborhood changes on gonorrhea rates. Prior studies that indicate gonorrhea rates are associated with alcohol outlet density and neighborhood deterioration have been cross-sectional and cannot establish causality. After the 1992 Civil Unrest in Los Angeles, 270 alcohol outlets surrendered their licenses due to arson and vandalism thus providing a natural experiment. We geocoded all reported gonorrhea cases from 1988 to 1996 in LA County, all annually licensed alcohol outlets, and all properties damaged as a result of the civil unrest. We ran individual growth models to examine the independent effects of changes in alcohol outlets and damaged buildings on gonorrhea. The individual growth model explained over 90% of the residual variance in census tract gonorrhea rates. After the civil unrest, a unit decrease in the number of alcohol outlets per mile of roadway was associated with 21 fewer gonorrhea cases per 100,000 ($p<.01$) in tracts affected by the Unrest compared to those not affected. Neighborhood alcohol outlets appear to be significantly associated with changes in gonorrhea rates. The findings suggest that efforts to control sexually transmitted diseases, including gonorrhea and HIV, should address contextual factors that facilitate high-risk behaviors and disease transmission

### Keywords

Gonorrhea; Alcohol outlets; Civil unrest; “Broken windows”; GIS; Los Angeles; Growth model

## Introduction

The world in which we live is a complicated ecosystem in which small changes in one seemingly distant component can affect other facets of the system indirectly. When neighborhoods and communities are physically altered, many social changes and unintended consequences may follow. For example, Wallace et al. (Wallace, 1990;Wallace & Wallace, 1991) described how the closure of fire stations in parts of New York City led to neighborhood deterioration, community destruction, and the spread of HIV. DeCosas describes how the

*Corresponding author.

building of a dam in Ghana displaced villages and resulted in an epidemic of HIV because villagers who lost their farmlands, and thus their livelihoods, took up sex work as a means to survive (Decosas, 1995).

Neighborhood change, however, is usually more subtle or gradual than these examples, making the impact of the physical environment on our social behaviors hard to identify. In addition, because many socioeconomic and demographic groups in the United States exhibit substantial mobility (20% of United States residents moved within 1 year, between 1999 and 2000 (Census, 2000)), it can be particularly difficult to link health outcomes at the individual level to neighborhood conditions. Lastly, despite legal protections to ensure residential choice, differential access to housing loans and markets can make it difficult to disentangle individual and group preferences for community types from the impact of a neighborhood's physical and social structure on the individuals who live there (Fischer, 2003;Holloway, 1998;Massey & Denton, 1993;Squires, Friedman, & Saidat, 2002). Opportunities to understand the discreet effects of the environment may arise when sudden changes occur and subsequent events can be clearly attributed to those changes.

Such an opportunity arose in Los Angeles in 1992, when, in the aftermath of the trial of the four police officers accused of brutally beating Rodney King, several days of rioting, looting, and arson resulted in the closure of 270 alcohol outlets, 55 deaths, and nearly one billion dollars of property damage (Fig. 1). In addition, a community mobilization effort in South Central Los Angeles that had begun prior to the civil unrest in response to the crack cocaine epidemic (Karen Bass, 2004, personal communication) was refocused on preventing destroyed alcohol outlets from reopening (Grills, Bass, Brown, & Akers, 1996). The property destruction coupled with community efforts that resulted in new conditional use zoning laws made it more difficult to open an alcohol outlet. Placing a variety of new requirements on operating alcohol outlets reversed a trend of increasing alcohol outlets in Los Angeles County (Berestein, 1994;Kang, 1994).

Since peaking in 1992, there has been a 9% decrease in overall on-premise alcohol outlets in Los Angeles County and an 11% decrease in overall off-premise outlets through 2000 (California Alcohol Beverage Control). Eighteen percent of this decline was a direct result of civil unrest caused destruction of alcohol outlets. Community mobilization prevented at least 40 off-premise alcohol outlets from re-opening and many were forced to reopen in other locations (Robinson-Jacobs, 2002).

Previous research has linked the density of neighborhood alcohol outlets with a variety of negative health outcome including homicides, assault, motor vehicle fatalities, and gonorrhea rates (2000; Gorman & Speer, 1997;Gruenewald & Ponicki, 1995;Scribner, Cohen, & Farley, 1998;Scribner, Cohen, & Kaplan, 1999;Scribner, MacKinnon, & Dwyer, 1994). In addition, previous studies indicate that deteriorated neighborhoods characterized by boarded up homes have higher rates of gonorrhea, premature mortality, and premature mortality from homicide and heart disease (Cohen et al., 2000;Cohen, Farley, & Mason, 2003;Cohen et al., 2003). However, these studies have been cross-sectional so it is unclear if these associations are causal.

