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Increasing powers to reject licences to sell alcohol: Impacts on availability, sales and behavioural outcomes from a novel natural experiment evaluation

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Title: Increasing powers to reject licenses to sell alcohol: impacts on availability, sales and behavioural outcomes from a novel natural experiment evaluation.

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Statement of Authors' Contributions

M Egan, J Gibbons, C Ashton, J Hart and K Lock conceived and designed the study.. T Pliakas conducted the data analysis. T Pliakas wrote the first draft of the manuscript with K Lock and M Egan. All authors contributed to the data interpretation and scientific content of the manuscript and approved the final version for publication.

Declaration of interest:

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Conflict of Interest

The authors declare there is no conflict of interest

Abstract (word limit: 250; word count: 237)

Excessive alcohol consumption leads to negative health and social impacts at individual and population levels. Interventions that aim to limit the density of alcohol retail premises (including cumulative impact policies (CIPs)) have been associated with decreases in alcohol-related crime and alcohol-related hospital admissions. We evaluated the quantitative impact of introducing a new alcohol licensing policy that included a comprehensive Cumulative Impact Policy (CIP) enforced in seven Cumulative Impact Zones (CIZs) in one English Local Authority in 2013. We used time series analysis to assess immediate and longer term impacts on licensing decisions and intermediate outcomes, including spatial and temporal alcohol availability, crime, alcohol-related ambulance call-outs and on-licence alcohol retail sales across the Local Authority and in CIZs and non-CIZs during the period 2008 to 2016. We found no impact on licence application rates but post-intervention applications involved fewer trading hours. Application approvals declined initially but not over the longer term. Longer term, small reductions in units of alcohol sold in bars (-2,060, 95% confidence interval (CI) = -3,033, -1,087) were observed in areas with more intensive licensing policies ('Cumulative Impact Zones' (CIZs)). Significant initial declines in overall crime rates (CIZs = -12.2%, 95% CI = -18.0%, -6.1%; non-CIZs = -8.0%, 95% CI = -14.0%, -1.6%) were only partially reversed by small, longer term increases. Ambulance callout rates did not change significantly. The intervention was partially successful but a more intensive and sustained implementation may be necessary for longer term benefits.

Introduction

Alcohol accounts for 5.1% of the global burden of disease and 5.9% of deaths worldwide.¹ Excessive alcohol consumption is associated with negative economic and social impacts, including increasing crime, anti-social behaviour and alcohol-related hospital admissions.¹⁻⁵ Population level approaches to reduce alcohol availability include modifying economic availability (i.e. taxation), temporal availability (i.e. modify premises' trading times) and spatial availability (i.e. reduce alcohol outlet density).^{1, 6-11}

The mechanisms for modifying alcohol availability differ by jurisdiction but many countries implement some form of licensing system – often regulated at a regional or local level, and often differentiating between licences to sell alcohol for on-premise and for off-premise consumption (in the UK, called 'on-licences' and 'off-licences').^{9, 12-14} For many of the world's high alcohol consuming populations, including countries in Europe, Australasia and North America, licensing is an important lever for reducing alcohol availability.^{1, 15} There is evidence that reduced availability leads to reductions in consumption and harm.^{2, 16, 17} Licensing restrictions have increasingly attracted public health interest for preventing alcohol harms at a populations level.

Regulating alcohol availability in urban areas is particularly important because the world is rapidly urbanising.¹⁸ Major cities often include multiple localities that serve as destinations for the Night Time Economy where consumers come from further afield, but also accommodate large residential populations who are adversely affected by crime and health issues linked to high levels of alcohol availability.¹⁹ If the Licensing system can be used to reduce alcohol availability and harms in London, this should be of interest to alcohol regulators in cities facing similar challenges, both in the UK and elsewhere.

In London, powers to control local alcohol supply and consumption are established by the English Licensing Act 2003.²⁰ Local 'Licensing Authorities' publish a Statement of Licencing Policy (SLP) every 5 years to show how they plan to meet statutory objectives focused on crime prevention, public safety, public nuisance prevention, and child protection. These SLPs allow discretion with respect to how Licensing Authorities pursue these objectives, taking account of local contexts and priorities.

