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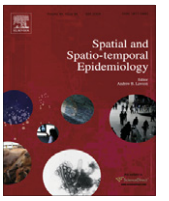

Multilevel spatiotemporal change-point models for evaluating the effect of an alcohol outlet control policy on changes in neighborhood assaultive violence rates

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ABSTRACT

Many previous studies have suggested a link between alcohol outlets and assaultive violence rates. In 1997 the City of New Orleans adopted a series of policies, e.g., increased license fee, additional enforcement staff, and expanded powers for the alcohol license board. The policies were specifically enacted to address the proliferation of problem alcohol outlets believed to be the source of a variety of social problems including assaultive violence. In this research, we evaluate the impact of a city level policy in New Orleans to address the problem alcohol outlets and their influence on assaultive violence. The spatial association between rates of assaultive violence at the census tract level (n = 170) over a ten year period raises a challenge in statistical analysis. To meet this challenge we developed a hierarchical change-point model that controls for important covariates of assaultive violence and accounts for unexplained spatial and temporal variability. While our model is somewhat complex, its hierarchical Bayesian analysis is accessible via the WinBUGS software program. Keeping other effects fixed, the implementation of the new city level policy was associated with a decrease in the positive association between census tract level rates of assaultive violence and alcohol outlet density. Comparing several candidate change-point models using the DIC criterion, the positive association began decreasing the year of the policy implementation. The magnitude of the association continued to decrease for roughly two years and then stabilized. We also created maps of the fitted assaultive violence rates in New Orleans, as well as spatial residual maps which, together with Moran's I's, suggest that the spatial variation of the data is well accounted for by our model. We reach the conclusion that the implementation of the policy is associated with a significant decrease in the positive relationship between assaultive violence and the off-sale alcohol outlet density.

1. Introduction

Over the past two decades, many researches have studied the contextual role of alcohol outlets on a variety of social problems such as assaultive violence. These studies focused on the relationship between alcohol outlet density and social problems, and how the change of alcohol outlet density affects the rate of social problems. For example, the first studies looked at the association between the alcohol environment (the availability of alcohol) and assaultive violence at the city level (Scribner et al., 1995; Watts and Rabow, 1983). As geographical

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information systems (GIS) software became well-developed and widely available, more local units (e.g., census tracts) were used for analysis when modeling the presumable relation between alcohol outlets and assaultive violence in a neighborhood. (Scribner et al., 1999; Speer et al., 1998). The assaultive violence rates in contiguous neighborhoods are likely correlated due to the fact that alcohol availability can spread to neighboring areas, leading to spatial clustering. Such spatially autocorrelated outcomes could not only reveal interesting spatial relation, they also introduce bias if not being accounted for. Studies now tend to include spatial data analysis techniques to address spatial autocorrelation (Scribner et al., 2008; Gorman et al., 2001; Gruenewald, 2000; Zhu et al., 2004). More recently, temporal dimensionality is being incorporated into these studies to analyze temporal trends (Zhu et al., 2004; Scribner et al., 2007; Gruenewald and Remer, 2006).

The advantage of being able to account for the spatial as well as the temporal dependence of the estimates has been making Bayesian methods more popular in subject fields including epidemiology, environmental science, and social science. The conditionally autoregressive (CAR) model (Besag, 1974) was introduced to account for spatial autocorrelation in neighboring areas. It was later applied to extract spatial patterns in regional disease maps (Besag et al., 1991). Hierarchical Bayesian spatial models were applied to examine the relationship between alcohol outlet density and violence in some areas (Britt et al., 2005; Zhu et al., 2006). Yu et al. (2008) proposed a dual-change-point model within the Bayesian framework to investigate the association between assaultive violence and alcohol outlet availability based on the natural experiment provided by a 1992 California civil unrest which resulted in decreasing in the number of liquor outlets. In our study, we move one step forward to investigate how specific policies targeting alcohol outlets may have affected the association between alcohol environment and assaultive violence rates, where we focus our research on a set of policy changes for alcohol outlet administration in New Orleans in 1997. The findings are of potential importance in guiding policy making for law makers, regulators, and social workers.

The current study is designed around a policy change that could be considered a societal intervention. In 1997 the City of New Orleans adopted a series of policies (e.g., increased license fee, additional enforcement staff, and expanded powers for the alcohol license board) to address the proliferation of problem alcohol outlets believed to be the source of a variety of social problems including assaultive violence. Consequently, the loss of these more problematic alcohol outlets should attenuate the relationship between alcohol outlet density and the social problems they are assumed to generate. Therefore, the objective of this study is to determine how the global effect of the policy affected the association between assaultive violence rates and alcohol outlet density. We add a temporal change-point dimension to the modeling in order to analyze the indirect effect of policy change on assaultive violence rates in New Orleans at the census tract-level.

2. Background and data description

The target of the 1997 policy change in New Orleans was the proliferation of problem alcohol outlets across the city. Over the summer of 1997 the New Orleans City Council approved 20 changes to laws affecting alcohol outlets including higher license fees, stiffer fines for violations, expanded enforcement authority for the Alcohol Control Board, and bans on selling alcohol through windows. In addition, a full time officer was assigned to the enforce liquor laws and investigate alcohol outlets for the Alcohol Control Board. The result was increasing rates of alcohol license suspensions and revocations. Finally, the city liquor license fee was increased by thirty five percent (Schleifstein, 1997).

2.1. Sociodemographic data

A number of sociodemographic variables were collected in this project. The investigators focus interest on three of them: percentage of less than high school education in a particular census tract, percentage living below the poverty line, and percentage of housing that is vacant. The values for these variables are averages from the 2000 census obtained from the US Census website. The intercensal data are obtained from the Claritas corporation. Claritas provides intercensal estimates of population stratified by age, race, and sex at the census tract level. The estimates take into account births, deaths, and immigration data to adjust the intercensal interpolation.

2.2. Alcohol outlet density

Exposure to alcohol outlets are assessed in terms of alcohol outlet density. Three measures of alcohol outlet density are obtained: (1) total outlet density, (2) on sale outlet density, and (3) off sale outlet density. All outlet data originates from the Louisiana Alcohol and Tobacco Control (ATC) office, the licensing agency for the state of Louisiana. The ATC only maintains an active file of currently licensed outlets. The researchers have been maintaining a biannual archive of alcohol outlets since 1995.

To generate annual outlet density measures, biannual outlet data were accessed and the total numbers of alcohol outlets by outlet type were generated for each census tract. Outlet densities are generated from these outlet totals using two denominators (1) census tract square miles, and (2) total census tract roadway miles. Each method has its advantages and disadvantages. As recommended, outlet densities obtained with both methods were used in analyses to determine if the results were sensitive to type of method used to generate the measure (Scribner et al., 1999).

2.3. Assaultive violence rates

The assaultive violence data are obtained from the New Orleans Police Department (NOPD). NOPD provides Uniform Crime Reports (UCR) Part 1 offenses by address of offense for all police beats within the study area for all years