A combination of theories has been put forward to explain the various components of the complex social, economic, and environmental interactions involved in a potential causal relationship between alcohol outlet density and alcohol related outcomes like gonorrhea. In a study of sexual networks involved in a gonorrhea outbreak, a popular motel bar was found to be the most important linking factor for eight large sexual networks (De, Singh, Wong, Yacoub, & Jolly, 2004). Gruenewald and colleagues (Gruenewald, Treno, Nephew, & Ponicki, 1995) have promoted a theory of economic optimization to explain the "choice" of drinking venues (i.e., liquor stores versus bars) by various risk populations in terms of maximizing their demand

for alcohol within economic and environmental constraints. Optimization theory explains why the drinking patterns of African Americans, the population at highest risk for gonorrhea, tend to be associated with off-premise liquor outlets, the type of outlet typically destroyed during the 1992 Civil Unrest. Treno, Alaniz, and Gruenewald, (2000) have extended optimization theory incorporating concepts of routine activities theory (Cohen & Felson, 1979) by demonstrating that African American and Hispanic drinking patterns associated with liquor stores results in drinking in less controlled environments (i.e., parties, special events, public places, and friend's houses). Presumably, it is in these environments that the greater risks of high risk sexual behavior and disease transmission occur, thus explaining the higher rate of gonorrhea associated with alcohol availability at local liquor stores. However, it should be noted that no research to support this final supposition has been conducted. Finally, race/ethnicity is also strongly associated with gonorrhea and STDs with African-Americans and Hispanics affected at rates 7–30 fold higher than Whites (Moran, Aral, Jenkins, Peterman, & Alexander, 1989). This large difference in disease prevalence has not been associated with any genetic predispositions (Aral, 1994;Ellen, Aral, & Madger, 1998;Garnett et al., 1996).

This paper investigates the temporal and geographic association between reported cases of gonorrhea and alcohol outlets and damaged buildings. On the one hand, if alcohol outlets are in the causal pathway of gonorrhea because they supply alcohol, which is associated with risky behaviors, we would expect declines in gonorrhea with their closure. On the other hand, if boarded up buildings signal social disorder and tolerance of deviant and high-risk behaviors, then an increase in gonorrhea should follow an increase in property damage.

The greatest numbers of reported gonorrhea cases tend to come from poor and minority communities (Cohen et al., 2000;Scribner et al., 1998). Since the poor and minority communities within our study area are composed of multiple contiguous census tracts, we expect that census tracts with high gonorrhea rates will be spatially clustered or spatially autocorrelated. Regression analyses involving spatially autocorrelated units can lead to inflation of the effect sizes resulting in Type 1 errors (Gruenewald, 2000). Consequently, our analysis includes a spatial regression model and a nuisance parameter to account for spatial error.

## Methods

### Sample description

The unit of analysis in this study was the census tract. The study includes 1652 census tracts in Los Angeles County from the 1990 US Census definitions, which represent a rich mix of race/ethnicity, socio-economic status and prevalence of gonorrhea. Of these, we excluded 159 tracts with a population less than 2700, and 12 unusual tracts that included ships-at-sea, group quarters and Universal Studios. As a result, the analysis sample included 1481 census tracts. Of the 1481 tracts, 420 tracts reported a total of 2240 unique addresses damaged in the 1992 civil unrest while 153 tracts had one or more off-premise liquor outlets whose license was surrendered. The majority of the damaged addresses were commercial businesses.

### Data sources

Annual population counts at the census tract level by age, gender and race/ethnicity from 1990–2000 were provided by the LA County Department of Health. Actual counts were available for 1990 and 1995, with values interpolated for intermediate years using 1990 census tract boundaries. The LA County Department of Health also provided annual counts of gonorrhea of which 83% of all cases between 1988 and 2001 were geocoded. The match rate was slightly higher for African-Americans than for whites but because the rate of gonorrhea is about 30-fold higher for African Americans than for whites (Moran et al., 1989) this geocoding disparity

was unlikely to bias our findings. Although census data may not be accurate in areas where there is much illegal immigration gonorrhea cases are also typically underreported, so if anything our estimates of gonorrhea rates are probably conservative (Kirsch, Shesser, & Barron, 1998;Rothenberg, Bross, & Vernon, 1980). There is no evidence of any change in the reporting processes over this time period.

Annual counts of liquor outlet licenses came from the California Department of Alcohol Beverage Control (ABC) and our geocode rate was 98%. We also obtained a list of outlets that surrendered their licenses as a result of the 1992 Los Angeles civil unrest. Using license codes provided by the ABC, we classified the alcohol outlets based on their license to sell alcohol on-premise (bars and restaurants) or off-premise (liquor stores, grocery stores, and convenience stores). The list of riot-damaged addresses comes from Ong (1993). The author compiled information on damaged buildings from three different sources: the Los Angeles City Department of Building and Safety, the Korean Central Daily and the California Insurance Commission. In addition, we also obtained a list of damaged addresses for the Compton area from the Compton Department of Building and Safety. We were able to geocode 99% of all damaged addresses mapping them to the 1990 Census tract areas. In order to quantify exposure to alcohol outlets, for each census tract we calculated the number of outlets per roadway mile. The remaining predictors were obtained from the 1990 US Census.

