

Change in alcohol outlet density and the associations with violent crime

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Summary

This paper explores the associations between changes in alcohol outlet density and violent crimes against a person in Wales, UK. Using Geographically Weighted Regression (GWR), we examine the relationship between three measures of change in alcohol outlet density and reported violent crime to the Police. The results show there is a strong relationship between alcohol availability and violent crime, particularly in more deprived areas.

KEYWORDS: Geographically Weighted Regression, Crime, Alcohol, GIS, Wales

1. Background

Excess alcohol consumption has many adverse effects on health but is also associated with an increased risk of harm resulting from violence including homicide (Parker, 1998) suicide (Ramstedt, 2001) road traffic accidents (del Rio *et al.*, 2002) domestic violence (Abramsky *et al.*, 2011), and attendance at Emergency Departments and Minor Injuries Units for treatment of violence-related injuries (Sivarajasingam *et al.*, 2009). Given the wide range of harm resulting from substantial level of excess alcohol consumption, the potential impact on health at the population level from a reduction in consumption is considerable. This paper describes a GWR approach to exploring associations between changes in alcohol outlet density and violent crime in Wales from 2008-2011 conducted as part of the CHALICE project (Fone *et al.*, 2016).

1.1. Alcohol and Violent Crime

Alcohol availability has been widely associated with crime in particular violent crime against a person (VAP) and has been reported across many different cultures and countries. For example a 6-year longitudinal in California found that increases in bar and off-licensed outlet densities were positively related to an increase in the rate of violence, defined as a hospital admission with an overnight stay (Gruenewald and Remer, 2006). A time series analysis of Norwegian data from 1960 to 1995 found that outlet density was significantly associated with violent crime (Norstrom, 2000). Further analysis from Australia (Livingston, 2008, 2011) and New Zealand (Cameron *et al.*, 2012, 2015) investigate change in outlet density, domestic violence and assault.

2. Data

This study included small-area aggregated data on residents of Wales aged ≥ 16 years who were victims of VAP from 2008 to 2011 inclusive and measures of outlet density modelled in a GIS using local

authority licensing data.

2.1. Crime Data

The population of Wales is served by four police forces; (a) Dyfed Powys; (b) Gwent; (c) North Wales; and (d) South Wales. The VAP crime data were requested from each Police force as counts per LSOA from the four police forces. This data included VAP crime recorded for calendar years 2005–11, by quarter. Data availability and consistency data from all four Welsh police forces varied in quality and completeness meaning that we were not able to stratify the data by age, victim/offender status or using an alcohol flag. Each crime was assigned a corresponding LSOA based on location of crime.

2.2. Alcohol Outlet Density Data

The collection and geocoding of alcohol outlet data for every Unitary Authority in Wales was a time-consuming task which is detailed in Fone *et al.*, 2016 and Fry *et al.*, 2016. The result of this process was a longitudinal dataset consisting detailing change in the numbers of alcohol outlets across Wales for 2006-2011. Using this data in conjunction with household location data and GIS data detailing road and footpath networks, a sophisticated alcohol outlet density model was produced for every LSOA in Wales (Fone *et al.* 2016). In this paper, we use the change in alcohol outlet density data produced for a 10-minute walking zones for each year where we had corresponding crime data; 2008-2011. Change in alcohol outlet density is measured as three variables; a) change from previous quarter value b) positive and negative change over the preceding five quarters and c) volatility - sum of the absolute differences between five successive quarterly values / square root of the mean of the five quarterly values) – a measure of “churn” for a local area.

3. Methods

We performed GWR analysis using an adaptive bandwidth to optimally fit the number of nearest neighbours in the analysis. Using standard GWR methods the spatial variation in the relationship between the independent variable (change in alcohol density) and the dependent variable (rate of VAP per 1000 per LSOA) were modelled in R using the GWModel (Gollini *et al.*, 2013) package for each of the 1896 LSOA's in the study area for each year between 2008 and 2011. We produced three models for analysis using GWR. Model A explored the alcohol availability measures (change from previous quarter value, positive and negative change and volatility) in relation to VAP. Model B introduced terms relating to deprivation, settlement type, local authority and police force areas. Model C stratified the models by the Welsh Index of Multiple Deprivation (WIMD) to explore the relationships between alcohol, crime and deprivation. Finally, each model was adjusted using the Benjamini-Hochberg correction to control for false discovery rates within the analysis.

4. Results

The results from the GWR models are summarised in Table 2.

Table 1: GWR Results

	2008	2009	2010	2011
Previous Quarter				
Estimate	3.253	3.131	2.936	2.825
SE	0.123	0.121	0.104	0.100
p-value	<0.001	<0.001	<0.001	<0.001
Negative Change				
Estimate	5.166	20.745	7.457	-5.964
SE	3.935	9.621	4.469	5.710
p-value	0.189	< 0.001	0.108	0.114
Positive Change				
Estimate	2.668	9.621	-1.038	-5.559
SE	0.970	4.186	4.469	-0.974
p-value	0.332	0.022	0.816	0.330
Volatility				
Estimate	-1.065	-2.416	-1.300	3.819
SE	1.515	2.157	1.578	2.138
p-value	0.482	0.263	0.410	0.033

The GWR modelling reveal there is a strong association between change and alcohol availability and the previous quarter alcohol outlet density. However, the estimate values indicate that the impact of alcohol on VAP is diminishing over the study period. The data stratified by urban and rural categorisation and by police force showed no notable differences. Stratifying the data using WIMD (Table 3) revealed an increase of 1.0 alcohol outlet density score (approximately 4 outlets for a 10 minute walking neighbourhood zone) resulted in an estimated increase on average of 3.8 more crimes of VAP per 1000 in the most deprived areas.

Table 2: Previous quarter values stratified by WIMD. MD = most deprived, LD = least deprived

	2008		2009		2010		2011	
	MD	LD	MD	LD	MD	LD	MD	LD
Previous Quarter								
Estimate	4.03	0.97	3.85	1.16	3.46	0.88	3.37	0.86
SE	0.22	0.09	0.23	0.09	0.19	0.08	0.18	0.07
p-Value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

5. Conclusions

The relationship between alcohol outlet density and crime is complicated but this study has shown that using GWR can reveal localised trends in associations between the two. We show that changes in alcohol outlet density in the short term result in more cases of VAP particularly in more deprived areas of Wales. The general trend in a decreasing association between outlet density and VAP over the study

period may be explained by changes in the reporting requirements for Police forces in Wales and improved night-time policing and city centre management interventions, particularly in the cities of Cardiff, Newport and Swansea

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7. Biographies

Dr Richard Fry is a Senior Research Fellow in GIS at the National Centre for Population Health and Wellbeing Research, Swansea University. His research interests include accessibility modelling, health geographies, data integration and data linkage, open source and Web GIS.

Dr Scott Orford is a Reader in GIS and spatial analysis at Cardiff University School of Geography and Planning. His research is on the spatial and statistical modelling of social and economic processes.

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