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Research Paper

What are the impacts of alcohol supply reduction measures on police-recorded adult domestic and family violence in the Northern Territory of Australia?

Sarah Clifford [a,*], Cassandra J.C. Wright [a,b,c], Peter G. Miller [a,d,e], Kerri Coomber [d], Kalinda E. Griffiths [a,f,g,h], James A. Smith [a,d,h], Michael Livingston [c,e]

[a] Menzies School of Health Research, Charles Darwin University, Darwin, Australia
[b] Burnet Institute, Melbourne, Australia
[c] Centre for Alcohol Policy Research, La Trobe University, Melbourne, Australia
[d] School of Psychology, Deakin University, Geelong, Australia
[e] National Drug Research Institute, Curtin University, Melbourne, Australia
[f] Centre for Big Data Research in Health, University of New South Wales, Sydney, Australia
[g] Centre for Health Equity, University of Melbourne, Melbourne, Australia
[h] College of Medicine and Public Health, Flinders University, Darwin, Australia

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ABSTRACT

Background: During 2017-18, the Northern Territory (NT) introduced a Banned Drinker Register (BDR) and Minimum Unit Price (MUP) NT-wide; Police Auxiliary Liquor Inspectors (PALIs) in three regional towns; and restrictions on daily purchases/opening hours (DPOH) in one regional town. The BDR is an individual-level alcohol ban; MUP is a pricing policy; and PALIs enforce bans on restricted areas at takeaway outlets. This study examines the impact of these policies on adult domestic and family violence (DFV).
Methods: We examined DFV assaults and breaches of violence orders from January 2014 – February 2020 using interrupted time series models for NT, Greater Darwin, Katherine, Tennant Creek, and Alice Springs. To account for increasing numbers of individuals on the BDR we tested two timepoints (Sept 2017, March 2018).
Findings: Following DPOH, assaults (78 %) and alcohol-involved assaults (92 %) decreased in Tennant Creek. After PALIs, assaults (79 %) in Tennant Creek, and breaches (39 %) and alcohol-involved breaches (58 %) in Katherine decreased. After MUP, assaults (11 %), alcohol-involved assaults (21 %) and alcohol-involved breaches (21%) decreased NT wide. After MUP/PALIs in Alice Springs, alcohol-involved assaults (33 %), breaches (42 %), and alcohol-involved breaches (57 %) decreased. BDR (Sept 2017) found increases in assaults (44 %) and alcohol-involved assaults (39 %) in Katherine and assaults (10%) and alcohol-involved assaults NT-wide (17 %). There were increases of 21 %-45 % in breaches NT-wide, in Darwin, Katherine, and Alice Springs. Following March 2018 found increases in assaults (33 %) and alcohol-involved assaults (48 %) in Katherine. There were increases - from 20 % to 56 % - in breaches in NT-wide, Katherine, and Alice Springs.
Conclusion: PALIs and DPOH were associated with some reductions in DFV; the BDR was associated with some increases. The upward trend commences prior to the BDR, so it is also plausible that the BDR had no effect on DFV outcomes. Although MUP was associated with reductions in the NT-wide model, there were no changes in sites without cooccurring PALIs.

Introduction

The Northern Territory (NT) is a sparsely populated jurisdiction in the central north of Australia, with 40 % of residents living in remote and very remote areas (Australian Bureau of Statistics, 2020). Alcohol use and harms are notably higher in the NT compared to the rest of

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* Corresponding author at: Menzies School of Health Research, John Mathews Building, Royal Darwin Hospital Campus, Rocklands Drive, Casuarina 0880, Australia.
E-mail address: sarah.clifford@menzies.edu.au (S. Clifford).

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Australia (Australian Institute of Health and Welfare, 2021; Skov, Chikritzhs, Li, Pircher, & Whetton, 2010; Smith et al., 2019), as are the rates of domestic and family violence (DFV). In 2021 there were 2331.4 (per 100,000 persons) victims of DFV-related assaults in the NT, more than 250 % greater than the next highest jurisdiction.[1] A large proportion of the DFV incidents in the NT involve alcohol (Kerr et al., 2017). There is strong evidence that alcohol increases the frequency and severity of violence (Foran & O'Leary, 2008) by increasing instigation and lowering inhibition. Violence is most likely to occur where there is strong instigation (immediate environmental stimuli), strong impellance (situational or dispositional qualities), and low inhibition (1^3 Model, see (Finkel & Hall, 2018) for more detail). Well recognised situational and dispositional factors include patriarchal privilege, poverty, experiences of trauma (particularly in childhood), normalisation of violence, poor mental health, and alcohol and other drug use (Gibbs et al., 2020). Alcohol and other drug use and trauma also intersect, independently of violence, which can then place individuals at greater risk of both perpetration and experience of violence (Voith et al., 2020).

Aboriginal and Torres Strait Islander peoples account for 30% of the NT population and for many Aboriginal and Torres Strait Islander peoples the ongoing impacts of colonisation results in additional layers of trauma (Atkinson, 2002). Aboriginal and Torres Strait Islander women and girls experience violence at a much higher rate than non-Indigenous women both in the NT and nationally (Kerr et al., 2017; Moore et al., 2022; Olsen & Lovett, 2016). Globally, patriarchal post-colonial contexts are associated with increased risk of intimate partner violence (Brown et al., 2023), and in the Australian context the practises of colonisation, which have resulted in dispossession of lands, dislocation of families through removal, and structural marginalisation, are recognised as a significant contributor to increased levels of DFV (Olsen & Lovett, 2016). These practises of colonisation impact health and wellbeing in a multitude of ways (King et al., 2009), including increased risk of substance use and related harms (Snijder et al., 2021), which, as outlined above, additionally contribute to DFV.

Alcohol policies and DFV

Although it is clear that population-level alcohol policies can reduce alcohol use (Sharma, Sinha, & Vandenburg, 2017) and related harms like injuries, hospitalisation, and homicides (Sanchez-Ramirez & Voaklander, 2018), there is less evidence about their impact on DFV (Wilson et al., 2014). A 2014 systematic review of the impact of alcohol interventions and policies found weak evidence that reductions in prices and availability reduced intimate partner violence (Wilson et al., 2014). Regarding remote Aboriginal and Torres Strait Islander communities specifically, a systematic review of alcohol restrictions and associated harms found no clear or consistent findings regarding DFV, with both decreases and increases evident (Hines et al., 2022). However, given what we know about the impact of alcohol on frequency and severity of violence, it is plausible that policies that reduce alcohol consumption or intoxication can reduce certain types of DFV at the population level. DFV is an overarching term which incorporates all forms of violence (physical, sexual, economic, verbal, emotional) committed in the context of domestic or family relationships, including intimate partner violence (Australian Bureau of Statistics 2013). Many of these behaviours are not captured well in administrative data, therefore epidemiological analysis can often only assess the impact of these interventions on physical violence and intimidation and will be an underestimation of the true extent of DFV.

Alcohol policy in the Northern Territory

The NT (Fig. 1) has a complex history of alcohol policy, with significant regional variation and 11 major policy changes in the past decade alone (Clifford et al., 2021).

The Banned Drinker Register (BDR)

The BDR came into effect on 1 September 2017 and is a register of individuals who are banned from purchasing alcohol. Individuals who already had alcohol bans (for example, throughout their parole orders) were automatically added to the BDR. At the end of the first day of full operation, there were 1114 individuals on the BDR (Smith & Adamson, 2018), and the maximum number during this study period was approximately 4000 (NT Health, 2024). It is enforced at takeaway outlets by scanning customer's identification at point of sale. Some relevant automated pathways onto the BDR include 'being the defendant on an alcohol-involved domestic violence order' and 'being arrested, charged or summoned in relation to any other alcohol related offence'. Other pathways include self-referral and referral by an authorised person (such as a social worker). The majority of people are referred to the BDR via Police (65%) and Courts (26%) (Ernst & Young 2020). Aboriginal and Torres Strait Islander peoples account for 84% of people on the BDR (Ernst & Young 2020) and this significant over-representation is most likely a flow-on effect from police and court referral pathways (Australian Bureau of Statistics, 2020; Smith & Adamson, 2018). Domestic violence has been involved in the initiating incident for between 25 % and 42 % of people on the BDR (NT Health, 2024).