Individual residences, age, gender and race/ethnicity of persons diagnosed with gonorrhea were obtained and addresses geo-coded then aggregated by census tracts for analysis. Over eighty percent of addresses were matched using Arcview 3.2 GIS software (ESRI Inc, Redlands, CA) along with Los Angeles County TIGER street files from the 2000 census. Addresses that the computer was unable to match were hand placed with the help of an Internet mapping site (Mapquest) and a Thomas Guide map book.

## Measures

The primary outcome in our analysis is annual age and sex adjusted gonorrhea rate (1988–1996) at the census tract level which we calculated using direct standardization (Page, Cole, & Timmreck, 1995). Because gonorrhea primarily affects individuals of child-bearing age, and disproportionately affects teenagers, we adjusted for five age groups (<15, 15–19, 20–29, 30–39 and 40+) and for gender. Only census tracts with populations of at least 2700 contributed to the county level rates. The number 2700 was obtained using the formula for minimum population size suggested by Wojdyla, Poletto, Cuesta, Badler, and Passamonti (1996) assuming a value of 1.96 for the *z*-statistic and an overall LA County gonorrhea rate of .001385.

The three key predictors associated with the 1992 civil unrest were: physical damage during the 1992 civil unrest, surrender of off-premise liquor outlet license around May, 1992, and annual alcohol outlet density from 1991 to 1996. Physical damage was measured as a binary indicator of any damage in the tract due to the civil unrest. We measured surrendered off-premise alcohol licenses due to the 1992 civil unrest by computing the ratio of the number of off-premise liquor outlet licenses surrendered in 1992 to the total number of off-premise liquor outlet licenses in the tract in 1991 just prior to the civil unrest. Annual alcohol outlet density was measured as the ratio of the number of off-premise liquor outlets to the number of miles of roadway in each tract.

The other covariates included were: (1) percentage Black, (2) percentage Hispanic, (3) percentage male, (4) an index of socio-economic status, computed by averaging standardized values of the 1990 Census measures: median income, percent of population with education level less than high school, and percent unemployed in the tract, and (5) baseline adjusted gonorrhea rate. The first three covariates were annual estimates available for the each of the

years between 1990 and 1999; socio-economic status was available for 1990 only; baseline gonorrhea rate is from 1988.

## Analysis procedures

Before performing modeling and advanced analyses, we calculated descriptive statistics and bivariate correlations, and checked the variables for linearity and normality. Preliminary analyses suggested that the full model including all of the mentioned predictors may be collinear. Therefore, we performed theory-driven predictor selection in conjunction with backwards and forwards stepwise regression to remove collinear variables. In all the models, we controlled for all available baseline and time-varying covariates to account for selection effects.

To appropriately model the longitudinal data (on tracts) over time, we used individual growth models realized through PROC Mixed in SAS (Littell, Milliken, Stroup, & Wolfinger, 1996;Singer, 1998). We used a two-level model, in which the level-1 model (within tract) is a linear individual growth model, and the level-2 model (between tract) expresses variation in parameters from the growth model as a function of tract-level covariates (characteristics) and interactions of time with tract-level covariates. The level-1 and level-2 models can be written as a single combined model with fixed and random effects, where we represent the fixed parameters as $\beta$ and the random parameters (or error terms) using $u$. The combined model is:

$$Y_{ij} = [\beta_{oo} + \beta_{10}\mathrm{TIME}_{ij} + \beta_{20}x_{ij} + \beta_{30}x_{ij}\mathrm{TIME}_{ij}] + [u_{oj} + u_{ij}\mathrm{TIME}_{ij} + r_{ij}],$$

Where $r_{ij} \sim N(0, \sigma^2)$.

Note that this model includes both a random intercept and a random slope over time for each tract. The measure of time was centered at 1992, while all of the variables were centered at their respective 1992 means.

We elected to use an individual growth model using direct standardized rates rather than a Poisson model because the use of standardized rates is the accepted practice in STD epidemiology and has the benefit of easy interpretation (Page et al., 1995). Furthermore, we could not find software that would fit longitudinal poisson count data as well as adjust for spatial clustering under a fully Bayesian approach.

## Spatial adjustment

As an initial step, we computed a Moran's I statistic to quantify the amount of clustering in annual gonorrhea rates. We enhanced the individual growth model to account for the effects of spatial autocorrelation amongst census tracts, using the Repeated statement in SAS Proc Mixed. This procedure allowed us to adjust the standard errors and significance tests to account for any inflation or deflation due to geographical clustering. We assumed a spherical covariance structure, based on a semivariogram computed from these data. The three parameters in the spherical covariance structure: partial sill ($\sigma^2$), range ($\rho$) and nugget ($\sigma_1^2$) were estimated from the semivariogram. The spherical covariance structure is given by the following equation:

$$\sigma^2\left[1 - \left(\frac{3d_{ij}}{2\rho}\right) + \left(\frac{d_{ij}^3}{2\rho^3}\right)\right]1(d_{ij} \le \rho),$$

where $d_{ij}$ is the Euclidean distance between the centroids of the $i$th and $j$th vectors of these coordinates, which correspond to the $i$th and $j$th tracts in the input data set.