Licensing Authorities also have discretion to identify sub-areas within their local boundaries (‘Cumulative Impact Zones’ (CIZs)) that will receive more intensive policies (‘Cumulative Impact Policies’ (CIPs)). CIZs can be created where adverse effects of excess alcohol availability can be demonstrated, with the objective to modify spatial and temporal alcohol availability. CIPs place a greater burden of proof on alcohol licence applicants, requiring them to demonstrate why an application does not undermine its licensing objectives. This puts local authorities in a stronger position to reject or modify a licence application in CIZs.¹³ Previous research at the local level in England found that the introduction of a CIP did not decrease successful licence applications²¹ but qualitative research has found that some implementers use the powers to modify applications to bring them in line with local policy objectives – for example by approving particular types of premise and seeking reduced hours of alcohol trade.¹³

A national study focusing on local licensing policies included CIPs and license application rejections as markers of intervention intensity. The study found that more intense local licensing policies were associated with reductions in alcohol-related hospital admissions and violent and sexual crimes, but not anti-social behaviour.²²⁻²⁴ This research was based on analysis of associations between national datasets and more recently time series analysis using synthetic controls.²⁴ However, these studies were not designed to evaluate *how* CIPs might have affected the number and types of licenced premises, changes in temporal alcohol availability, and alcohol sales; nor to differentiate between CIZs and non-CIZs when assessing how these changes effect intermediate behavioural outcomes, such as crime and ambulance call-outs.

CIPs are introduced by local authorities within SLPs that summarise all their different alcohol licensing policy objectives, not just those related to cumulative alcohol impacts. This can lead to two levels of policy change taking place concurrently: one set of changes implemented across the whole area, whilst additional CIP requirements are implemented in sub-areas identified as CIZs.¹³

In this paper we present the results of an impact evaluation of a new alcohol licensing policy in an area of London that has one of the highest densities of pubs, bars, clubs and off-licences in the UK and second highest in London. Alcohol consumption has been identified as a major factor behind crime and disorder in the area with consequences to victims, businesses and local communities. The population suffers from high levels of

alcohol-related ill health and premature deaths.²⁵ The focus of the new SLP was on implementing an extensive CIP across one local government area and adopting new guidelines of earlier closing times for on and off-licence premises. This paper aims to understand how, and to what extent, the new SLP (including CIP; SLP-CIP) affected alcohol licencing decisions, and how this impacted on temporal, economic and spatial alcohol availability and alcohol-related harms (Figures S1 and S2, Appendix 1 and 2).

Methods

Design overview

We used interrupted time series analysis to evaluate the impact of introducing the new SLP-CIP on outputs (i.e. licencing decisions; times of alcohol sales permitted by licences) and intermediate behaviour outcomes (i.e. crime, alcohol related ambulance call-outs and on-licence retail sales). We assessed immediate impacts (i.e. step change at the start of the policy in 2013) and impacts over time (i.e. slope change comparing trends before and after the introduction of SLP-CIP). We examined impacts on all outputs and intermediate behaviour outcomes separately for CIZs and non-CIZs and impacts on intermediate behaviour outcomes of the less permissive SLP-CIP across the whole Local Authority. Seasonality and serial autocorrelation were examined and accounted for, where appropriate.

Setting and intervention

In January 2013, a new Licencing Policy implemented a SLP-CIP, which introduced 7 CIZs across the area (Figure S1, Appendix 1). The new policy also adopted a borough-wide guideline framework of closing times for businesses applying for new and variation alcohol licences as follows: (i) off-licences - 11pm; (ii) night clubs - 1am Sunday to Thursday, 2am Friday and Saturday; (iii) restaurants, cafes and bars - 11pm Sunday to Thursday, midnight Friday and Saturday; (iv) hot food and drink from takeaways - midnight Sunday to Thursday, 1am Friday and Saturday; (v) 24 hour sales of alcohol to hotel residents (Table S2b). The SLP-CIP aimed to change the alcohol environment (both day and night) by promoting safe and well managed retail premises, reducing off-licence sales and reducing hours of alcohol sales.¹⁹ This more comprehensive 2013 area-wide policy was implemented following a successful 2011

pilot of one small CIZ introduced in a small area with high concentration of nightclubs at the Local Authority boundary.

