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Takeaway alcohol sales and violent crime: the implications of extended trading hours

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AIM To examine the impact of the extension to the trading hours of bottle shop and alcohol home delivery services from 10 p.m. to 11 p.m. in December 2016 on the incidence of domestic assault in NSW.

METHOD The monthly rate of police recorded domestic violence (DV) assaults, non-DV assaults and DV assaults occasioning grievous bodily harm (DV-GBH) were examined over the period February 2014 to February 2020 for all of NSW. The analysis was repeated for all DV and non-DV assaults occurring between 10 p.m. and 2 a.m.. Interrupted time series methods (specifically GLARMA models) were used to test for an effect of the policy on violent crime.

RESULTS The analyses showed an initial significant drop immediately after the policy change in the mean rate of DV assaults at any time, followed by an increasing trend in domestic assaults after the new policy commenced. A 0.4% increase in DV assaults per month was estimated for the 38-month period after the extension to trading hours. No significant increase in non-DV assault rates or DV-GBH rates was observed. When the analyses were restricted to the 10 p.m. to 2 a.m. time-period the statistically significant increase in the trend in DV assaults after the trading hours extensions remained but, there was still no change in the level or trend for the other two series.

CONCLUSION The results suggest that the extension to takeaway alcohol sales was associated with a very small but statistically significant increase in DV assaults. We estimate that an additional 1,120 DV assaults occurred in the 38-months after trading hours were extended.

KEYWORDS

Domestic violence

alcohol consumption

trading hours

assault

INTRODUCTION

Alcohol consumption is associated with a wide range of health and social problems, including violence. In 2019, one in five Australians aged 14 years and over reported being verbally or physically abused or put in fear by someone under the influence of alcohol in the previous 12 months (Australian Institute of Health and Welfare, 2020). This corresponds to 4.5 million Australians. For females, the abuser is more likely to be a current or former spouse or partner and for males, more likely to be a stranger. Many of these violent episodes are serious enough to come to the attention of the police. In New South Wales (NSW), almost 20,000 alcohol-related assaults are recorded by police each year, half of which are related to domestic violence (NSW Bureau of Crime Statistics and Research, 2020).¹ Identifying effective policy levers to reduce problems associated with alcohol is therefore an ongoing concern for government. This is especially true for domestic violence which has remained relatively stable over the last 10 years despite other types of violent crime falling significantly (Goh & Ramsey, 2021).

Policies regulating the availability of alcohol are one approach to reducing alcohol-related harms that have been discussed widely in the literature. This includes both restricting the spatial availability (outlet density) and the temporal availability (number of days and/or hours of sale) of alcohol.

A substantive body of research exists demonstrating a strong link between the concentration of liquor outlets in a neighbourhood and levels of alcohol consumption and associated harms. Relying on spatial statistical approaches, both cross-sectional and longitudinal in nature, these studies show that neighbourhoods with a higher density of liquor outlets generally have increased rates of violence (e.g. Gorman, Speer, Gruenewald, & Labouvie, 2001; Gruenewald & Remer, 2006; McKinney, Caetano, Harris, & Ebama, 2009; Nordstrom, 2000), family violence (Livingston, 2011a; Livingston, 2011b), chronic disease (e.g. Livingston, 2011b; Theall et al., 2009), motor vehicle crashes (e.g. Chikritzhs & Stockwell, 2006; Treno, Johnson, Remer, & Gruenewald, 2007) and child abuse and neglect (e.g. Freisthler, Midanik, & Gruenewald, 2004).

In fact, certain types of liquor outlets have been found to be more strongly related to particular harms. For example, Livingston (2011a) used fixed effects models and 9 years of liquor licensing postcode level data to examine trends in the number of liquor outlets and police recorded domestic violence assaults in Melbourne, Victoria. While significant positive relationships were found for all three licence types (general, on-licence and packaged), packaged (or off-site) licences appeared to have a much greater impact on domestic violence than either general or on-licences. Work by Liang and Chikritzhs (2011) suggests that the increased likelihood of domestic violence in areas with a higher concentration of off-site liquor stores is likely due to increased volumes of alcohol being sold in those locations. They found that once alcohol sales are controlled for, numbers of off-site outlets in local government areas of Perth, Western Australia (W.A.), did not significantly predict risk of assault at private residences.