In this particular application, the spherical clustering was specified on the state plane coordinate system in miles using a 3-mile lag distance. We found that the semivariogram was robust to

choices of lag distance and maximum number of lags. We also provided estimates of the covariance parameters as starting values to PROC Mixed. We conducted a test for $H_0$: $\rho = 0$ that there is no spatial clustering. In order to do this, we computed a likelihood ratio test statistic as the difference of −2 times the REML log likelihood (−2 REML LL) of the spatially adjusted model and that of a model without spatial adjustment. The resulting likelihood ratio test has two degrees of freedom. Finally, we compared the regression coefficients, standard errors and the associated tests of significance between the unadjusted and adjusted growth models to determine the impact of the adjustment.

## Results

Table 1 summarizes the predictors used in the models and describes the demographic characteristics of the 1481 tracts in Los Angeles County. Among the tracts, the average number of off-premise alcohol outlets per road mile prior to the 1992 riot was 0.49, the average percent of off-premise liquor outlet licenses surrendered immediately after the riot was 3%, and the proportion of tracts that reported any damage due to the civil unrest was 28%.

Table 2 lists correlations between tract characteristics and age-sex-adjusted post riot (1993–1996) gonorrhea rate. All predictors were strongly correlated with the gonorrhea rate except for percentage Hispanic and percentage male.

Table 3 shows a series of four individual growth models predicting age-sex adjusted gonorrhea rates. The first three models explored the hypothesized association of each riot-related key predictor separately (percentage of off-premise alcohol outlet licenses surrendered, indicator of damage due to riot and alcohol outlet density) with gonorrhea rates after controlling for other time varying and tract level covariates and an overall time trend. The fourth model includes all three riot-related predictors and interactions of surrenders and damage with time. All models controlled for baseline gonorrhea rates, percentage Black, percentage Hispanic, percentage male, and socio-economic status.

Relative to the simplest model, the final model including all of the above tract-level and year-level characteristics explained 92% of the between-tract variance and 93% of the within-tract variation. The final model also had the best fit compared to the other three models that fit one key predictor at a time, so we will discuss its results here. All predictors except for socio-economic status were statistically significant at the $p<.01$ level. The average gonorrhea rate in 1992 for tracts with no damage, with all continuous characteristics fixed at their overall mean (representing the “average” tract), is 110 per 100,000. In 1992, a tract with damage had a higher intercept of 56 additional cases per 100,000 than a tract without damage, provided the two tracts had all the average characteristics. The overall time trend indicates a decline of 11 cases per 100,000 for the non-damaged “average” tract. However, damaged tracts had a more rapid decline of 33 cases ($\beta = -10.96$ to 21.90) per 100,000 annually.

Similarly, tracts with more off-premise liquor outlet licenses surrendered in 1992 had higher gonorrhea rates ($\beta = 2.93$, $p<.0001$) at baseline than tracts with fewer licenses surrendered. However, the rate of decline over time for tracts with more surrendered licenses was steeper than in tracts with fewer surrendered licenses. For a typical tract in LA with 5 off-premise outlets the effect size of closing one of these outlets translates to 42 fewer gonorrhea cases per 100,000, if other characteristics are set to their average value.

Even after controlling for the effect of property damage and surrendered licenses during the riot, alcohol outlets had a positive association with gonorrhea rates. The median number of off-premise outlets per roadway mile is 0.36 and the average number of roadway miles per census tract is 16. Thus, for a tract with the median outlet density and “average” characteristics,

the increase is 62 additional gonorrhea cases per 100,000 compared to a tract with zero outlet density.

The results of the spatial analysis suggest that there is a significant degree of clustering amongst tracts within 3 miles (Moran's I value of .73, $p<.0001$). The −2REML_LL from the unadjusted model is 32,719.3 while the same quantity from the spherical model is 32,587.1. Thus, the likelihood ratio test statistic is 132.2. Comparing 132.2 to $\chi^2_{(2)}$, $H_0$ is clearly rejected, suggesting that a spatially adjusted model is needed. The betas and results are the same as in the MIXED model without spatial correction except for % Licenses Surrendered, where the coefficient and standard error was much smaller but remained significant at $p<.05$ (data not shown).

## Discussion

Our findings support the significant role of alcohol outlets, but not damaged buildings in the spread of gonorrhea. Although a plausible mechanism for alcohol outlets is their supply of a substance that is used to facilitate sex, alcohol outlets can facilitate other substance use by selling drug use paraphernalia (i.e. tobacco rolling papers that can be used for marijuana, clear tubing used to make crack cocaine pipes, single steel wool pads used to fashion crack cocaine pipe filters). Off-premise outlets can be sites where people who engage in high-risk behaviors gather, not just for drinking, but sometimes to use and exchange other drugs. The closure of outlets thus may have led not only to a decreased supply of alcohol, but also to fewer potential gathering places for high-risk individuals.