Data

Longitudinal data were obtained on licensing decisions (2008-2016), on-licence sales data (2010-2016), crime (2011-2016) and ambulance service incidents (2008-2016). Details of the datasets are available in Appendix 1. We used UK grid coordinate references and latitude and longitude to assign each premise and each variable to either CIZs or non-CIZs.

Licensing variables include (i) number of applications, (ii) decisions on applications and (iii) trading hours. To evaluate the impact on spatial availability of alcohol we used a combined measure of granted licence applications. We calculated proportion of applications granted ('licence approval rates') for total applications and separately for on- and off-licence applications. We studied the impact of SLP-CIP on temporal availability using average weekly trading hours of all granted applications based on opening and closing times of premises. We also calculated the proportion of all granted applications with a closing time on or after midnight on Friday and Saturday ("late closing").

Intermediate behaviour outcomes included alcohol related ambulance call-outs using London Ambulance Service data), and overall crime and anti-social behaviour rates using Home Office and open source police data.^{26, 27} We calculated crime and alcohol related ambulance call-out rates using mid-year population estimates at Local Authority level. We examined the impact of SLP-CIP on economic availability using on-licence retail sales data (from pubs and bars) to examine effects on alcohol sales, units and quantity of alcohol sold. Data were available for participating premises separately for CIZs and non-CIZs (see Appendix 1 for further details).

Analysis

Statistical analysis was based on interrupted time series analysis undertaken separately for CIZs and non-CIZs and for the whole Local Authority area. For continuous outcomes, we used generalized linear models to obtain Prais-Winsten transformed regression estimators, that are corrected for first-order serially correlated residuals.²⁸ We used poisson regression for count data. We examined the change in level (i.e. the step change

or immediate impact of the SLP-CIP in 2013), and change in slope (i.e. the trend change or impact of CIP over time comparing the trends before to the trends after the introduction of SLP-CIP in 2013). We conducted secondary analysis in the form of a controlled interrupted time series analysis to examine the impact of SLP-CIP on outcomes in CIZs controlling for trends in non-CIZs. Further details of the analysis including corrections for seasonality, serial auto correlation, and secondary analysis are provided in Appendix 2. Regression coefficients with 95% confidence intervals (CI) are presented for all models. All analyses were performed in Stata 14.1.

Results

Characteristics of data

A total of 752 alcohol licence applications were made in the Local Authority area between April 2008 and June 2016, of which 697 (92.7%) had data on decision outcomes and typology (on- or off-license) (Appendix 4, Figure S4). Overall, 78.6% (n=395) and 82% (n=159) applications were granted in CIZs and non-CIZs, respectively (Table 1). A total of 537 of 697 (71.4%) applications had complete data on trading times, of which 442 (82.3%) were granted (Appendix 4, Figure S4).

Applications for premises in non-CIZs tended to be for off-licences (n=120, 61.9% vs n=194, 38.6%) whilst application in CIZs tended to be for on-licences. The licenced opening hours of premises tended to be longer in CIZs compared to non-CIZs, amongst those licences granted during the study period particularly for on-licence applications.

The total number of overall crime, but not anti-social behaviour, and alcohol-related ambulance call out events and on-licence retail sales were much higher in CIZs compared to non-CIZs (Table 1).