There is also strong evidence to suggest that increased trading hours of licensed venues are associated with significant increases in alcohol consumption and related harms. Several high quality evidence reviews conclude that restrictions on trading hours can be an effective strategy for reducing alcohol-related harm (e.g. Hahn et al., 2010; Middleton et al., 2010; Stockwell & Chikritzhs, 2009). Based on a recent systematic review of robust evaluations from Australia, Norway and the Netherlands, Wilkinson, Livingston, and Room (2016) estimate that trading hours restrictions of on-licence venues could result in reductions in alcohol-related harms of between 16% and 37%. Hahn et al. (2010) determined that there was sufficient evidence to suggest that even a 2-hour decrease in trading hours of licensed venues could result in significant benefits, including reductions in violence. However, a limitation of the research reviewed to date is that most studies have focused on the impact of variations (most commonly extensions) in trading hours for premises where alcohol is consumed on-site (e.g. pubs, hotels, nightclubs). Only a small number of studies have examined the effect of variations in trading hours for packaged liquor outlets on alcohol-related harms.

¹ This is based on the BOCSAR yearly figure to June 2019 from the BOCSAR online crime tool. 2020 figures are not reported due to the impact of COVID-19 restrictions on crime.

One of the few studies in this area was undertaken by Wicki and Gmel (2011). They examine the impact of a ban on off-premise alcohol sales from 9 p.m. to 7 a.m. and a more general ban on alcohol sales in petrol stations and video stores in the Swiss canton of Geneva. Using interrupted time-series they found significant and sizeable reductions (25-40%) in hospital admission rates for intoxication coinciding with the policy change, with the largest effects observed for adolescents and young adults. However, it could not be determined from the analysis which component of the reforms (i.e. the change in trading hours or the general ban) contributed to the effect. In more recent work, Wicki, Bertholet, and Gmel (2020) confirm that even partial temporal restrictions of off-premises alcohol sales (early closures two days a week) can reduce hospital admissions for alcohol intoxication, with a moderate effect observed across a wide range of age groups. In similar work, Marcus and Siedler (2015) studied the impact of prohibiting alcohol sales at off-premises between 10 p.m. and 5 a.m. on hospital admission rates in the German state of Baden-Württemberg. They found a seven per cent reduction in alcohol-related hospitalisations among adolescents and young adults following the ban. The policy changes were found to impact both hospitalisations due to acute alcohol intoxication and hospitalisations due to violent assault. Kolosnitsyna, Sitdikov, and Khorkina (2014) provide further evidence for an impact of changes in takeaway alcohol hours on alcohol consumption levels in Russia based on a 2010 study. The authors exploited region-level variation in restrictions imposed on the hours of retail alcohol sales (ahead of a country-wide ban on sales after 11 p.m. which was introduced in 2011). Using both alcohol sales data and household-based survey data they demonstrated a significant correlation between the number of hours when off-premises sales are permitted in a region and alcohol consumption levels.

The studies above are suggestive of a relationship between trading hours of packaged liquor outlets and alcohol-related harms but tell us very little about the likely impact of trading hours policies on rates of domestic violence. The drivers of domestic violence are complex and multifaceted. While alcohol may not be a causal factor driving the offending behaviour, various experimental and non-experimental studies have demonstrated that acute intoxication increases aggressive behaviour (particularly amongst males) and results in more severe episodes of intimate partner violence (Eckhardt, 2007; Leonard & Quigley, 1999; McKinney, Caetano, Rodriguez, & Okoro, 2010). Any factors increasing the risk of excessive use of alcohol, such as policies increasing the availability of alcohol, could therefore lead to changes in domestic violence. However, there is only weak evidence for alcohol policy impacting rates of domestic violence, particularly interventions or policy approaches at the population or community-level (Wilson, Graham, & Taft, 2014). It is therefore an area where further research is clearly warranted.