Minimum Unit Price (MUP)

MUP is a price-based policy that sets a minimum (or floor) price at which alcohol can be sold. On 1 October 2018 the NT introduced a MUP of $1.30AUD per standard drink (10g ethanol) (Clifford et al., 2021).

Police Auxiliary Liquor Inspectors (PALIs)

PALIs are auxiliary police officers, who are stationed at the entrance of takeaway alcohol outlets. This approach developed from a policing practice of stationing officers at takeaway outlets, which begun in 2012. Initially, this practice was called Temporary Beat Locations (TBLs) and subsequently Point of Sale Inspectors (POSIs). However, this practice was done sporadically based on police resourcing and often did not cover all outlets in a town, creating significant loopholes (Clifford et al., 2021). PALIs seek to prevent purchase of alcohol by people suspected of intending to consume alcohol in public and restricted areas, by requesting identification and questioning customers (Clifford et al., 2021). This relates to other existing legislation restricting alcohol use on Aboriginal lands. While the BDR and MUP are both NT-wide policies, PALIs are only in place in the three regional towns (Alice Springs, Tennant Creek, and Katherine) (Clifford et al., 2021).

Daily purchase limits/opening hours restrictions (DPOH)

In addition to the above interventions, since 28 February 2018 there have been additional restrictions imposed in Tennant Creek (Clifford et al., 2021). Enacted as a response to a highly publicised incident of child sexual abuse, the restrictions include daily limits on the amount of takeaway alcohol customers can purchase and restriction of takeaway outlets opening hours from 4-7pm only with closures on Sundays.

This project

This is the first implementation of a MUP in Australia, and PALIs are currently unique to the NT (Clifford et al., 2021). While MUP has been implemented elsewhere internationally, there has been limited exploration of MUP's impact on DFV (Livingston et al., 2019). Ford and colleagues (Ford, Myers, Burns, & Beeston, 2020) found participants were not able to identify any specific or recent changes in DFV in the context

[1] Assault data, and therefore rates, are not available for New South Wales and Victoria.

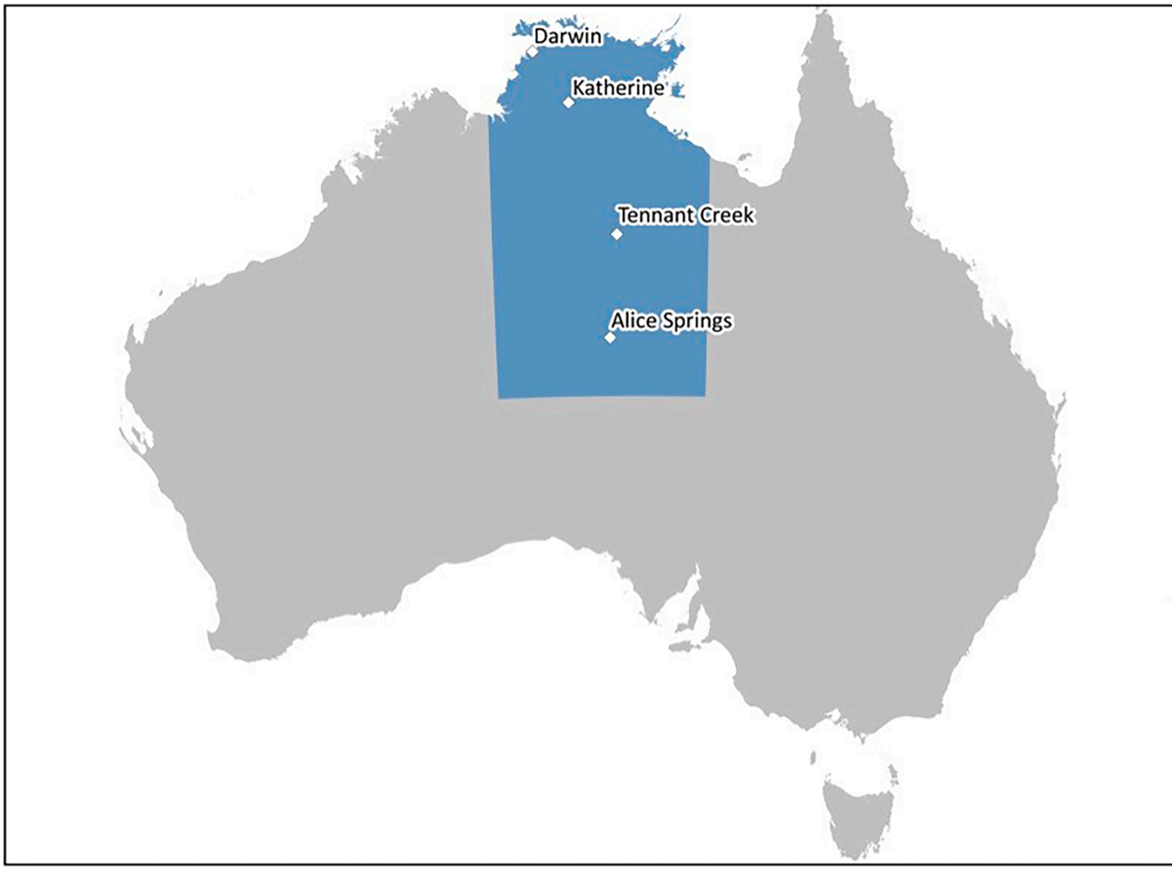

Fig. 1. Map of the Northern Territory (Clifford et al., 2021).

of the Scottish MUP. A 2022 evaluation of MUP in the NT examined DV assaults, finding no significant impact, however, they only examined the outcome at an NT level and included the COVID-19 period (Yarning & Frontier Economics, 2022). This is a limitation because of the regional variation in policies and implementation timelines, particularly the combined introduction of MUP and PALIs in Alice Springs and the impact of COVID-19 related policies. DFV has not been examined as an outcome variable in any previous evaluation of the BDR (Adamson et al., 2021, 2021; Ernst & Young 2020; Smith & Adamson, 2018; Smith et al., 2019), although a blood alcohol monitoring intervention for repeat drink-driving offenders (the most similar intervention to the BDR in international literature) found a 9 % reduction in subsequent DFV arrests (Kilmer et al., 2013). No evaluation of the impact of PALIs has been undertaken to date (Clifford et al., 2021). Thus, this paper represents a novel study into the impact of these alcohol policies on DFV.

Methods

Ethics approval

Ethics approval was obtained from the Northern Territory Department of Health and Menzies School of Health Research Human Research Ethics Committee (HREC 2020-3926) and the Central Australian Human Research Ethics Committee (CA-21-3968).

Study design

The impact of these four policies on DFV assaults and breaches were modelled using interrupted time series analyses for both total and alcohol-involved records.

Data

Police records of crimes represent cases where there is prima-facie evidence of a crime and in the NT include a flag for domestic and family violence and a flag for alcohol-involvement. We included records for assaults (ANZSOC code 0211; 0212; 0213) and breaches of violence orders (ANZSOC code 1531). We used victim records because we wanted to limit our analysis to adult DFV and incident records did not include the age of the victim. All records where the victim was aged 14 and below were excluded. This was done to align with the Australian Bureau of Statistics definition of adult violence, that is, abuse which occurs when the victim was 15 or older (Australian Bureau of Statistics, 2013). Child abuse, while a facet of DFV, is beyond the scope of this paper. Date of incident was not available for victim data, and therefore we used date reported. To account for any historical reports, we excluded records where the age at report was different to age at event. To exclude the impact of the COVID-19 pandemic and related public health measures on trends we analysed data from 1 Jan 2014 – 29 Feb 2020.