<Table 1 here>

Impact of intervention on licence applications

The introduction of SLP-CIP had no immediate impact on the number of alcohol licence applications submitted (Table 2) but it did result in statistically significant decreases in 'licence approval rates' for total alcohol licence applications in both CIZs (-28.6%, 95%

CI = -39.7 to -15.4) and non-CIZs (-24.0%, 95% CI = -41.9 to -0.7) (Table 3). These were mainly driven by decreases in off-licence applications approved (biannual estimates: -41.4%, 95% CI = -53.2 to -26.5 in CIZs; -24.9%, 95% CI = -44.0 to 0.6 in non-CIZs). These changes were not sustained over time, with 'licence approval rates' for all applications increasing again longer term (Table 2).

The introduction of SLP-CIP led to immediate, but non statistically significant, reductions in alcohol retail premise opening hours in both CIZs and non-CIZs. Longer term impacts on temporal alcohol availability was observed in non-CIZs but not in CIZs. Specifically, a reduction of 4.8 hours per week in trading hours (95% CI = -6.6 to -2.9 hours) was observed in non-CIZs, mainly driven by an average reduction in opening hours of on-licence applicants of 10.2 per week (95% CI = -16.0 to -4.5 hours) (Table 2).

<Table 2 here>

Behavioural Outcomes

Total crime and anti-social behaviour declined over the period when data were available. Our analysis indicated a statistically significant immediate drop in overall crime rates following SLP-CIP. There was a greater drop in CIZs (-12.22%, 95% CI = -17.95 to -6.09) compared to non-CIZs (-7.97%, 95% CI = -13.96 to -1.56). These impacts were reversed over the longer term. Similar trends were observed across the Local Authority (Table 3, Appendix 5). Table 3 shows immediate impacts on anti-social behaviour were not statistically significant, and increased over the longer term both in CIZs and non-CIZs and across the Local Authority. We found no statistically significant impacts on alcohol-related ambulance call-out rates (Table 3).

<Table 3 here>

Sales Outcomes

Our analysis of a sample of on-licence retail sales data found no immediate impact of CIP on sales and units of alcohol sold across the whole study area. In the longer term, there was a significant, but very small, reduction in units of alcohol sold (-2,060, 95% CI = -3,033 to -1,087) but not in total sales value (-664, 95% CI = -3,237 to 1,909) in CIZs. In non-CIZs, we found a small significant reduction in the sales value (-4,394, 95% CI = -

6,421 to -2,367) but not in units of alcohol sold (385.2, 95% CI = -758.5 to 1,528.9). Similar trends to those in non-CIZ were observed across the Local Authority (Table 4).

<Table 4 here>

Secondary analysis

Findings from this analysis are presented in Appendix 7. There was little difference in licensing outcomes, except from a longer term increase in the duration of trading hours for on-licence applications following the introduction of SLP-CIP. However, this finding should be interpreted with caution as baseline trends in CIZs were significantly different to non-CIZs. The behavioural outcomes did provide more evidence of a difference between CIZ and non-CIZ: notably some evidence of immediate and particularly longer term benefits in terms of reducing anti-social behaviour rates in CIZs compared to non-CIZs (Table S7c). Baseline trends were significantly different between CIZs and non-CIZs for the remaining behavioural outcomes and retail sales data and impact estimates should be interpreted with caution. In summary, the results of the evaluation suggest that overall the SLP-CIP was effective across the whole borough but CIZs, that experienced the policy in a more intense way, did not experience substantially greater impacts on outcome measures.

Discussion

This study used a natural experimental design to evaluate the impact of the introduction of a new alcohol licensing policy that included CIZs in one of London's major night time economy areas. Our evaluation indicates that the new policy has led to a reduction in temporal availability of alcohol, and an immediate reduction in overall crime rates. The policy did not appear to lead to long term reductions in the number of licence applications submitted or rates of licence applications approved, indicating that SLP-CIP has not been a barrier to gaining a licence to sell alcohol in the area. It suggests successful businesses have been able to adapt to comply with the current Licencing Strategy requirements and, in the case of bars, maintain sales-levels in CIZs even though the amount of unit alcohol consumed fell. We found no policy impact on alcohol-related ambulance call out rates, but this was against a background of declining trends. We observed similar trends in intermediate behaviours outcomes when looking at impacts across the whole Local Authority and separately for CIZs and non-CIZs.