The current study

In January 2014 liquor licence restrictions were introduced in NSW to reduce alcohol-related violence and improve public safety. The restrictions, which took effect on 24 February 2014, focused mostly on two Sydney entertainment districts (Sydney CBD and Kings Cross) and included lock outs, early cessation of alcohol service, a freeze on new licences and banning orders for problematic patrons. However, one restriction was applicable across the State; a ban on takeaway alcohol sales after 10 p.m.. Prior to the 2014 amendments packaged liquor could be sold until 11 p.m. in NSW.

While several studies have considered the impact of the 2014 reforms on the incidence of non-domestic assault in Kings Cross and the Sydney CBD (see for example, Athanasopoulos, Sarafidis, Weatherburn & Miller, 2021; Donnelly & Poynton, 2019; Donnelly, Poynton, & Weatherburn, 2017; Menéndez, Kypri, & Weatherburn, 2017; Menéndez, Weatherburn, Kypri, & Fitzgerald, 2015), none to date have examined whether the licensing restrictions affected rates of domestic assault. This is because many of the policy changes targeted on-premises licensed venues and only a relatively small proportion of assaults are domestic violence related in and around these locations.

The ban on 10 p.m. takeaway sales is one element of the reform package that may be expected to have an impact on rates of domestic violence (given the evidence summarised above and its statewide reach) but isolating the effect of this specific policy from other contextual factors is challenging. The 10 p.m. restrictions coincided not only with increased licensing restrictions in the Sydney central business districts but also the implementation of other state-wide measures to tackle alcohol-related violence, such as the introduction of one-punch laws with 20-year maximum prison penalties and mandatory minimum terms for offenders intoxicated by alcohol. The restrictions on trading hours were also introduced at a time when there was wide-scale community, media and police attention focused on alcohol-related violence as the result of two high profile deaths from alcohol-related assaults.

In December 2016, based on recommendations from the Callinan review (Callinan, 2016), the NSW Government reversed the ban on takeaway sales after 10 p.m. and further, extended the hours of sale of home delivered alcohol to 11 p.m.. This policy change affected all of NSW and occurred in isolation from any other major alcohol policy initiatives. This extension of packaged liquor trading hours from 10 p.m. to 11 p.m.² is the focus of the current study as it allows for a more definitive test of the impact of the changes in the availability of packaged liquor on the incidence of domestic assault. The impact of this policy on non-domestic assault is also considered.

The specific research questions that we wish to address here are:

1. Was the reversal of the ban on takeaway alcohol sales after 10 p.m. and the extension of hours of sale of home delivered alcohol associated with an increased incidence of domestic or non-domestic assault in NSW?
2. Was the reversal of the ban on takeaway alcohol sales after 10 p.m. and the extension of hours of sale of home delivered alcohol associated with an increased incidence of domestic or non-domestic assault between 10 p.m. and 2 a.m. (the time period when takeaway alcohol sales was extended)?

METHOD

The outcome for this analysis is the monthly rate of recorded domestic violence (DV) assaults and non-DV assaults per 100,000 population, between February 2014 and February 2020 for all of NSW. We do not include data after February 2020 as the COVID-19 restrictions began in March 2020 and that had a substantial impact on the rate of assault (particularly non-DV assault). As trends in DV may be influenced by the victim's willingness to report to police we also consider changes in the monthly rate of more serious DV incidents, namely DV assaults occasioning grievous bodily harm (DV-GBH). These more serious incidents are considered to be less influenced by trends in reporting as victims would typically require medical attention for injuries sustained during the incident. We also repeat the analysis for all DV, DV-GBH and non-DV assaults occurring between 10 p.m. and 2 a.m. given this is the time period when the availability of alcohol increased and also the time period when a greater proportion of assaults are known to be alcohol-related.³ All rates were calculated by dividing the total counts recorded by NSW police for each incident type and dividing by the number of NSW residents for the given year (Australian Bureau of Statistics, 2020). For each time series, a total number of 73 months, comprising a pre-intervention period from February 2014 to December 2016 (n = 35) and a post-intervention period from January 2017 to February 2020 (n = 38), were included in the analyses. These data were sourced from the NSW Police Force's Computerised Operational Policing System (COPS).

² From Monday through Saturday only.

