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Assessing the risk of domestic violence recidivism

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Aim: *To determine what factors independently predict violent DV-related re-offending among a cohort of people convicted of a(ny) DV offence and given a non-custodial penalty.*

Method: *Data from the NSW Bureau of Crime Statistics and Research (BOCSAR) Reoffending Database were used to examine violent DV-related reconviction. A cohort of DV offenders convicted in 2011-12 was first identified using domestic violence lawpart codes, and followed up for two years. To identify the best fitting model we first examined bi-variate relationships between explanatory variables and the dependent variable. We then estimated a multivariate logistic regression model to determine which variables independently predicted reconviction. Finally, we tested the predictive validity of the model using a range of cross-validation strategies.*

Results: *Among the cohort of adult offenders (n = 14,660), 8% were reconvicted of a violent DV-related offence within two years of the index conviction. Eleven explanatory variables were found to best predict reconviction – representing offender demographic, index offence, and criminal history characteristics. The resulting model showed acceptable levels of predictive validity.*

Conclusion: *To the extent that they direct appropriate interventions, risk assessment tools could be one part of a more complete community safety strategy aimed at violent DV recidivism. Limitations of the current study are discussed.*

Keywords: *domestic violence, recidivism, administrative data, reconviction, prediction, violent offences*

INTRODUCTION

Evidence consistently shows that domestic violence (DV) – or violence between current or former intimate partners – is a serious and costly crime problem affecting the Australian community (ABS, 2015; Cox, 2015; Mouzos & Makkai, 2004; People, 2005). While DV can affect both partners, research underscores the gendered nature of the problem, with lifetime estimates of experiencing some form of violence at the hands of an intimate partner, cohabiting or not, at one in four women in Australia (Cox, 2015). The analysis of DV-related offences is complex due to the range of issues that are related to the behaviour. In the spectrum of DV offences, the most serious are those that result in bodily harm or death. Greater understanding of the factors associated with the future risk of violent DV would be of benefit, helping to create improved justice system responses to ensure victim safety.

Police represent a critical frontline of the criminal justice system response to DV in the Australian community. Police in NSW handled approximately 58,000 call-outs for domestic violence-related incidents in 2014 (Bulmer, 2015), and DV-related assault accounted for about 43% of the police-recorded crimes against persons in NSW in 2014-15 (New South Wales Police Force, 2015).

Until recently, very little Australian research has focussed on the risk of family violence and DV offending in Australia (Boxall, Rosevear, & Payne, 2015; Mason & Julian, 2009; Trujillo & Ross, 2008). The National Council to Reduce Violence against Women and their Children (2009) has called for a greater understanding of the possible utility of risk assessment tools for managing DV risk and better targeting interventions. In the policing context, if sufficiently reliable predictors could be found, it may be possible

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to develop a risk assessment tool that allows police to more effectively use resources to improve the safety of victims. Formal risk assessment tools can assist front-line agencies like the police to make quick decisions about detention, bail, and victim assistance. In addition, the use of front-line risk assessment tools could serve to improve collaboration between police and victim support agencies to better manage DV cases.

Risk assessment has been employed in the clinical arena, where practitioners assess risk through a combination of knowledge, clinical experience and intuition (Pinard & Pagani, 2001); or through a growing number of stand-alone DV-related risk assessment tools designed for criminal justice and social service settings including the police (for example, Campbell, Sharps, & Glass, 2000; Hilton, et al., 2004; Kropp & Hart, 2000; Mason & Julian, 2009; Messing, Campbell, Wilson, Brown, & Patchell, 2015; Williams & Grant, 2006).

Researchers have begun to test the predictive validity of these tools to assess the extent to which they correctly predict future DV offending among different populations of offenders. While some tools offer reasonably high levels of predictive accuracy (Rice, Harris & Hilton, 2010), they often rely on detailed offender and victim information that must form part of specialised data collection, either through in-take or self-report instruments, clinical assessment, or police or practitioner observation. Examples of this kind of information that have been demonstrated to be associated with DV include prior antisocial behaviour, violence in the offender's family of origin, hostility towards others, controlling behaviours, and substance abuse (Hilton et al., 2004). However, there are also items in these risk assessment tools that are easily drawn from official data sources and that are strongly associated with the risk of DV – such as, the age of the offender, the nature of the offence, and the nature and extent of prior violent offending (Hilton et al., 2004).