## Limitations

Although our study is a longitudinal design, the data we have obtained are ecological and so there are several limitations that need to be recognized. The civil unrest and loss of outlets are closely intertwined and it is not possible to identify the precise mechanism of gonorrhea decline —whether due to community change in norms and tolerance for deviant behaviors or due to closure of alcohol outlets alone. The secular trend over this time period showed a decline in gonorrhea in all areas of Los Angeles. Our findings indicated that declines were steeper in census tracts where alcohol outlets were closed. Nevertheless, it is possible that independent events, such as targeted HIV prevention efforts and STD control efforts may have also contributed to the decline. These may have facilitated the interruption of sexual networks associated with alcohol outlets (De et al., 2004). A simultaneous dynamic relationship between physical structures (outlets) and social structures (community norms and behaviors) makes it impossible to exactly pinpoint whether the closure of alcohol outlets operates directly on sexual behaviors or through a norm-changing mechanism. It is clear however, that the riots were a seminal event that preceded the subsequent steeper decline in gonorrhea in affected tracts compared to non-damaged tracts.

Although we did obtain annual data on race/ethnicity, gender, and age of the denominator populations, and our models controlled for changes in the population, our SES measures were only from 1990, and our damage indicator was only for 1992. An important concern is that the census tends to undercount populations in low-income areas with high rates of minorities (Anderson & Fienberg, 2000). However, the tendency to underreport gonorrhea and our geocode rate of 83% together are both likely to be even lower than a population undercount, making our annual estimates of gonorrhea rates conservative (Kirsch et al., 1998;Rothenberg et al., 1980). These biases in reporting and identifying gonorrhea cases are likely to be constant over time. Since our geocode rate was similar each year, our analysis of the relative changes in gonorrhea over time, rather than the absolute estimates, should be correct.

Another concern was the lack of information on when and if damaged building were repaired after the riots, making it impossible to discern the impact of damage over time. If buildings were repaired, it might explain why we found a negative association between damaged buildings and gonorrhea, as these would have represented new, potentially improved buildings rather than “broken windows”.

Activities related to efforts to preventing closed alcohol outlets from re-opening subsequent to the civil unrest may also have resulted in other unmeasured community changes that could influence continued sexual risk taking among populations in affected areas. Potential unmeasured examples of this include community and police efforts to close down crack houses, shooting galleries and open air drug markets, greater police presence and enforcement in these neighborhoods that also discouraged prostitution and disrupted drug markets (Operation Cul–De–Sac), and better parental and community monitoring of adolescents and young adults during high risk times (3–6 pm).

Other possibilities might include greater police presence and enforcement in these neighborhoods that also discouraged high-risk behaviors. Although 12,000 persons were arrested for rioting and looting during this period, most were quickly released, so it is unlikely that the incarceration of large number of high-risk residents could have explained subsequent continued declines in community rates of gonorrhea.

Alcohol outlets have historically been considered nuisances in residential neighborhoods. In particular, the presence of community activists who had the closure of alcohol outlets at the top of their agenda made a difference in preventing dozens of businesses that had previously been problematic from reopening as alcohol outlets. In the short-term, the combined community activism and the obvious physical neighborhood change reduced overt social disorder, like public drinking and loitering youths. Curfews, initial successes in preventing the reopening of closed outlets, and other control measures after the civil unrest may have given a boost to what has been called “collective efficacy,” with people more willing to exert even greater informal social controls, knowing that there might be more back-up from the law enforcement infrastructure. There was also a subsequent optimism, in that several high profile efforts to “Rebuild LA” occurred in the aftermath of the civil unrest. Although it is not possible to tease out which of these changes might be most responsible for the decline in gonorrhea, each component is likely to have made an important contribution.

One final concern with our spatial analysis was the use of census tracts which are arbitrarily related to the clustering of alcohol outlets. The absolute availability of alcohol might not be best captured by a census tract analysis even accounting for spatial autocorrelation. Also the choice of the appropriate range for assessing spatial autocorrelation is not clear.

Although the LA civil unrest changed both the physical and social structures of affected communities, the loss of alcohol outlets was particularly salient. The contribution of outlet decline to reductions in gonorrhea cases appears significant and it is also possible that other outcomes may be affected as well, including domestic violence, assaults, injuries, and traffic fatalities, and even AIDS cases. While future studies can investigate these possibilities, the findings we have support the importance of continuing controls and limits on alcohol outlet density.

**Acknowledgements**

This study was funded by NICHD #R21HD42980, Drew/UCLA Project Export Center #P0MD000148, and Drew Core Infrastructure Development Grant #G12RR03026.

## References


CDC. Alcohol policy and sexually transmitted disease rates—United States, 1981–1995. In: Harrison, P.; Kassler, WJ., editors. MMWR Morbidity and mortality weekly report. 49. 2000. p. 346-349.

Anderson M, Fienberg SE. Race and ethnicity and the controversy over the US census. Current Sociology 2000;48(3):87–110.

Aral SO. Sexual behavior in sexually transmitted disease research. An overview. Sexually Transmitted Diseases 1994;21(Suppl 2):S59–S64. [PubMed: 8042119]

Berestein, L. Rebuilding rules prevail merchants must hire guards, shorten hours if they want to sell liquor. Los Angeles: LA Times; 1994. p. B3

Census, U. 2000. Table. HCT24 tenure by year householder moved into unit.