³ Between 2014 to 2018, around 65-80% of all non-DV assaults between 10 p.m. to 2 a.m. were alcohol-related compared with just 5-22% during the day (9 a.m. to 5 p.m.). For DV assaults over the same period, about 55-65% of all DV assaults occurring between 10 p.m. and 2 a.m. were alcohol-related compared with just 8-28% during the day (9 a.m. to 5 p.m.).

Statistical analysis

An interrupted time series (ITS) model is used to assess the effect of the extension to trading hours for bottle-shops and alcohol home delivery services. The particular ITS model chosen to account for serial dependence in regression modelling of time series of counts is a generalised linear autoregressive moving average (GLARMA) model (Davis, Dunsmuir, & Streett, 2003). The model for a Poisson response has the following form:

$$Y_t | F_t \sim \text{Poisson}(\mu_t)$$

$$\log(\mu_t) = \beta_0 + \beta_1 \text{Time}_t + \beta_2 \text{Intervention} + \beta_3 \text{Time}_t \times \text{Intervention} + \log(\text{offset}) + Z_t$$

$$Z_t = \phi_1 (Z_{t-1} + e_{t-1}) + \dots + \phi_p (Z_{t-p} + e_{t-p}) + \theta_1 e_{t-1} + \dots + \theta_q e_{t-q}$$

where F_t is information up to time t . In the above notation, Y_t represents the count of DV and non-DV assaults and the time variable Time_t represents monthly intervals and was treated as a continuous covariate. Thirty-five months pre- and 38 months post-policy data was included in a 73-month analysis period centred on the date that the extension to trading hours came into effect. **Intervention** is an indicator variable which takes on the value 0 prior to January 2017 and 1 after policy implementation. In the above model, β_0 estimates the level of DV and non-DV assault incidents prior to the extension to trading hours, β_1 estimates the pre-policy trend, β_2 estimates the change in the intercept after the policy and β_3 estimates the change in trend after the policy commenced. Note that β_2 also represents the intervention effect, which is the difference between the predicted outcome based on the intervention and the value estimated at intervention but based on baseline level and trend only, as if the intervention had not occurred (the counterfactual value). We use the population size of NSW as the **Offset**, hence we are effectively modelling the monthly rate of DV and non-DV assaults.

For the innovation process, Z_t is an autoregressive moving average process used to account for possible serial correlation, ϕ_i is the autoregressive (AR) coefficient with order $i = 1, \dots, p$ and θ_i is the moving average (MA) coefficient with order $i = 1, \dots, q$. A GLARMA model would reduce down to a standard Poisson log-linear model if we let $Z_t = 0$ for all t or equivalently setting $\phi_1 = \dots = \phi_p = \theta_1 = \dots = \theta_q = 0$.

Dunsmuir and Scott (2015) suggested using the histogram of the probability integral transformation (PIT) as a diagnostic tool to assess the distributional assumption in the GLARMA model. For a well-calibrated model, the PIT histogram should resemble one obtained from a sample of a (standard) uniform distribution. Any deviation from uniformity hints at model deficiencies. A distinct U-shape for example indicates over-dispersion, which is a common phenomenon for a model based on the Poisson distribution. The equi-dispersed Poisson distribution is often too restrictive and a more flexible distribution such as negative binomial may be better suited for analysing data. Rather than repeatedly fitting different conditional distributions until a good fit is found, Fung and Huang (2016) proposed a semiparametric framework so that a GLARMA model can be implemented without specifying explicitly a conditional distribution for the outcome. This is achieved by letting the underlying distribution be estimated from the data simultaneously with the coefficients in the mean model. In other words, we let the empirical data inform which distribution is the most appropriate, hence adapting automatically to the underlying data-generating model. For more details, see Fung and Huang (2016).

We fit several models with increasing complexity to each time series: 1) standard GLM Poisson model, 2) Semiparametric GLM and 3) Semiparametric GLARMA model. We first fit a standard Poisson model to identify appropriate AR and MA orders from the autocorrelation function (ACF) and partial autocorrelation function (PACF) plots of the residuals. Where significant AR and/or MA terms are identified, we revise the model to incorporate the serial dependence. We then implement semiparametric GLM and semiparametric GLARMA models. We use the Box-Ljung (Ljung & Box, 1978) test to assess the independence of the model randomised quantile residuals. Binary terms for months of the year or sinusoidal functions are used to capture seasonality in the time series. The final model is chosen based on a combination of the Akaike Information Criterion (AIC) and PIT plot.