Areas

Areas were defined using the Australia Bureau of Statistics statistical areas (SA) (Australian Bureau of Statistics, 2021). Greater Darwin is already a SA4, Katherine and Tennant Creek are both already defined as singular SA2 areas. The SA3 Alice Springs include ten SA2 areas. It was not considered appropriate to use Alice Springs (SA3) as is, because it includes a large amount of land defined as Aboriginal Land as per the *NT Aboriginal Land Rights Act 1976* where the legalities of alcohol access are complex (Clifford et al., 2021). We therefore have defined Alice Springs (town) as including the following SA2s: Charles; East Side; Flynn (NT); Larapinta; Mount Johns; Ross.

Intervention measures

The BDR came into effect on 1 September 2017, with the number of individuals on the register increasing in the months following implementation. We ran two models, one which assessed changes associated with the BDR introduction (Sept 2017) and an alternate model which assessed changes after the number of active bans per month had reached approximately 3000 (March 2018). We also note that scanners had been rolled out in some sites (Alice Springs, Katherine) prior to the official restart.

The second model does not represent an exact intervention point, so emphasis will be placed on the slope effects. In order to account for the variation in PALI roll out across regions we conducted analyses for the NT as a whole and separately for the four main towns. Interrupted time series models allow us to treat the BDR as both an immediate (step variable) and gradual intervention (slope variable). MUP, PALIs, and DPOH were treated as step variables (0=pre implementation, 1=post-implementation). The first cohort of PALIs graduated in August 2018 but the logistics of implementation meant that full coverage was achieved in Alice Springs in Oct 2018, and Katherine and Tennant Creek in Jan 2019. Because of the timing of interventions in Alice Springs, we were unable to model the introduction of MUP (1 Oct 2018) and full coverage of PALIs (also Oct 2018) separately. In Tennant Creek, the second BDR model is complicated because DPOH came into effect on 28 February 2018 (which in a monthly format is modelled from March 2018) and thus cannot be modelled separately.

Analyses

Interrupted time series allows for examination of the impacts of these policies on the trends of DFV assaults and breaches, while controlling for autocorrelation in the time-series data (Linden, 2015). Interrupted time series is considered an appropriate study design for population level health interventions which have been implemented from a clearly defined point in time (Bernal et al., 2017). Analysis was undertaken using the *itsa* command (Linden, 2015) in Stata 17 (StataCorp, 2017). We performed Portmanteau's test for white noise to test model fit - a non-significant Portmanteau test implies no residual autocorrelation in the models and thus no bias due to the time-series design. Where Portmanteau's test was significant, we have provided the Durbin–Watson statistic. Durbin-Watson statistics range between 0 and 4, with values around 2 indicating no problems with first-order autocorrelation in the models (Bartels & Goodhew, 1981). Models were run using counts of victims, but graphs are presented as rates per 10,000 for comparison purposes. Within the models we also controlled for seasonality. Percentage changes were calculated by dividing the coefficient by the monthly average prior to the intervention. Serious assaults resulting in injury (ANZSOC code 0211) are considered the most reliable indicator for monitoring DFV trends over time (Nepal et al., 2019) so we also conducted a sensitivity analysis using just those records. This outcome was not used as a main analysis because of lower monthly counts (particular for alcohol-involved).

Results

To contextualise the data we present a brief descriptive overview. From Jan 2014-Feb 2020 the majority of assault (n = 25,244) and violent order breach (n = 16,753) victims were female (82 % and 85 %, respectively) and Aboriginal (87 % and 84 %, respectively). Intimate partner violence was the most common form of DFV, with the majority of assaults (73 %) and breaches (90 %) committed by current or former partners (see Supplementary Material Table 1 for more detail). Multi victim incidents represented 0.4 % of records. Alcohol was involved in the majority of assaults (70 %) and breaches (69 %). Table 1 provides the breakdown of alcohol use by offenders and victims.

Table 1
Alcohol involvement in DFV assaults and breachs.

	Assaults	Breaches
No alcohol involved	17 %	16 %
Alcohol used by offender only	32 %	44 %
Alcohol used by victim only	3 %	1 %
Alcohol used by both	35 %	24 %
Unknown	13 %	15 %

Timeseries results for DFV assaults can be found in Table 2, alcohol-involved DFV assaults in Table 3, DFV breaches in Table 4, and alcohol-involved DFV breaches in Table 5. We summarise the findings in Table 6. Graphs of the data by region can be found in Figs. 2-11.

BDR

September 2017

In the NT wide model there was an immediate 10 % increase in all DFV assaults (p = 0.049) and a 17 % immediate increase in alcohol-involved DFV assaults (p = 0.014). In Katherine there was a 44 % step increase in all DFV assaults (p = 0.003) and a 39 % step increase in alcohol-involved DFV assaults (p = 0.009) after September 2017. There were no significant changes in DFV assaults in Greater Darwin, Tennant Creek, or Alice Springs following the BDR.

In the NT wide model there was a 21 % step increase in all DFV breaches ($p<0.001$) and a 33 % step increase alcohol-involved breaches ($p<0.001$). In Greater Darwin all DFV breaches step increased by 23 % (p = 0.003) and alcohol involved DFV breaches step increased by 40 % (p = 0.001). In Katherine there was a 42 % step increase in all DFV breaches (p = 0.001) and a 45 % immediate increase alcohol-involved breaches ($p<0.000$). There was also a gradual (slope) 3 % increase in all DFV assaults (p = 0.042) and a gradual 3 % increase in alcohol-involved assaults (p = 0.030). In Alice Springs there was a 35 % immediate increase in all DFV breaches ($p<0.000$) and a 45 % immediate increase in alcohol-involved breaches (p = 0.001). There were no significant changes in DFV breaches in Tennant Creek following the BDR.

March 2018

There were no changes seen in assaults for the NT, Greater Darwin or Alice Springs after March 2018. In Katherine, following March 2018 there was an immediate 33 % increase (p = 0.019) in all DFV assaults and an immediate 48 % increase in alcohol-involved assaults (p = 0.004). Although after March 2018 the BDR was associated with decreases in all assaults and alcohol-involved assaults in Tennant Creek, in this model the BDR timepoint is directly confounded by the introduction of DPOH. An overview of these decreases is provided under the sub-heading *DPOH (Tennant Creek only)* below. No significant changes in assaults were found in the NT wide model, in Greater Darwin, or Alice Springs following March 2018.

In the NT wide model alcohol-involved DFV breaches increased immediately by 20 % (p = 0.004). In Katherine there was a 40 % increase (p = 0.013) in all DFV breaches and an immediate 56 % increase in alcohol-involved breaches (p = 0.001). In Alice Springs there was a 21 % increase (p = 0.025) in all DFV breaches and an immediate 34 % increase in alcohol-involved breaches (p = 0.015). In Greater Darwin and Tennant Creek there was no changes in breaches.

There were no slope changes following the BDR for any outcomes in following March 2018.

DPOH (Tennant Creek only)

Following the introduction of these restrictions, all DFV assaults decreased by 78 % (p = 0.027) and alcohol-involved DFV assaults decreased by 92 % (p = 0.004). There was no significant change for DFV breaches.

Table 2
Interrupted time series models for all DFV assaults.