Cohen D, Spear S, Scribner R, Kissinger P, Mason K, Wildgen J. "Broken windows" and the risk of gonorrhea. American Journal of Public Health 2000;90(2):230–236. [PubMed: 10667184]

Cohen DA, Farley TA, Mason K. Why is poverty unhealthy? Social and physical mediators. Social Science & Medicine 2003;57(9):1631–1641. [PubMed: 12948572]

Cohen DA, Mason K, Bedimo A, Scribner R, Basolo V, Farley TA. Neighborhood physical conditions and health. American Journal of Public Health 2003;93(3):467–471. [PubMed: 12604497]

Cohen LE, Felson M. Social change and crime rate trends: A routine activity approach. American Sociological Review 1979;44:588–608.

De P, Singh AE, Wong T, Yacoub W, Jolly AM. Sexual network analysis of a gonorrhoea outbreak. Sexually Transmitted Infections 2004;80(4):280–285. [PubMed: 15295126]

Decosas J. Epidemic in Ghana: "A very distinct profile". AIDS Analysis Africa 1995;5(3):12.

Ellen JM, Aral SO, Madger LS. Do differences in sexual behaviors account for the racial/ethnic differences in adolescents' self-reported history of a sexually transmitted disease? Sexually Transmitted Diseases 1998;25(3):125–129. [PubMed: 9524987]

Fischer MJ. The relative importance of income and race in determining residential outcomes in the US urban areas. Urban Affairs Review 2003;38(5):669–696.

Garnett GP, Hughes JP, Anderson RM, Stoner BP, Aral SO, Whittington WL, et al. Sexual mixing patterns of patients attending sexually transmitted diseases clinics. Sexually Transmitted Diseases 1996;23 (3):248–257. [PubMed: 8724517]

Gorman DM, Speer PW. The concentration of liquor outlets in an economically disadvantaged city in the northeastern United States. Substance Use & Misuse 1997;32(14):2033–2046. [PubMed: 9440151]

Grills, C.; Bass, K.; Brown, D.; Akers, A. Empowerment evaluation: Building upon a tradition of activism in the African American community. In: Fetterman, D.; Kaftarian, S.; Wandersman, A., editors. Empowerment evaluation: Knowledge and tools for self-assessment & accountability. Thousand Oaks, CA: Sage Publications; 1996. p. 123-140.

Gruenewald, P. Small area estimates from a geostatisical perspective: Current status and future directions. In: Wilson, R.; Dufour, M., editors. The epidemiology of alcohol problems in small geographic areas. Bethseda, MD: NIAAA DHHS; 2000. p. 245-250.

Gruenewald PJ, Ponicki WR. The relationship of the retail availability of alcohol and alcohol sales to alcohol-related traffic crashes. Accident Analysis and Prevention 1995;27:249–259. [PubMed: 7786392]

Gruenewald PJ, Treno AJ, Nephew TM, Ponicki WR. Routine activities and alcohol use: Constraints on outlet utilization. Alcoholism: Clinical and Experimental Research 1995;19:44–53.

Holloway SR. Exploring the neighborhood contingency of race discrimination in mortgage lending in Columbus, Ohio. Annals of the Association of American Geographers 1998;88(2):252–276.

Kang, C. Store owners to fight restrictions on reopening business. Los Angeles: LA Times; 1994. p. B3

Kirsch TD, Shesser R, Barron M. Disease surveillance in the ED: Factors leading to the underreporting of gonorrhea. American Journal of Emergency Medicine 1998;16(2):137–140. [PubMed: 9517687]

Littell, R.; Milliken, G.; Stroup, W.; Wolfinger, R. SAS system for mixed models. Cary, NC: SAS Institute Inc.; 1996.

Massey, D.; Denton, NA. American apartheid: Segregation and the making of the underclass. Cambridge, MA: Harvard University Press; 1993.

Moran JS, Aral SO, Jenkins WC, Peterman TA, Alexander ER. The impact of sexually transmitted diseases on minority populations. Public Health Reports 1989;104(6):560–565. [PubMed: 2511588]

Ong, P. Losses in the Los Angeles civil unrest, April 29– May 1, 1992: Lists of the damaged properties and Korean merchants and the L. A. riot rebellion. Los Angeles: UCLA; 1993.

Page, R.; Cole, G.; Timmreck, T. Basic epidemiological methods and biostatistics A practical guidebook, chapter 2. Sudbury, MA: Jones and Bartlett; 1995.

Robinson-Jacobs, K. Replacing stores has lifted spirits. Los Angeles: Los Angeles Times; 2002. p. C1

Rothenberg R, Bross DC, Vernon TM. Reporting of gonorrhea by private physicians: A behavioral study. American Journal of Public Health 1980;70(9):983–986. [PubMed: 7406099]

Scribner RA, Cohen DA, Farley TA. A geographic relation between alcohol availability and gonorrhea rates. Sexually Transmitted Diseases 1998;25(10):544–548. [PubMed: 9858351]

Scribner RA, Cohen DA, Kaplan S. Alcohol availability and homicide in New Orleans: Conceptual considrations for small area analysis of the effect of alcohol outle density. Journal of Studies on Alcohol 1999;60:310–316. [PubMed: 10371257]

Singer J. Using SAS PROC MIXED to fit multilevel models, hierarchical models, and individual growth models. Journal of Educational and Behavioral Statistics 1998;24(4):323–355.