RESULTS

Figure 1 presents the times series plots of the monthly counts of non-DV, DV and DV-GBH assaults in NSW. Both the non-DV and DV assault series display strong seasonality, whereas in the DV-GBH time series it is less clear. We also observe a clear increasing trend in DV assaults during the post-intervention period.

Figure 1. Monthly counts of non-DV, DV and DV-GBH assaults in NSW, February 2014 – February 2020

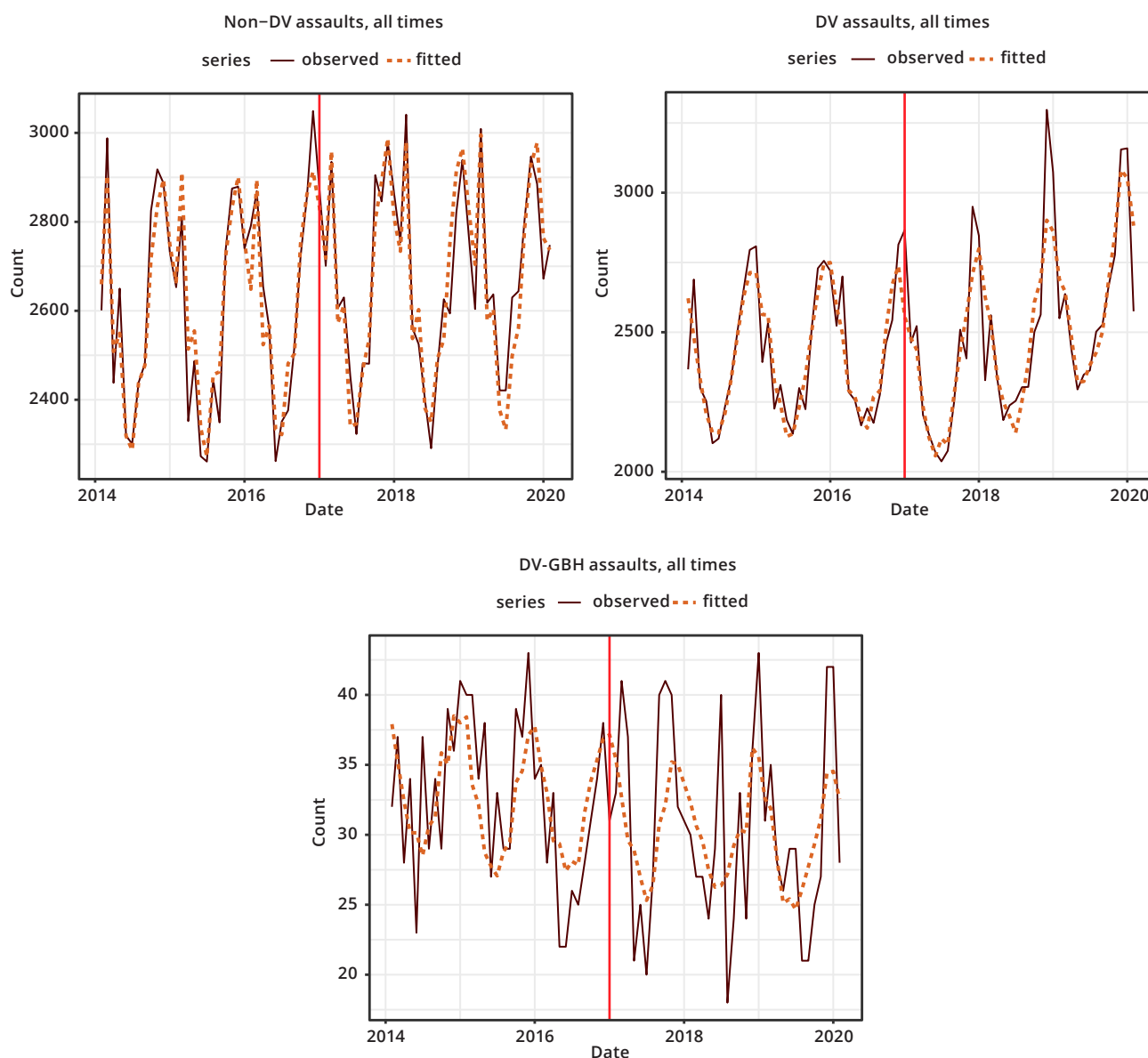


Table 1 summarises the results from the final time-series models for the three different assault types. The first row displays the estimated underlying trend prior to the extension to trading hours for bottle shops and alcohol home delivery services (i.e. prior to January 2017). The second and third rows show the change in the level and the change in the trend, respectively, after the policy commenced. The fourth row presents the estimated number of extra cases occurring from January 2017 to February 2020. This was calculated by comparing the fitted values from the full model with and without those level and trend changes. The fifth row shows the final model and the method used to capture seasonality in the final model. The last two rows provide the AIC values and the p-values from the Ljung-Box test for checking autocorrelation in model residuals. In Tables 1 and 2, “NS” stands for “non-significant”, indicating this term

has been dropped from the model. As the main research question is whether there is a significant change in the level or trend for each time series of interest, we will keep the level change term if the trend change was not statistically significant so that the model does not solely consist of a time trend. Where both level and trend change estimates were not statistically significant, we put “NS” for the “number of extra cases in 38 months post-intervention”.

Table 1. Final model estimates of changes in non-DV, DV and DV-GBH assaults (rates) in NSW following the 2016 extension to trading hours for takeaway and home delivered alcohol

	Non-DV	DV	DV-GBH
Underlying trend	-0.001* <i>p</i> = 0.001	0.000 <i>p</i> = 0.819	-0.003* <i>p</i> = 0.035