Area		β coefficient (standard error) Sept 2017	95 % CI	p-value	β coefficient (standard error) March 2018	95 % CI	p-value
NT wide							
Average monthly count = 341	Time (slope)	−0.13	−0.92, 0.67	0.748	0.47[2]	−0.38, 1.31	0.273
	BDR (step)	**31.49**	**0.20, 62.77**	**0.049**	−2.28	−30.43, 25.87	0.872
	Time X BDR (slope)	0.63	−1.92, 3.19	0.621	1.10	−2.06, 4.23	0.493
	Post Intervention Trend	0.51	−1.91, 2.93	0.677	1.55	−1.46, 4.56	0.307
	MUP	**−37.22**	**−73.95, −0.48**	**0.047**	*Presented in Supplementary Material*		
Greater Darwin							
Average monthly count = 91	Time (slope)	0.03[3]	−0.25, 0.30	0.839	0.22[4]	−0.06, 0.49	0.120
	BDR (step)	11.33	−1.41, 24.08	0.080	2.55	−8.45, 13.56	0.644
	Time X BDR (slope)	0.09	−1.09, 1.28	0.872	−0.03	−1.56, 1.51	0.971
	Post Intervention Trend	0.12	−1.02, 1.27	0.831	0.19	−1.33, 1.70	0.805
	MUP	−4.99	−24.34, 14.36	0.608	*Presented in Supplementary Material*		
Katherine							
Average monthly count = 30	Time (slope)	**−0.23**	**−0.43, −0.02**	**0.033**	−0.07	−0.28, 0.13	0.478
	BDR (step)	**12.29**	**4.23, 20.23**	**0.003**	**9.64**	**1.62, 17.66**	**0.019**
	Time X BDR (slope)	0.25	−0.60, 1.12	0.554	−0.05	−1.31, 1.21	0.938
	Post Intervention Trend	0.03	−0.81, 0.86	0.947	−0.12	−1.36, 1.11	0.841
	MUP	−4.06	−12.38, 4.26	0.332	*Presented in Supplementary Material*		
	PALIs	−1.89	−13.04, 9.25	0.735			
Tennant Creek							
Average monthly count = 18							
	Time (slope)	0.04[5]	−0.16, 0.25	0.666	0.11[6]	−0.06, 0.29	0.202
	BDR (step)	3.70	−3.95, 11.35	0.337	**−8.82**	**−15.53, −2.11**	**0.011**
	Time X BDR (slope)	0.66	−0.15, 1.47	0.110	0.54	−0.27, 1.35	0.190
	Post Intervention Trend	0.70	−0.07, 1.48	0.074	0.65	−0.14, 1.44	0.105
	PLOH	**−14.50**	**−24.15, −4.85**	**0.004**	*Presented in Supplementary Material*		
	MUP	2.02	−4.43, 8.47	0.533			
	PALIs	**−9.20**	**−17.32, −1.08**	**0.027**			
Alice Springs							
Average monthly count = 78	Time (slope)	0.01[7]	−0.39, 0.41	0.958	0.15[8]	−0.23, 0.52	0.439
	BDR (step)	6.81	−8.32, 21.92	0.371	−1.02	−23.95, 21.92	0.930
	Time X BDR (slope)	0.35	−1.04, 1.74	0.613	0.70	−0.87, 2.27	0.375
	Post Intervention Trend	0.36	−0.92, 1.64	0.571	0.84	−0.66, 2.35	0.266
	MUP/PALIs	−18.24	−39.91, 3.41	0.097	*Presented in Supplementary Material*		

[2]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 2.019960.
[3]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.979671.
[4]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.990325.
[5]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.927500.
[6]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.932246.
[7]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.917292.
[8]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.928114.

MUP

In the NT wide model all DFV assaults fell by 11 % (p = 0.047). Alcohol-involved DFV assaults fell by 21 % (p = 0.001). In the NT wide model alcohol-involved DFV breaches also decreased by 21 % (p = 0.006). In Greater Darwin, Katherine, and Tennant Creek there was no significant changes following MUP.

MUP/PALIs (Alice Springs only)

Following the MUP/PALIs introduction in Alice Springs, alcohol-involved DFV assaults decreased by 33 % (p = 0.030). All DFV breaches and alcohol-involved DFV breaches decreased by 42 % (p<0.001) and 57 % (p<0.001), respectively.

PALIs

In Tennant Creek all DFV assaults decreased by 79 % (p = 0.027) following the implementation of PALIs. In Katherine all DFV breaches decreased by 39 % (p = 0.045) and alcohol-involved DFV breaches decreased by 58 % (p = 0.003). NT-wide analyses were not possible due to limited policy coverage.

Sensitivity analysis

The sensitivity analysis, which examined serious assaults resulting in injury, found broadly similar trends (see Supplementary Material Table 2 and 3). In Greater Darwin, however, there is some evidence of a gradual decrease in alcohol-involved serious assaults causing injury post BDR.

Table 3
Interrupted time series models for alcohol-involved DFV assaults

Area		β coefficient (standard error) Sept 2017	95 % CI	p-value	β coefficient (standard error) March 2018	95 % CI	p-value
NT wide							
Average monthly count = 202	Time (slope)	−0.46	−1.16, 0.23	0.189	0.03[9]	−0.81, 0.87	0.943
	BDR (step)	**33.96**	**7.25, 60.67**	**0.014**	18.21	−12.13, 48.55	0.235
	Time X BDR (slope)	0.78	−0.86, 2.43	0.344	0.28	−1.58, 2.14	0.767
	Post Intervention Trend	**0.32**	**−1.10, 1.75**	**0.652**	0.31	−1.28, 1.89	0.699
	MUP	**−43.67**	**−69.60, −17.75**	**0.001**	*Presented in Supplementary Material*		
Greater Darwin							
Average monthly count = 58	Time (slope)	0.01	−0.24, 0.25	0.957	0.13[10]	−0.11, 0.38	0.280
	BDR (step)	7.22	−2.82, 17.27	0.155	4.38	−4.82, 13.58	0.344
	Time X BDR (slope)	0.39	−0.50, 1.28	0.384	0.18	−1.00, 1.35	0.764
	Post Intervention Trend	0.40	−0.46, 1.25	0.356	0.31	−0.84, 1.46	0.591
	MUP	−7.83	−21.45, 5.79	0.255	*Presented in Supplementary Material*		
Katherine							
Average monthly count = 23	Time (slope)	**−0.23**	**−0.39, −0.06**	**0.008**	−0.13	−0.28, 0.02	0.099
	BDR (step)	**8.47**	**2.18, 14.77**	**0.009**	**10.73**	**3.51, 17.95**	**0.004**
	Time X BDR (slope)	0.46	−0.29, 1.22	0.222	0.01	−1.10, 1.12	0.987
	Post Intervention Trend	0.24	−0.50, 0.97	0.518	−0.12	−1.23, 0.99	0.829
	MUP	−3.02	−10.39, 4.36	0.416	*Presented in Supplementary Material*		
	PALIs	−6.49	−16.13, 3.14	0.182			
Tennant Creek							
Average monthly count = 14	Time (slope)	0.000[11]	−0.20, 0.20	1.000	0.08[12]	−0.10, 0.26	0.390
	BDR (step)	4.87	−2.82, 12.55	0.210	**−8.20***	**−14.69, −1.71**	**0.014**
	Time X BDR (slope)	0.53	−0.24, 1.29	0.172	0.42	−0.37, 1.22	0.292
	Post Intervention Trend	0.53	−0.22, 1.27	0.161	−0.50	−0.28, 1.29	0.205
	PLOH	**−13.75**	**−22.85, −4.65**	**0.004**	*Presented in Supplementary Material*		
	MUP	0.61	−5.63, 6.85	0.846			
	PALIs	−5.87	−13.96, 2.21	0.151			
Alice Springs							
Average monthly count = 57	Time (slope)	−0.05[13]	−0.32, 0.21	0.692	0.09[14]	−0.21, 0.40	0.547
	BDR (step)	8.11	−4.28, 20.49	0.195	−0.02	−18.12, 18.07	0.998
	Time X BDR (slope)	0.15	−0.88, 1.18	0.774	0.29	−0.75, 1.33	0.580
	Post Intervention Trend	0.10	−0.88, 1.08	0.845	0.38	−0.61, 1.37	0.441
	MUP/PALIs	**−19.75**	**−37.47, −2.04**	**0.030**	*Presented in Supplementary Material*		

[9]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 2.092857.
[10]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.977894.
[11]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.916737.
[12]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.929268.
[13]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.977853.
[14]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.999244.