Scribner RA, MacKinnon DP, Dwyer JH. Alcohol outlet density and motor vehicle crashes in Los Angeles County cities. Journal of Studies on Alcohol 1994;55:447–453. [PubMed: 7934052]

Squires GD, Friedman SR, Saidat CE. Experiencing residential segregation: A contemporary study of Washington, D.C. Urban Affairs Review 2002;38(2):155–183.

Treno AJ, Alaniz ML, Gruenewald PJ. The use of drinking places by gender, age and ethnic groups: An analysis of routine drinking activities. Addiction 2000;95:537–551. [PubMed: 10829330]

Wallace R. Urban desertification, public health and public order: Planned shrinkage, violent death, substance abuse and AIDS in the Bronx. Social Science & Medicine 1990;31:801–813. [PubMed: 2244222]

Wallace R, Wallace D. Contagious urban decay and the collapse of public health. Health Pac Bulletin 1991;21(2):13–18. [PubMed: 10115980]

Wojdyla D, Poletto L, Cuesta C, Badler C, Passamonti ME. Cluster analysis with constraints: Its use with breast cancer mortality rates in Argentina. Statistics in Medicine 1996;15:741–746. [PubMed: 9132901]

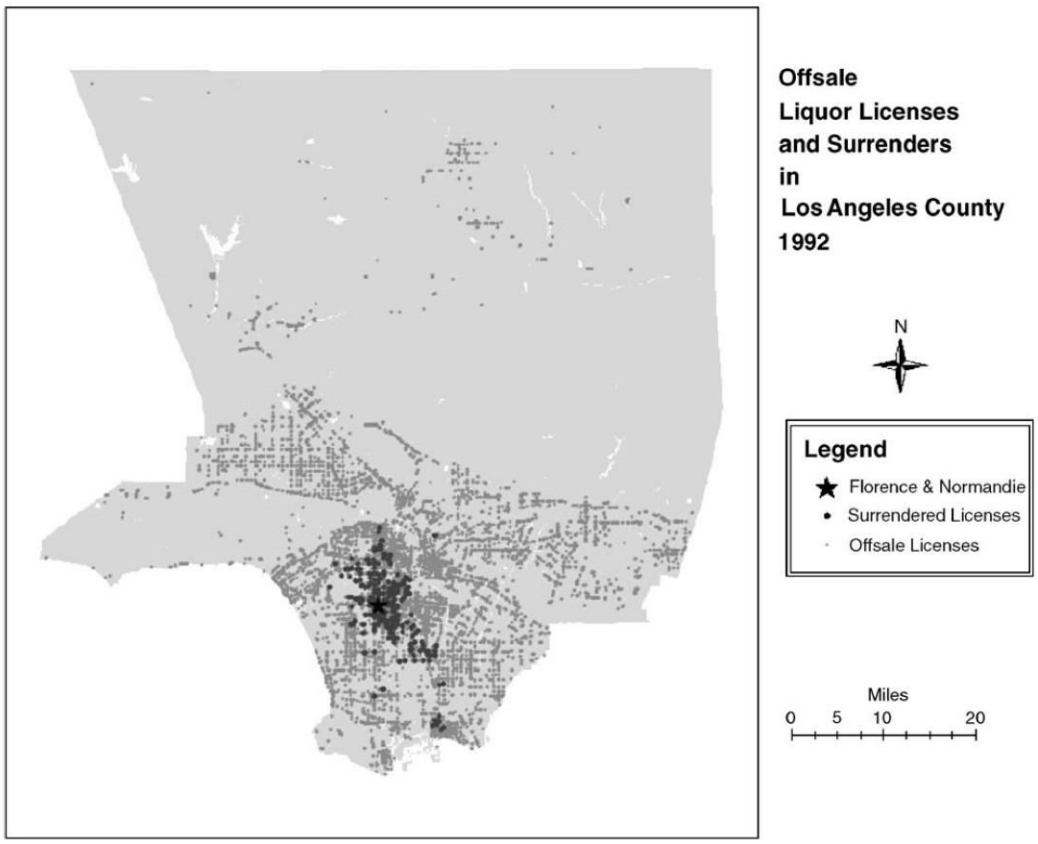


**Fig 1.**

**Table 1**

Demographic data for 1481 tracts in Los Angeles county

| | Mean | SD | Min. | Max. |
|---|---|---|---|---|
| 1990 Population | 5752 | 2324 | 2715 | 28,649 |
| Avg. 1988–1991 gonorrhea rate per 100,000 | 234 | 432 | 0 | 5316 |
| Avg. 1993–1996 gonorrhea rate per 100.000 | 80 | 132 | 0 | 1431 |
| Avg. 1993–1996 percentage African American | 11 | 18 | 0 | 94 |
| Avg. 1993–1996 percentage Hispanic | 40 | 28 | 3 | 98 |
| Avg. 1993–1996 percentage Asian | 11 | 12 | 0 | 82 |
| Avg. 1993–1996 percentage male | 49 | 3 | 41 | 93 |
| 1990 SES index (%<high school, median income, % unemployed) | −0.05 | 0.88 | −2.56 | 2.81 |
| 1990 Percentage boarded | 0.16 | 0.31 | 0 | 4.28 |
| 1990 Percentage married | 48 | 10 | 5 | 72 |
| Any damaged properties in 1992 civil unrest (binary) | 0.28 | 0.45 | 0 | 1.00 |
| Percentage of off-premise outlets that surrendered license in 1992 | 3 | 12 | 0 | 100 |
| Pre riot number of off-premise outlets per road mile | 0.49 | 0.51 | 0 | 4.25 |
| Pre–post riot change in # off-premise outlets per road mile | 0.01 | 0.09 | −0.73 | 1.09 |
| Number of off-premise outlets in 1991 per census tract | 4.8 | 3.7 | 0 | 28 |
| Road miles per census tract | 16 | 35 | 1 | 780 |

**Table 2**

Correlations between demographics, damage, alcohol outlet density and age-sex adjusted post riot (1993–1996) gonorrhea rate

| | Corr. | *p* |
|---|---|---|