Level change	0.013 <i>p</i> = 0.404	-0.069* <i>p</i> < 0.001	-0.006 <i>p</i> = 0.934
Trend change	NS	0.004* <i>p</i> = 0.001	NS
Number of extra cases in 38 months post-intervention	NS	1120.013	NS
Model	SPGLARMA Monthly indicators	SPGLARMA Sinusoid	SPGLARMA Sinusoid
AIC	477.934	493.943	430.282
Ljung-Box test	<i>p</i> = 0.224	<i>p</i> = 0.342	<i>p</i> = 0.574

* Significant at the 0.05 level

There was a significant pre-policy downward trend in the rate of non-DV assaults and DV-GBH assaults. After December 2016, there was no significant change in either the mean rate of non-DV assaults or the trend. For DV rates, we estimated an immediate reduction in the level (6.9%) after the extension to trading hours was introduced and then a significantly increasing trend (0.4% per month). The result of these two opposing effects is an estimated increase in the number of DV assaults of 1,120 cases over 38 months from the policy commencement to February 2020. Lastly, there were no significant changes in the level or trend in the rate of DV-GBH assaults after December 2016.

Time series plots of monthly rates of non-DV, DV and DV-GBH assaults occurring between 10 p.m. and 2 a.m. in NSW are shown in Figure 2. Again, we see strong seasonality in the data. The results from the final estimated time series models for assaults occurring during this restricted time period are shown in Table 2. There was a significant decreasing trend in the monthly rate of non-DV assaults prior to the changes in trading hours for takeaway alcohol sales but there was no significant change in this trend or in the level of non-DV assaults after the intervention commenced. In contrast, we found no significant trend in DV assault rates in the pre-policy period but a significant increase in the trend after the new trading hours commenced, rising by 0.5% per month. This equates to an additional 1,054 DV assaults occurring between 10 p.m. and 2 a.m. from January 2017 to February 2020. For DV-GBH assaults occurring between 10 p.m. and 2 a.m., there was a significant underlying trend, but no significant change in level or change in trend during the post-period.