Discussion

This paper contributes new findings on the impact of alcohol policy measures on DFV in the NT. We found the strongest evidence for reductions in DFV associated with PALIs and DPOH, with limited evidence regarding MUP, and some increases associated with the BDR.

Banned Drinker Register

Following both September 2017 and October 2018 there were significant step increases for some outcomes and sites (see Table 6 for overview). Similar increases immediately following the BDR have been found for other outcome measures, such as Territory-wide alcohol-related emergency department presentations and assault offences (Ernst & Young 2020).

There are two ways to interpret these findings. The first is that the BDR was related to increases in DFV. This could be an actual increase or an artificial increase due to increased recording or reporting. We know that controlling behaviours, conflict and erratic behaviour can escalate when a perpetrator is craving or in withdrawal from alcohol (Gilchrist et al., 2019). 'Committing an alcohol-related offence' and 'being the defendant on an alcohol-related DVO' are both automatic triggers to be added to the BDR. Therefore, it is possible this was an artificial increase related to increased attention regarding recording of alcohol. However, because the overall number of assaults also increased, and not just alcohol involved, as did emergency departments presentations, this seems unlikely. Other literature suggests that alcohol interventions can influence reporting by victims. In an evaluation of alcohol restrictions in the Fitzroy Valley, Kinnane and colleagues (Kinnane et al., 2010) found an increase in domestic violence assaults, with both police and service providers attributing this to a decreased tolerance of DFV and increased willingness to report. With reduced access to alcohol, Kinnane and colleagues (Kinnane et al., 2010) report a perception that less victims and bystanders were themselves intoxicated and therefore both more comfortable calling the police and better able to verify events surrounding an assault.

The second option is that the BDR has no effect on DFV. Examination of the graphs for most outcomes demonstrates an increasing trend before the BDR, which continues after the BDR introduction. As highlighted by Adamson and colleagues (Adamson et al., 2021), a major impediment to

Table 4
Interrupted time series models for DFV breaches

Area		β coefficient (standard error) Sept 2017	95 % CI	p-value	β coefficient (standard error) March 2018	95 % CI	p-value
NT wide							
Average monthly count = 226	Time (slope)	0.18	−0.26, 0.62	0.418	**0.74**[15]	**0.20, 1.28**	**0.008**
	BDR (step)	**45.37**	**29.29, 61.45**	**0.000**	18.00	−5.86, 41.85	0.136
	Time X BDR (slope)	−1.14	−2.57, 0.29	0.115	−1.51	−3.35, 0.33	0.107
	Post Intervention Trend	−0.96	−2.32, 0.39	0.161	−0.76	−2.52, 0.99	0.387
	MUP	−23.41	−47.62, 0.80	0.058	*Presented in Supplementary Material*		
Greater Darwin							
Average monthly count = 70	Time (slope)	0.03[16]	−0.22, 0.28	0.822	0.22[17]	−0.01, 0.45	0.062
	BDR (step)	**15.21**	**5.29, 25.13**	**0.003**	3.30	−9.05, 15.64	0.595
	Time X BDR (slope)	−0.70	−1.45, −0.04	0.065	−0.88	−1.79, 0.04	0.060
	Post Intervention Trend	−0.67	−1.37, 0.03	0.059	−0.66	−1.54, 0.22	0.141
	MUP	2.25	−11.50, 16.01	0.744	*Presented in Supplementary Material*		
Katherine							
Average monthly count = 25	Time (slope)	**−0.20**	**−0.37, −0.03**	**0.019**	−0.07	−0.25, 0.11	0.456
	BDR (step)	**9.90**	**3.58, 14.79**	**0.001**	**9.69**	**2.13, 17.24**	**0.013**
	Time X BDR (slope)	**0.58**	**0.22, 1.14**	**0.042**	0.32	−0.28, 0.92	0.288
	Post Intervention Trend	0.38	−0.15, 0.90	0.156	0.25	−0.32, 0.82	0.378
	MUP	−2.26	−12.17, 7.65	0.650	*Presented in Supplementary Material*		
	PALIs	**−9.86**	**−19.49, −0.24**	**0.045**			
Tennant Creek							
Average monthly count = 21	Time (slope)	**0.21**[18]	**0.03, 0.39**	**0.026**	**0.20**[19]	**0.05, 0.34**	**0.009**
	BDR (step)	−0.36	−8.96, 8.24	0.934	−3.10*	−10.01, 3.63	0.353
	Time X BDR (slope)	−0.29	−1.46, 0.88	0.619	−0.40	−1.67, 0.87	0.533
	Post Intervention Trend	−0.08	−1.23, 1.06	0.886	−0.20	−1.46, 1.06	0.751
	PLOH	−1.92	−12.49, 8.66	0.718	*Presented in Supplementary Material*		
	MUP	0.08	−8.00, 8.17	0.984			
	PALIs	−0.96	−12.16, 10.23	0.864			
Alice Springs							
Average monthly count = 56	Time (slope)	0.19	−0.02, 0.41	0.082	**0.40**[20]	**0.15, 0.65**	**0.002**
	BDR (step)	**18.30**	**9.76, 26. 83**	**0.000**	**11.71**	**1.54, 21.88**	**0.025**
	Time X BDR (slope)	−0.15	−0.81, 0.50	0.636	−0.59	−1.47, 0.29	0.182
	Post Intervention Trend	0.04	−0.58, 0.66	0.900	−0.19	−1.03, 0.65	0.649
	MUP/PALIs	**−24.12**	**−34.23, −14.02**	**0.000**	*Presented in Supplementary Material*		

[15]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 2.022142.
[16]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.978964.
[17]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 2.008249.
[18]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.887749.
[19]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.869439.
[20]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 2.014653.

the BDR is the ease with which banned drinkers can still access alcohol, via secondary supply, through illegal markets, and through consumption in a licensed premise. NT alcohol restrictions, including, but not limited to, those described in this paper, have incentivised an illegal market for alcohol (colloquially called ‘grog running’) (Adamson et al., 2021). The BDR also only affects a smaller proportion of people, approximately 2% of the NT population aged 18 and older (Clifford et al., 2024); which may impact its ability to influence population-level trends. A media release from the People’s Alcohol Action Coalition in Alice Springs suggests increases in alcohol-related harms may be due to reduced coverage by POSI (noting that they were always subject to police availability) during this period (People’s Alcohol Action Coalition 2017). We also see these increases in Darwin, however, where POSIs were not being utilised. Scrutiny of the graphs show the largest spike in assaults occurring in December 2017 (see Supplementary Material Figure 1). Media reports from this period note an increase in crime involving young people in Alice Springs, but these reports do not explicitly discuss increases in DFV nor any change in other sites where increases were also evident (Sleath, 2017). Although within the models we controlled for seasonality and are not aware of any relevant intervention in December 2017, it is possible that an unknown factor influenced this increase.

In summary, it is unclear if these increases were caused by BDR, if the increases reflect parallel changes in policing practices, increased reporting, or community attitudes, or if the BDR simply had no impact on population-level DFV.

Daily purchase limits /opening hour restrictions

The Tennant Creek restrictions resulted in reductions in both all DFV assault and alcohol-involved DFV assaults. Restricting trading hours at both on- and off-license premises has been associated with decreases in assaults and hospitalisation (Nepal et al., 2020). The magnitude of the decrease is likely influenced by the smaller population size, so small changes have a larger proportional impact. Tennant Creek has a long history of restricting takeaway alcohol hours and sales, which have

Table 5
Interrupted time series models for alcohol-involved DFV breaches.