There has been relatively little research considering specific impacts of local licensing policies,¹⁶ and less still focused specifically on CIPs.²¹ The most relevant UK study did not distinguish between CIZs and non-CIZs within local authorities when identifying areas of licensing ‘intensity.’ It did find the local authorities that implemented CIPs and rejected at least one alcohol license application over a two year period experienced moderate reductions in alcohol-related hospital admissions and violent and sexual crimes, although there was inconclusive evidence of an effect on anti-social behaviour.²⁴ Studies suggest areas categorised as having more intense implementation of alcohol licensing policies have greater reductions in alcohol-related hospital admissions and rates of violent crimes, sexual crimes and public order offences.^{22, 23} In our evaluation, we found no impact on alcohol-related ambulance call-outs. However, we found that CIZs did not appear to have a greater impact on reducing crime rates compared with non-CIZs. Our results only partially support the environment to behavioural change pathway described by Vocht et al (2017)²³ that more intense licencing policies reduce temporal availability and in turn reduce anti-social behaviour. Taking an ecological public health perspective, our study considers how alcohol purchase and consumption may be influenced by multiple dimensions of the local ‘alcohol environment’ including temporal, spatial and economic availability. In figure S1 we present possible mechanisms by which licencing polices lead to changes in the behaviours studied.

Declines in alcohol related social harms following introduction of zoning policies in alcohol availability have been observed in other countries. A US multi-component community trial, involving local restrictions to alcohol access through local zoning powers and municipal control on outlet density, showed reductions in assault injuries observed in emergency departments and in all hospitalized assault injuries. However, this intervention involved several mutually reinforcing strategies including community mobilization, media, beverage service policies in premises that sell alcohol, training of retailers, and enforcement to reduce drink driving.^{29, 30} In Australia, liquor licensing restrictions to reduce temporal availability of alcohol have shown some evidence of reductions in assaults.³¹

Similar interventions and policies to English SLP-CIPs have been described elsewhere. In the US the conditional use permits were used to qualify or provide limits on permits on a case-by-case basis if alcohol-related community problems where identified.³⁰ Other

forms of enforcement include distribution of notification letters to licenced premises,³² but this is different to zoning restrictions. Government monopolies of alcohol sales have been effective in reducing alcohol-related harms, but difficult or impossible to implement in many settings.⁶ In the UK, CIPs have been widely used in local government not necessarily to regulate alcohol outlet density but to influence the diversity of the alcohol retail environment. One study suggests the focus of CIP is to change from predominantly alcohol led drinking establishments towards premises where alcohol consumption is regarded as subsidiary to other forms of consumption such as food.^{13, 33}

There are limitations of this study. The number of submitted applications varied monthly throughout the period of data availability. To overcome this, we aggregated figures at three or six months in order to undertake interrupted time series analysis, which led to some loss in statistical power. As a result of the temporal resolution, we analysed trading hours and closing times, and on- and off-licences using biannual data. In these models, we did not account for seasonal effects. We did not have data for other local alcohol interventions occurring in the study area at the same time and therefore we cannot account for any potential impact on our results. Prior to Islington's CIP, the Police Reform and Social Responsibility Act (2011) gave local authorities some additional licensing powers and made local health authorities 'responsible authorities,' thus enabling them to make representations against licence applications. These changes are reflected in Islington's 2013 Statement of licensing policy, which is evaluated here.¹³ ³⁴We do know that national duty on alcohol changed during the study period: rising from 2007 then peaking and beginning to fall by 2014. Over the same time, there was a corresponding rise and fall in price for alcohol sold at UK off-licences, but on-license alcohol prices rose throughout the study period.³⁵

We can not rule out the possibility of boundary effects, for example premises moving to neighbouring areas with less restrictive licensing policies, although neighbouring London Boroughs did have SLP-CIP.²³ Although there had been a small pilot CIZ introduced in 2011, we chose to design the analysis to evaluate the introduction of area-wide CIZs as part of a comprehensive licensing policy in 2013. The findings from the retail sales data should be interpreted with caution due to the small sample size and selective nature of premises included in the analysis. We were also unable to assess the impacts of SLP-CIP on alcohol consumption. There are no routine national surveys of

alcohol intake. Although retail sales and rates of alcohol related disease (e.g. liver cancer) are often used as proxy measures, we did not attempt to model intake using them.