Figure 2. Monthly number of non-DV, DV and DV-GBH assaults occurring between 10pm-2am in NSW, February 2014 – February 2020

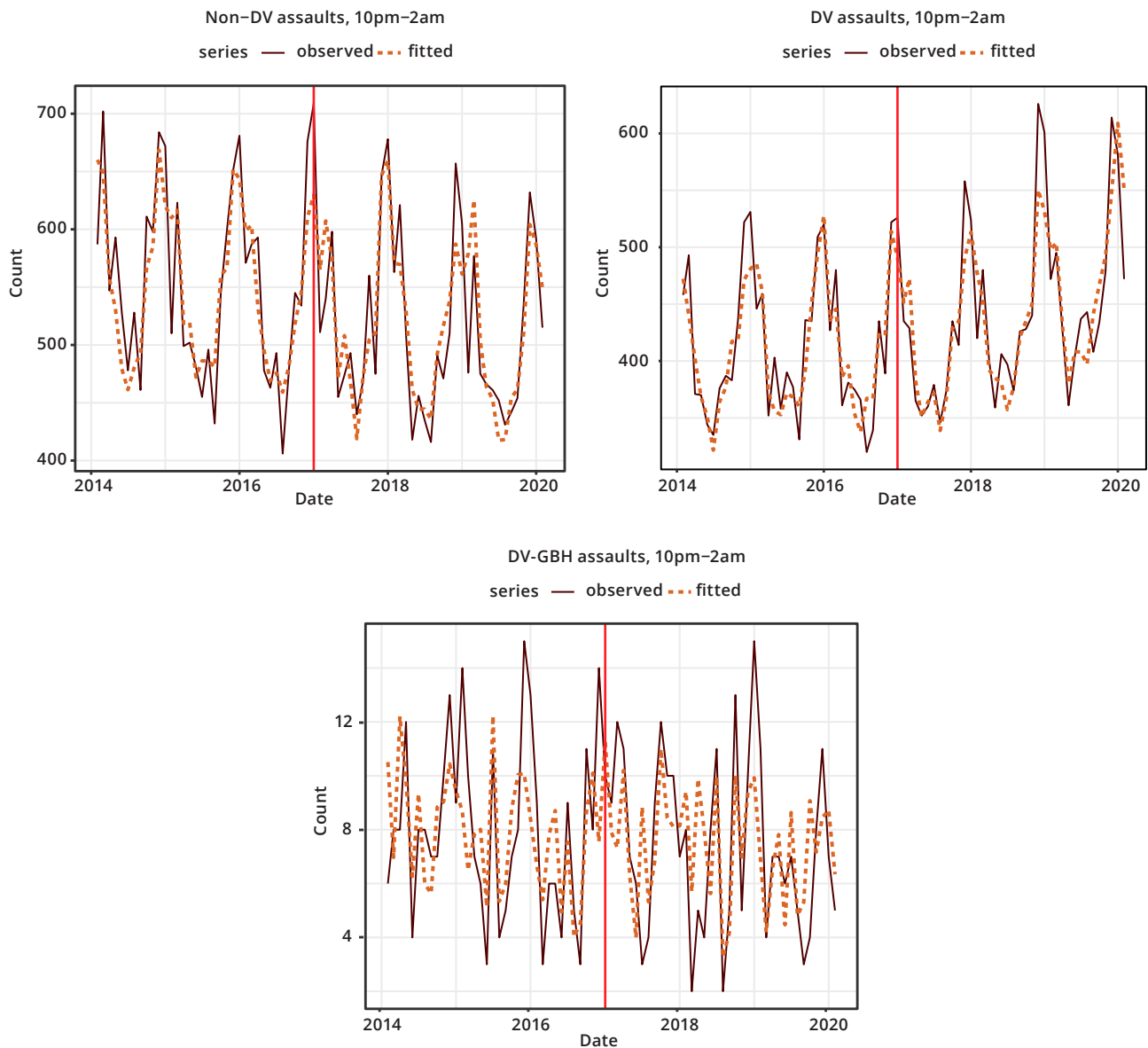


Table 2. Final model estimates of changes in non-DV, DV and DV-GBH assaults (rates) between 10pm-2am in NSW following the 2016 extension to trading hours for takeaway and home delivered alcohol