Area		β coefficient (standard error) Sept 2017	95 % CI	p-value	β coefficient (standard error) March 2018	95 % CI	p-value
NT wide							
Average monthly count = 144	Time (slope)	−0.30	−0.79, 0.19	0.230	0.24[21]	−0.38, 0.87	0.435
	BDR (step)	**46.26**	**28.31, 64.21**	**0.000**	**28.05**	**9.17, 46.93**	**0.004**
	Time X BDR (slope)	−0.34	−1.63, 0.95	0.596	−1.26	−2.80, 0.28	0.107
	Post Intervention Trend	−0.64	−1.81, 0.53	0.278	−1.01	−2.38, 0.34	0.141
	MUP	**−30.85**	**−52.33, −9.37**	**0.006**	*Presented in Supplementary Material*		
Greater Darwin							
Average monthly count = 42	Time (slope)	−0.07	−0.27, 0.13	0.484	0.13	−0.08, 0.34	0.212
	BDR (step)	**15.13**	**6.57, 23.68**	**0.001**	5.57	−3.98, 15.11	0.248
	Time X BDR (slope)	−0.22	−0.85, 0.42	0.498	−0.38	−1.23, 0.47	0.372
	Post Intervention Trend	−0.289	−0.90, 0.32	0.346	−0.25	−1.06, 0.56	0.538
	MUP	−1.20	−10.87, 8.47	0.805	*Presented in Supplementary Material*		
Katherine							
Average monthly count = 20	Time (slope)	**−0.21**	**−0.36, −0.06**	**0.008**	−0.11	−0.27, 0.03	0.133
	BDR (step)	**8.36**	**4.06, 12.66**	**0.000**	**10.74**	**4.39, 17.10**	**0.001**
	Time X BDR (slope)	**0.52**	**0.05, 0.99**	**0.030**	0.01	−0.37, 0.54	0.696
	Post Intervention Trend	0.31	−0.13, 0.76	0.164	−0.02	−0.47, 0.43	0.924
	MUP	−0.19	−8.23, 7.85	0.962	*Presented in Supplementary Material*		
	PALIs	**−11.79**	**−19.47, −4.10**	**0.003**			
Tennant Creek							
Average monthly count = 18	Time (slope)	0.13	−0.06, 0.32	0.173	0.14	−0.01, 0.29	0.076
	BDR (step)	0.38	−7.18, 7.94	0.920	−4.23	−10.85, 2.38	0.205
	Time X BDR (slope)	−0.02	−1.06, 1.03	0.976	−0.14	−1.28, 0.99	0.798
	Post Intervention Trend	0.12	−0.90, 1.13	0.820	−0.01	−1.13, 1.11	0.992
	PLOH	−4.70	−14.50, 5.10	0.341	*Presented in Supplementary Material*		
	MUP	−2.95	−10.33, 4.42	0.426			
	PALIs	0.44	−9.45, 10.33	0.929			
Alice Springs							
Average monthly count = 40	Time (slope)	0.02	−0.21, 0.25	0.882	0.21[22]	−0.08, 0.49	0.148
	BDR (step)	**16.96**	**7.69, 26.23**	**0.001**	**13.42**	**2.74, 24.10**	**0.015**
	Time X BDR (slope)	0.07	−0.63, 0.76	0.848	−0.48	−1.42, 0.46	0.308
	Post Intervention Trend	0.08	−0.56, 0.73	0.796	−0.27	−1.15, 0.60	0.534
	MUP/PALIs	**−23.87**	**−34.33, −13.42**	**0.000**	*Presented in Supplementary Material*		

[21]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 2.120529.
[22]Model does not pass whitenoise test, Durbin–Watson statistic (transformed) = 1.999440.

previously resulted in reductions in assaults and injury (d'Abbs et al., 1996, 2000; Gray et al., 1998).

Minimum Unit Price

We observed immediate (step) decreases in all DFV assaults, alcohol-involved DFV assaults, and alcohol-involved DFV breaches in the NT wide model following the implementation of MUP. However, no changes were observed in Greater Darwin, Tennant Creek, or Katherine following the MUP. Greater Darwin, in particular, acts a quasi-control as the only site without PALIs. Thus, this analysis does not provide evidence that MUP as a single intervention has impacted DFV. Instead, it is more likely the significant decreases seen in the NT wide model and in the Alice Springs model at this timepoint were driven by the PALIs. Although Miller and colleagues found MUP reduced all (DFV and non-DFV) alcohol-related assaults in Greater Darwin (Miller et al., 2023), similar decreases have not been observed in other jurisdictions. In Scotland no significant change in trend direction or level was found for assaults after the introduction of MUP (Krzemieniewska-Nandwani, Bannister, Ellison, & Adepeju, 2021), while in Saskatchewan no significant immediate changes were observed, although there were reductions in violent crimes perpetrated by men 4-6 months after an increase in the MUP (Stockwell et al., 2017). MUP is set at different price levels across jurisdictions, which may alter its effect. Reviews of MUP indicate that the policy is likely to be more effective at reducing other alcohol-related harms (such as consumption and alcohol-related hospitalisation) than assaults and other crime (Maharaj et al., 2023; Livingston et al., 2019).

Police Auxiliary Liquor Inspectors

There were decreases in DFV assaults in Tennant Creek and DFV breaches in Katherine following PALIs. Decreases were most notable in Alice Springs, following the MUP/PALI introduction. This finding aligns with decreases in other alcohol-related harms previously observed in Alice Springs following the combined introduction (Secombe et al., 2021). These decreases are encouraging and provide evidence of an alcohol policy which reduced DFV. However, policies may have unintended impacts which should also be considered.

So what does this mean?

In summary, we found evidence illustrating potential impacts of both universal interventions (DPOH) and more targeted approaches (PALIs) in reducing DFV. This adds to the limited evidence base surrounding

Table 6
Summary table.

		Northern Territory		Greater Darwin		Katherine		Tennant Creek		Alice Springs	
	Model	1	2	1	2	1	2	1	2	1	2
Banned Drinker Register	DFV assaults	↑ (red)				↑ (red)	↑ (red)		↓ (yellow)		
	Alc-involved DFV assaults	↑ (red)				↑ (red)	↑ (red)		↓ (yellow)		
	DFV breaches	↑ (red)		↑ (red)		↑ (red)	↑ (red)			↑ (red)	↑ (red)
	Alc-involved DFV breaches	↑ (red)	↑ (red)	↑ (red)		↑ (red)	↑ (red)			↑ (red)	↑ (red)
Daily Purchase limits / Opening Hour restrictions	DFV assaults	*Not applicable*		*Not applicable*		*Not applicable*		↓ (green)	↓ (yellow)	*Not applicable*	
	Alc-involved DFV assaults							↓ (green)	↓ (yellow)		
	DFV breaches										
	Alc-involved DFV breaches										
Minimum Unit Price	DFV assaults	↓ (green)									↓ (blue)
	Alc-involved DFV assaults	↓ (green)	↓ (green)							↓ (blue)	↓ (blue)
	DFV breaches									↓ (blue)	↓ (blue)
	Alc-involved DFV breaches	↓ (green)								↓ (blue)	↓ (blue)
Police Auxiliary Liquor Inspectors	DFV assaults	*Not applicable*		*Not applicable*				↓ (green)	↓ (green)		↓ (blue)
	Alc-involved DFV assaults									↓ (blue)	↓ (blue)
	DFV breaches					↓ (green)				↓ (blue)	↓ (blue)
	Alc-involved DFV breaches					↓ (green)				↓ (blue)	↓ (blue)

↓ (yellow) Timepoint represents both DPOH and BDR Timepoint 2
↓ (blue) Timepoint represents both MUP and PALI

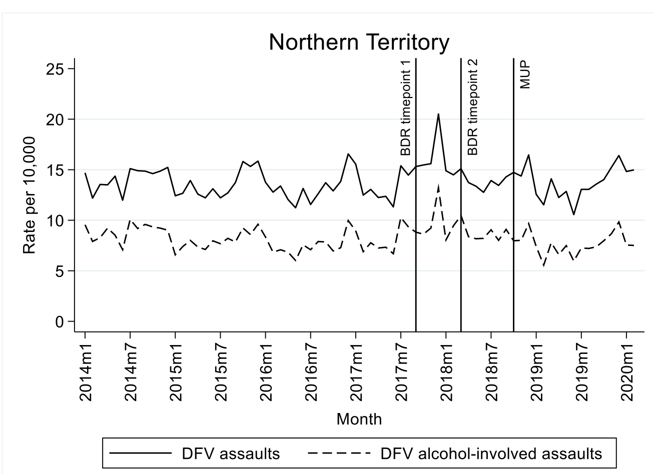

Fig. 2. Northern Territory rate of police-recorded DFV assault victims aged 15+ per 10,000.