| 1990 Population | −0.095 | ** |
| Avg. 1988–1991 Age-sex adjusted gonorrhea rate | 0.956 | ** |
| Avg. 1993–1996 percentage black | 0.843 | ** |
| Avg. 1993–1996 percentage Hispanic | 0.041 | NS |
| Avg. 1993–1996 percentage Asian | −0.275 | ** |
| Avg. 1993–1996 percentage male | −0.045 | NS |
| 1990 SES | −0.400 | ** |
| 1990 Percentage boarded | 0.325 | ** |
| 1990 Percentage married | −0.470 | ** |
| Any damaged properties in 1992 riot | 0.490 | ** |
| Percentage of off-premise outlets surrendered in 1992 | 0.556 | ** |
| Pre riot number of off-premise outlets per road mile | 0.156 | ** |
| Pre–post change in off-premise outlets per road mile | 0.208 | ** |

** $p<.01$

NS = not significant *p*-value.

**Table 3**

Models predicting age and sex adjusted gonorrhea rate (per 100,000)

| | Model 1 | SE | Sig. | Model 2 | SE | Sig. | Model 3 | SE | Sig. | Overall | SE | Sig. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intercept | 155.58 | 2.12 | ** | 128.97 | 2.68 | ** | 126.06 | 2.45 | ** | 110.27 | 2.52 | ** |
| *Time varying measures (annual)* | | | | | | | | | | | | |
| % African American | 2.26 | 0.11 | ** | 2.24 | 0.11 | ** | 2.25 | 0.10 | ** | 2.22 | 0.11 | ** |
| % Hispanic | −0.26 | 0.08 | NS | −0.25 | 0.08 | ** | −0.28 | 0.08 | ** | −0.29 | 0.08 | ** |
| % Male | 1.62 | 0.41 | ** | 1.58 | 0.41 | ** | 1.26 | 0.39 | ** | 1.21 | 0.39 | ** |
| # Off-premise outlets per road mile | | | | | | | 11.57 | 2.39 | ** | 10.78 | 2.43 | ** |
| Time centered at 1992 | −31.45 | 1.37 | ** | −12.25 | 1.73 | ** | −17.19 | 0.90 | ** | −10.96 | 0.86 | ** |
| *Tract level measures* | | | | | | | | | | | | |
| Baseline age-sex adjusted GC rate (1988) | 0.25 | 0.00 | ** | 0.25 | 0.00 | ** | 0.15 | 0.00 | ** | 0.16 | 0.00 | ** |
| SES index (1990) | −7.09 | 2.79 | * | −6.35 | 2.84 | * | −3.91 | 2.81 | NS | −4.16 | 2.84 | NS |
| % Off-premise licenses surrendered (1992) | 3.93 | 0.19 | ** | | | | | | | 2.93 | 0.19 | ** |
| Damaged properties/ tract (1992) | | | | 93.83 | 5.23 | ** | | | | 55.72 | 5.21 | ** |
| *Interaction terms* | | | | | | | | | | | | |
| % Off-premise surrendered licenses by time | −2.96 | 0.11 | ** | | | | | | | −1.22 | 0.06 | ** |
| Damaged properties by time | | | | −67.76 | 3.24 | ** | | | | −22.00 | 1.73 | ** |
| Between-tract variation | 8066.56 | 88.5% | | 9173.58 | 86.9% | | 8954.76 | 87.3% | | 5804.44 | 91.7% | |
| Within-tract variation | 10,508.00 | 78.1% | | 10,507.00 | 78.1% | | 3243.27 | 93.2% | | 3243.17 | 93.2% | |

* *P*<.05;

** *P*<.01

NS = not significant *P*-value