	Non-DV	DV	DV-GBH
Underlying trend	-0.004* $p < 0.001$	0.000 $p = 0.943$	-0.009* $p = 0.009$
Level change	0.024 $p = 0.303$	-0.027 $p = 0.154$	0.199 $p = 0.159$
Trend change	NS	0.005* $p = 0.003$	NS
Number of extra cases in 38 months post-intervention	NS	1054	NS
Model	SPGLARMA Sinusoid	SPGLARMA Sinusoid	SPGLARMA Monthly indicators
AIC	514.319	496.626	351.365
Ljung-Box test	$p = 0.305$	$p = 0.662$	$p = 0.882$

* Significant at the 0.05 level

DISCUSSION

This study set out to assess the impact of the 2016 extension to trading hours for the sale of takeaway and home delivered alcohol (by 1 hour from 10 p.m. to 11 p.m.) on domestic and non-domestic assault rates in NSW. The findings from the analysis suggest that the extension to trading hours was associated with a very small but statistically significant increase in the trend in late-night DV assaults recorded by police. We estimate that in the 38-month period after policy commencement the rate of DV assaults occurring between 10 p.m. and 2 a.m. increased by 0.5% per month. This equates to an additional 1,054 DV assault incidents over three years. However, the results for all DV assaults (i.e. those occurring at any time) are less straightforward. While we found an increasing trend in the full DV assault series of 0.4% per month, this was partially offset by a drop in the level of the assault rate after the policy was implemented. The result being an estimated increase in the overall DV assault rate of 1,120 cases during the post-policy period.

The time-series methods used in this study are able to account for any pre-existing underlying trends in DV assault rates as well as any seasonal variation in the data but do not permit causal inferences. The slightly more pronounced effect after 10 p.m., the time period when the extended trading hours came into effect, lends some support to the proposition that the rise in domestic assaults was due to the policy and not some other temporal change influencing rates of alcohol consumption and/or violence. However, we cannot rule out the possibility that the small increase in late-night DV assaults is due to some other confounding factor coinciding with the change in trading hours. No effect was found for DV-GBH assaults occurring between 10 p.m. and 2 a.m. or for the full DV-GBH series, which suggests that there was no change in the rate of more serious DV assaults. However, more serious violent crime occurs at a much lower rate, which makes it difficult to detect small effects (if they exist).

We did not find a significant change in the trend or the mean rate of non-DV assaults occurring at any time after December 2016. Likewise, there was no change in the trend or the mean rate when the analysis was restricted to late-night non-DV assaults which are more likely to be alcohol-related and arguably more likely to be affected by the variation in trading hours. The weaker evidence for an impact on non-DV assaults is perhaps not surprising given previous research suggesting a stronger correlation between the availability of packaged liquor and domestic assault (e.g. Liang & Chikritzhs, 2011; Livingston, 2008) than other types of violence.

One notable limitation of the current study is that we are unable to tell from the available data what impact the new policy had on actual trading hours of bottle shops/home delivery services in NSW. Without this information we cannot be entirely confident that the small increase in violence coinciding with the extension to trading hours is due to the increased availability of alcohol. Similarly, in the absence of these data it is impossible to determine whether any change is due to extended trading hours of bottle shops only, home delivery services only, or a combination of the two. Were data available on actual trading hours and geographical variation in the uptake of the policy was evident, this could be exploited in future research to better test the availability hypothesis.

Nevertheless, these findings are broadly consistent with the extant literature on the impact of trading hours policies on alcohol-related harms and is one of only a handful of studies focusing specifically on changes in the temporal availability of packaged liquor. Further research in this area is clearly needed. There is also little Australian research to date on the impact of home delivered alcohol on consumption and related harms. Evidence from a small survey recently undertaken by Mojica-Perez, Callinan, and Livingston (2019) in Australia suggests that fast delivery services (under two hours) are most often used by younger people and people who are more likely to engage in heavy episodic drinking. Further, these high-risk groups report that they would have stopped their drinking had the service not been available. Given the significant uptake in home delivery services since the COVID-19 restrictions began and the potential for this business model to be adopted more widely in the future, work in this area of alcohol policy is of critical importance.

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