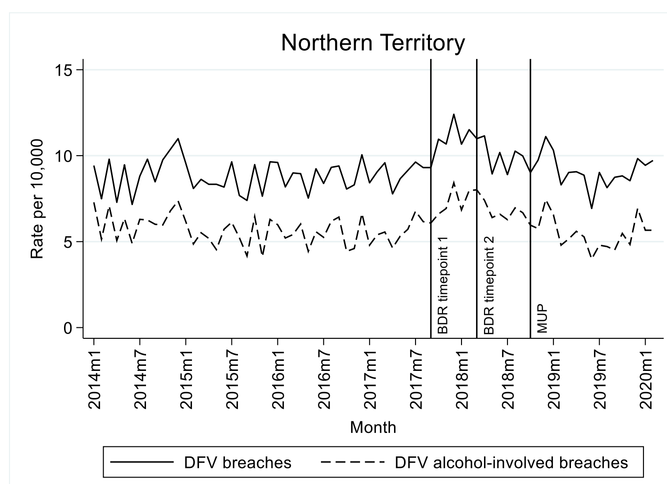

Fig. 3. Northern Territory rate of police-recorded DFV breach victims aged 15+ per 10,000.

alcohol policy and DFV. Yet, there remain complex issues in this space. In his historical review of individualized bans, Room describes that many Western countries moved away from individualised bans in the 20th century in response to public health arguments that population-oriented approaches were more effective, cost-effective, and ethically preferable over individual restrictions or punishment (Room, 2012). Locally, scholars have raised concerns about restrictions which undermine self-determination processes for Aboriginal and Torres Strait Islander people (d'Abbs, 2015; Stearne et al., 2022), and one qualitative study has described some First Nations peoples' perceptions that screening conducted by PALIs was racially targeted (Stearne et al., 2022). This paper found the introduction of PALIs to be associated with some reductions in DFV, but also considering these other social consequences, particularly as they relate to the ongoing impact of colonisation, is important (d'Abbs, 2015; Department of Attorney-General and Justice 2019; Stearne et al., 2022). Neither MUP or DPOH single out individuals, with DPOH demonstrating the greatest association with DFV reductions of any measure examined, although we note this

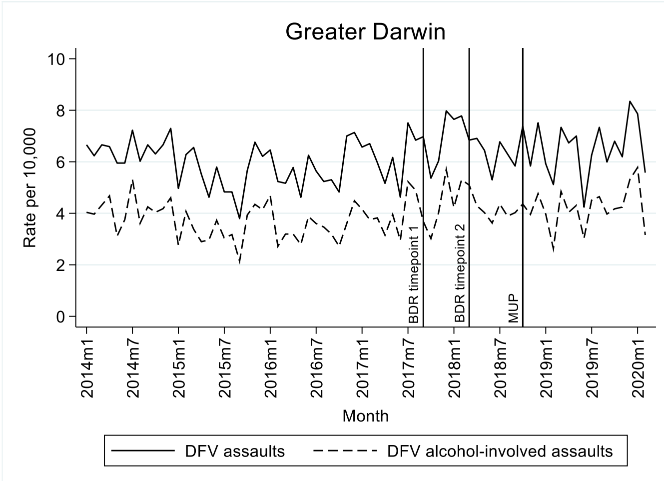

Fig. 4. Greater Darwin rate of police-recorded DFV assault victims aged 15+ per 10,000.

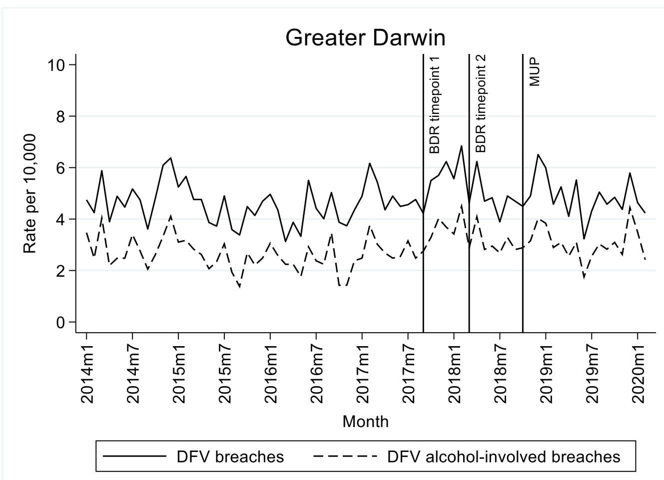

Fig. 5. Greater Darwin rate of police-recorded DFV breach victims aged 15+ per 10,000.

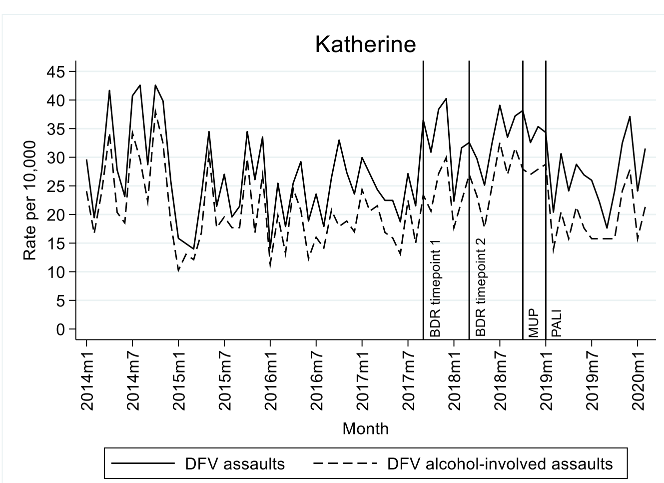

Fig. 6. Katherine rate of police-recorded DFV assault victims aged 15+ per 10,000.

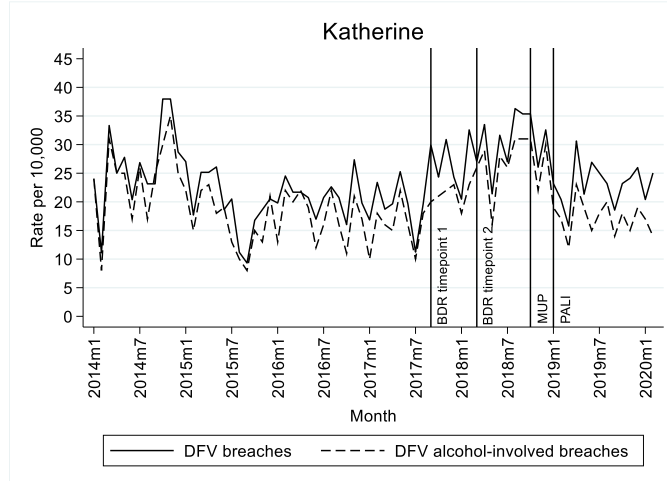

Fig. 7. Katherine rate of police-recorded DFV breach victims aged 15+ per 10,000.