Strengths of this study include the use of detailed longitudinal licensing data in combination with detailed intermediate health behaviour data. We have undertaken an in-depth analysis, adjusting for autocorrelation and seasonal effects, where applicable. Presence of autocorrelation was minimal in almost all models, and further adjustments were made when this was not the case using heteroskedasticity- and autocorrelation-consistent variance estimates.³⁶ We have also used UK grid coordinate references and latitude and longitude to assign each premise and each event/incident to the CIZs and non-CIZs, which reduces the risk of exposure misclassification. However, it is important to note that geomasking was used for the crime data, which may introduce a higher risk of misclassification.³⁷

Conclusion

This evaluation shows that more intensive licencing policies can influence alcohol consumption and reduce harms in an area that is a major destination point for consumers of alcohol in one of the world's largest cities. One mechanism for impact could be that more intensive policies encourage license applicants to ensure applications are a 'better fit' with licensing objectives by, for example, asking for fewer hours of sale. Such policies can also lead to reductions in some alcohol-related harms such as crime, while having little negative economic impacts on an area, an important consideration for local government facing austerity. However, determinants and impacts of alcohol consumption are complex, and licencing policies can only shape some aspects of the 'alcogenic environment'. Alcohol policies will need to be multi-sectoral to ensure that alcohol licencing and taxation lead to reductions in alcohol harms at a population level, but are coordinated with focused programmes aimed at higher risk groups.

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Table 1 Summary statistics for licensing data and intermediate behaviour outcomes in the English Local Authority between 2008 and 2016.

	Non CIZ		CIZ	
	n / mean	% / SD	n / mean	% / SD
Licensing data				
Type of license application (n=697) ¹				
New	121	62.4%	317	63.0%
Variation	38	19.6%	122	24.3%
Review	35	18.0%	64	12.7%
Outcome of licence application (n=697) ¹				
Granted ^a	155	79.9%	376	74.8%
Granted but varied ^a	0	0.0%	7	1.4%
Granted with conditions ^a	4	2.1%	12	2.4%
Other ^b	35	18.1%	108	21.5%
Licensable activities (n=697) ¹				
On license	46	23.7%	168	33.4%
Off license	120	61.9%	194	38.6%
Both on and off license	28	14.4%	141	28.0%
Closing times on Friday and Saturday (n=442) ^{c, 2}				
<i>All license applications</i>				
Close Friday and Saturday by midnight	101	79.5%	239	75.9%
Open Friday and Saturday after midnight	26	20.5%	74	23.5%
Open Friday only after midnight	0	0.0%	1	0.3%
Open Saturday only after midnight	0	0.0%	1	0.3%
Weekly duration of trading hours	94	29.3	94	32.7
<i>On license applications ^d</i>				
Close Friday and Saturday by midnight	47	82.5%	165	77.5%
Open Friday and Saturday after midnight	10	17.5%	47	22.1%
Open Friday only after midnight	0	0.0%	1	0.5%
Weekly duration of trading hours	81	25.2	87	32.0
<i>Off license applications ^d</i>				
Close Friday and Saturday by midnight	74	81.3%	146	72.6%
Open Friday and Saturday after midnight	17	18.7%	54	26.9%
Open Saturday only after midnight	0	0.0%	1	0.5%
Weekly duration of trading hours	99	29.8	100	32.9
Intermediate behaviours outcomes				
Crime events (n=188,248) ³				
Anti-social behaviour (ASB)	25,421	29.5%	25,714	25.2%
Other types ^e	60,692	70.5%	76,421	74.8%
Overall crime	86,113	100.0%	102,135	100.0%
Alcohol-related ambulance callout events (n=20,250) ⁴				
	8,573	-	11,677	-
On-license retail sales data ^{f, 5}				
Quantity sold per premise per quarter	43,944	3,867	58,416	3,083
Value (£) per premise per quarter	193,083	31,128	244,553	25,853
Units of alcohol sold per premise per quarter	107,815	9,322	131,949	7,493

Note. CIZ: Cumulative Impact Zones; SD: Standard deviation.