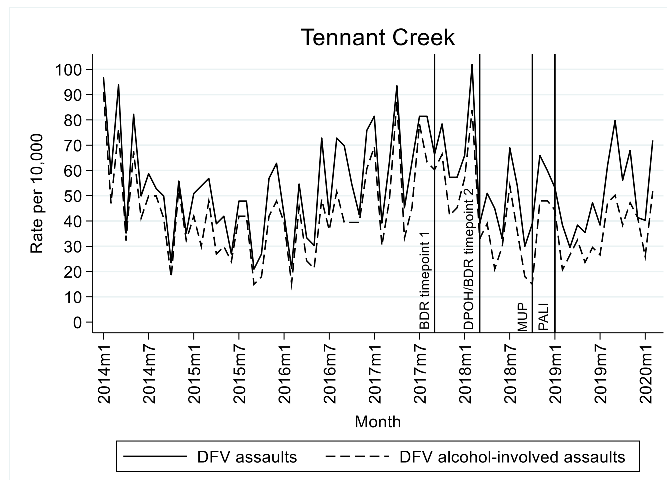

Fig. 8. Tennant Creek rate of police-recorded DFV assault victims aged 15+ per 10,000.

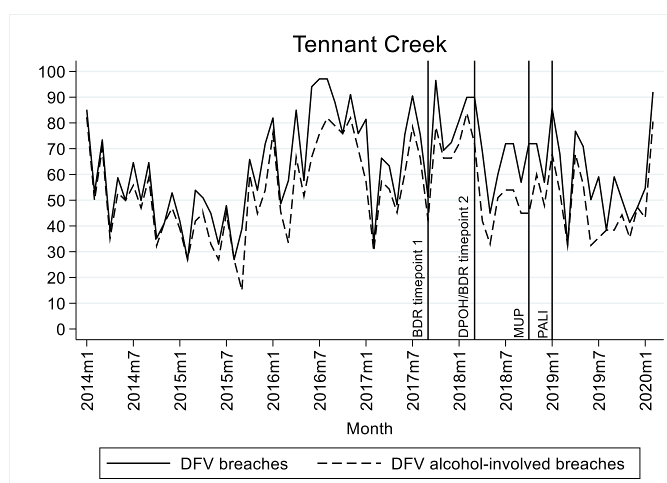

Fig. 9. Tennant Creek rate of police-recorded DFV breach victims aged 15+ per 10,000.

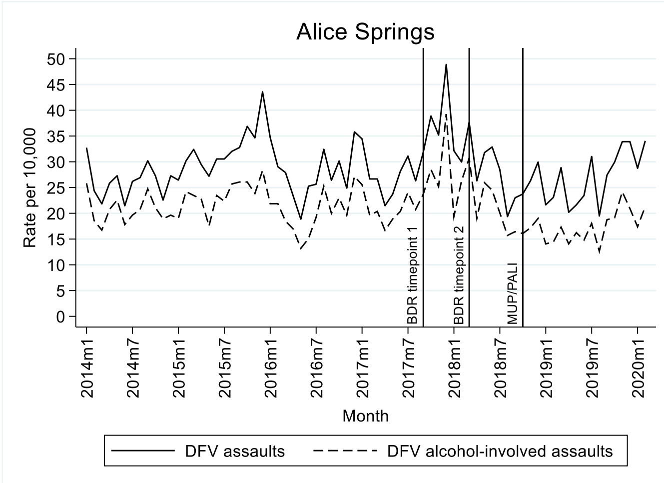

Fig. 10. Alice Springs rate of police-recorded DFV assault victims aged 15+ per 10,000.

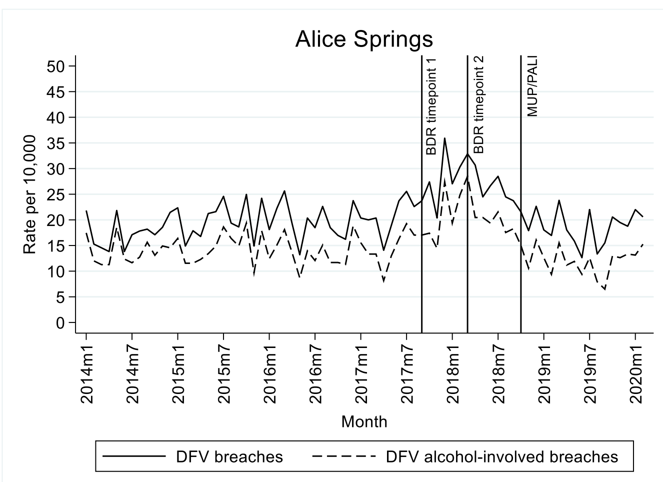

Fig. 11. Alice Springs rate of police-recorded DFV breach victims aged 15+ per 10,000.

occurred in a small population and so the magnitude of the change should be treated with caution.

Limitations

DFV includes a wide range of abusive behaviours, many of which are not captured well in police data (Mayshak et al., 2022). Therefore our analyses can only assess the impact of these interventions on physical violence and intimidation, and will be an underestimation of the true extent of DFV. In addition, DFV is substantially underreported to police; the 2016 Personal Safety Survey found 69 % of women did not report their most recent physical assault by a man (Australian Bureau of Statistics 2017). However, police data remains one of the few ways to investigate changes in DFV in a jurisdiction over time. As noted in the discussion, although it's unclear if the DFV related BDR triggers impacted the data, the consistency between alcohol-involved assaults and all assaults suggests this has not been a major issue. The regression models relied on counts of victims rather than population rates, but the relative stability of the NT population size and the incorporation of trend variables in the models means the results are robust. This paper exemplifies the challenges in assessing the impact of policies where there are regional variations in the nature or timing of implementation, or where different policies are introduced over a similar time period. In regions where multiple policies are implemented simultaneously (i.e. MUP and PALIs in Alice Springs) it is not possible to isolate the impact of a single policy in observational studies. Even in regions where policies are introduced with a time-gap (i.e. BDR and MUP in Darwin), it is still possible that the second or subsequent policies interact to create a cumulative effect. Still, observational studies such as this are considered important in cost-effectively measuring effects of policies on a population. Where possible, we have attempted to reduce confounding by separating analyses by region, and by comparing policy impact across sites. The NT has a very small population, and this study estimates the separate effects of four policies that came into effect in a relatively short timeframe, which impacts the power of our study. The COVID-19 pandemic and associated responses, which increased the onset or escalation of DFV in many families (Boxall, Morgan, & Brown, 2020), began only 14 months after the last policy was full implemented (PALIs – Jan 2019 in Katherine and Tennant Creek). Ideally evaluations of such policies would examine longer post intervention time periods. However, controlling for the COVID-19 related restrictions and their potential impact of DFV, in addition to the multiple alcohol policies, in a small population was not feasible. It is also likely that these policies interact in complex ways that we cannot easily measure.

Conclusion

This study provided evidence that two of the four alcohol policies assessed were associated with some reductions in DFV (PALIs and DPOH). It appears that MUP did not affect DFV outcomes. The BDR was associated with some increases, which could represent an actual increase or artificial increase. Given that the upward trend appears to commence prior to the BDR and continue after BDR, it is also possible that the BDR simply had no effect on population-level DFV outcomes. Future research should consider the impact of the BDR, as an individual ban, on individual outcomes rather than at the population level. Exploration of the impact of these policies on other alcohol-related harms would provide a more robust picture of the extent of the policies' impacts.

Ethics approval

Ethics approval was obtained from the Northern Territory Department of Health and Menzies School of Health Research Human Research Ethics Committee (HREC 2020-3926) and the Central Australian Human Research Ethics Committee (CA-21-3968)

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CRediT authorship contribution statement

Sarah Clifford: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Cassandra J.C. Wright:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Peter G. Miller:** Writing – review & editing, Methodology, Funding acquisition, Conceptualization. **Kerri Coomber:** Writing – review & editing, Methodology, Conceptualization. **Kalinda E. Griffiths:** Writing – review & editing, Funding acquisition, Conceptualization. **James A. Smith:** Writing – review & editing, Supervision, Funding acquisition. **Michael Livingston:** Data curation, Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2024.104426.

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