^a: By applicant/committee/court. Category used to derive an application success rate.

^b: Refused, withdrawn, surrendered, revoked, incomplete, not licensable, or suspended.

^c: Granted applications only.

^d: Numbers don't add up as applications submitted for both on and off license are also included separately in the on and off license applications categories.

^e: Bicycle theft, burglary, criminal damage and arson, drugs, other crime, other theft, possession of weapons, public disorder and weapons, public order, robbery, shoplifting, theft from the person, vehicle crime, violence and sexual offences and violent crime.

^f: Range of outlets per product per quarter (1 to 9 for non CIZ and 1 to 26 in CIZ).

¹: Covering the period between April 2008 and June 2016; ²: Covering the period between January 2009 and June 2016; ³: Covering the period between January 2011 and March 2016; ⁴: Covering the period between April 2008 and March 2016; ⁵: Covering the period between January 2010 and December 2016.

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Table 2 Impacts on licence applications in the English Local Authority between 2008 and 2016.

	Number of applications ^{a, b}	Weekly duration of trading hours ^{a, c, d}	Licence approval rates ^{b, e}	Closing times before midnight on Friday and Saturday ^{c, e}
	b (95% CI)	b (95% CI)	% (95% CI)	% (95% CI)
<i>All license applications^f</i>				
CIZ				
Intercept/step change	-5.69 (-11.63, 0.25)	-11.69 (-26.96, 3.57)	-28.55 (-39.68, -15.36)	-1.04 (-10.74, 9.71) ^h
Slope change	-0.01 (-0.68, 0.68)	-3.03 (-6.58, 0.52)	5.75 (3.80, 7.72)	-5.99 (-8.34, -3.58) ^h
Non CIZ				
Intercept/step change	-2.41 (-7.96, 3.13)	-7.24 (-15.67, 1.18)	-24.03 (-41.90, -0.65)	25.39 (-6.48, 68.12)
Slope change	-0.19 (-0.86, 0.47)	-4.79 (-6.65, -2.93)	7.63 (4.38, 10.99)	0.15 (-6.44, 7.21)
<i>On license applications^g</i>				
CIZ				
Intercept/step change	-	-14.84 (-33.84, 4.17)	-16.61 (-32.72, 3.36)	5.69 (-11.32, 25.96) ^h
Slope change	-	-2.61 (-6.86, 1.64)	4.67 (-0.02, 9.57)	-6.02 (-9.55, -2.36) ^h
Non CIZ				
Intercept/step change	-	-21.69 (-47.85, 4.47)	-16.54 (-41.05, 18.16)	4.72 (-25.34, 46.88) ^h
Slope change	-	-10.24 (-16.01, -4.48)	4.31 (-2.62, 11.73)	-2.75 (-9.73, 4.76) ^h
<i>Off license applications^g</i>				
CIZ				
Intercept/step change	-	-10.31 (-31.17, 10.55)	-41.36 (-53.23, -26.48)	-1.93 (-29.56, 36.52)
Slope change	-	-4.30 (-9.11, 0.50)	18.10 (12.32, 24.18)	-6.55 (-13.54, 1.00)
Non CIZ				
Intercept/step change	-	1.95 (-14.71, 18.62)	-24.91 (-43.95, 0.60)	45.75 (-6.18, 126.40)
Slope change	-	-3.26 (-6.95, 0.42)	20.69 (12.58, 29.38)	0.75 (-9.01, 11.56)

Note. CIP: Cumulative Impact Policy; CI: Confidence Intervals; CIZ: Cumulative Impact Zones.

^a: Use of a generalized linear model to obtain Prais-Winsten transformed regression estimators that are corrected for first-order serially correlated residuals.

^b: Covering the period between April 2008 and June 2016.

^c: Covering the period between January 2009 and June 2016.

^d: For granted applications only.

^e: Use of poisson regression with estimates converted to a % change using the Incidence Rate Ratio values.

^f: Quarterly data for number of applications and for licence approval rates. Biannually data for weekly duration of trading hours and for closing times before midnight on Friday and Saturday.

^g: Biannually data.

^h: Taking into account heteroskedasticity- and autocorrelation-consistent variance estimates.

Table 3 Impacts on behavioural outcomes in the English Local Authority between 2008 and 2016.

	Overall crime rates^{a, b, c}	ASB rates^{a, b, c}	Ambulance call-outs rates^{a, b, d}
	% (95% CI)	% (95% CI)	% (95% CI)
CIZ			
Intercept/step change	-12.22 (-17.95, -6.09)	9.12 (-9.21, 31.14)	-2.50 (-12.74, 8.95)
Slope change	1.65 (0.45, 2.87)	3.87 (0.65, 7.19)	-0.90 (-2.23, 0.45)
Non CIZ			
Intercept/step change	-7.97 (-13.96, -1.56)	-0.67 (-14.92, 15.97)	8.83 (-5.51, 25.35)
Slope change	3.24 (2.03, 4.46)	6.31 (3.55, 9.14)	-0.50 (-2.17, 1.21)
Across the Local Authority			
Intercept/step change	-10.32 (-15.19, -5.18)	4.25 (-10.73, 21.75)	2.13 (-8.13, 13.54)
Slope change	2.37 (1.37, 3.38)	5.06 (2.32, 7.88)	-0.73 (-2.00, 0.55)

Note. ASB: Anti-social behaviour; CIP: Cumulative Impact Policy; CI: Confidence Intervals; CIZ: Cumulative Impact Zone.

^a: Rates were calculated as events per quarter in a given year divided by the total population in Islington for that year (mid-year population estimates from 2015 were used for 2015 and 2016 data).

^b: Use of poisson regression with estimates converted to a % change using the Incidence Rate Ratio values.

^c: Quarterly data covering the period between January 2011 to March 2016.

^d: Quarterly data covering the period between April 2008 to March 2016.

Table 4 Impacts on on-license retail sales outcomes in the English Local Authority between 2010 and 2016.

	Quantity ^{a, b} b (95% CI)	Sales (£) ^{a, b} b (95% CI)	Units of alcohol ^{a, b} b (95% CI)
CIZ			
Intercept/step change	2,042 (-1,967, 6,051)	9,741 (-10,879, 30,360)	-4,016 (-11,889, 3,858)
Slope change	12 (-483, 507)	-664 (-3,237, 1,909)	-2,060 (-3,033, -1,087)
Non CIZ			
Intercept/step change	-2,025 (-5,136, 1,085)	-5,362 (-21,837, 11,114)	8,468 (-818, 17,755)
Slope change	-901 (-1,284, -518)	-4,394 (-6,421, -2,367)	385 (-759, 1,529)
Across the Local Authority			
Intercept/step change	93 (-5,826, 6,011)	5,539 (-27,072, 38,151)	4,321 (-10,464, 19,106)
Slope change	-885 (-1,622, -147)	-5,011 (-9,110, -913)	-1,683 (-3,528, 162)

Note. CIP: Cumulative Impact Policy; CI: Confidence Intervals; CIZ: Cumulative Impact Zones.

^a: Use of a generalized linear model to obtain Prais-Winsten transformed regression estimators that are corrected for first-order serially correlated residuals.

^b: Quarterly data covering the period between January 2010 to December 2016.

Highlights

- Modifying alcohol availability is widely advocated to reduce alcohol-related harms.
- Impact evaluation of a new alcohol licensing policy in one London Local Authority.
- First study to examine licensing decisions, alcohol-related harms and retail sales.
- We found moderate reductions in crime and no impact on ambulance callouts.
- We found little or no impact on sales volume and sales revenues.