There is a presumption that the development of more extensive risk tools combining both official and clinical or observational forms of data may provide the greatest degree of predictive accuracy (Campbell, Sharps, & Glass, 2000; Hilton, et al., 2004; Kropp & Hart, 2000; Mason & Julian, 2009; Messing, Campbell, Wilson, Brown, & Patchell, 2015; Williams & Grant, 2006). However, there may be reasons to question this presumption. For example, Ringland (2013) has suggested that comprehensive instruments may result in greater time and resource costs for little if any additional predictive accuracy. Further, it is optimal if tools employed by front-line agencies are relatively straightforward to use and cost-effective to administer (Hilton et al., 2004). From this perspective, it may be preferable to focus on readily available administrative data, rather than data types which are more difficult and expensive to obtain.

THE CURRENT STUDY

The aim of this study was to explore the potential of existing administrative data drawn from the NSW Bureau of Crime Statistics and Research (BOCSAR) Reoffending Database (ROD) to accurately predict violent DV-related recidivism.

Since violence is of primary concern to first responders such as the police, and there is no evidence that non-violent offenders will remain non-violent if they continue to offend (Piquero, Jennings, & Barnes, 2012), this study examines the future risk of violent DV offending among a cohort of individuals convicted of any DV offence (regardless of whether it is violent or not). For the purposes of this analysis we exclude offenders who receive a custodial penalty, on the grounds that separate risk assessments are conducted for this group (see for example, Corrective Services NSW, 2014).

We follow standard procedures to arrive at the best fitting model and test its predictive validity. We first examine bivariate relationships between the range of available offender demographic, offence, and criminal history variables and the violent DV-related recidivism variable. We then model the relationship between a range of these variables and the risk of re-offending to obtain the model that was best able to discriminate between violent DV recidivists and other offenders. Finally, we employ a range of procedures to test the predictive validity of the model.

METHOD

Data source

Data for the study were extracted from ROD: the NSW Bureau of Crime Statistics and Research re-offending database (Hua & Fitzgerald, 2006). ROD consists of a set of linked records of all persons cautioned, conferenced or charged with a criminal offence in NSW since 1994. Data sourced from the NSW Department of Births, Deaths and Marriages is used to identify the date of death of persons in ROD who have died. An important feature of ROD is that it contains information (lawpart codes) which can be used to identify domestic violence-related incidents (see Ringland & Fitzgerald, 2010 for details). It should be noted that since domestic violence reported to the police represents only a fraction of the DV revealed in self-report data (Birdsey & Snowball, 2013), the DV in this study cannot be considered to be a representative sample (People, 2005). Data for the current study were extracted from ROD in January 2016 and include data up until 1 January 2015.

Sample

The study is a retrospective analysis of a cohort of all adult offenders identified using ROD, who were found guilty of a domestic violence-related offence in a NSW Local or District

Court during the index period, 1 January 2011 to 30 June 2012, and who received a non-custodial penalty. Domestic violence-specific lawpart codes were used to identify offences occurring within domestic relationships (in accordance with the *Crimes (Domestic and Personal Violence) Act 2007 (NSW)*; Ringland & Fitzgerald, 2010).

During the index period, there were 16,592 records relating to offenders found guilty of DV-related offences and receiving a non-custodial sentence. Since offenders could have more than one DV-related conviction during the index period, offenders in the sample could have multiple court finalisations in the index period. For each offender, we identified the finalised DV-related court appearance closest to, but no later than, 30 June 2012. A total of 15,201 unique offenders met the study criteria.

A total of 151 offenders had a period of custody which was 30 days or less, occurring after the index conviction and before the end of the two-year follow-up period, and was not a result of a violent DV offence. For these offenders, time-at-risk (in days) was adjusted for their days in custody.

The DV conviction occurring between 1 January 2011 and 30 June 2012 was defined as the index conviction.

Missing data: An initial examination was conducted to determine patterns and percentages of missing data. This analysis indicated that 10 of the 11 predictor variables had less than 1% missing data. Rather than imputing missing data, the decision was made to employ listwise deletion of missing data, resulting in a final sample size of 14,660 unique offenders.

Variables

Dependent variable: recidivism

The dependent variable for this study is a dichotomous measure of whether or not recidivism had occurred. Recidivism was operationally defined as any further proven DV offence involving violence, stalking or intimidation with an offence date occurring after the index court appearance finalisation date and before the end of the 24-month follow-up period. Violent DV re-offences included the following offence categories recognised by the Australian and New Zealand Standard Offence Classification (ANZSOC; Australian Bureau of Statistics, 2011): murder, attempted murder and manslaughter (ANZSOC 111-131), serious assault resulting in injury, serious assault not resulting in injury and common assault (ANZSOC 211-213), aggravated sexual assault and non-aggravated sexual assault (ANZSOC 311-312), abduction and kidnapping and deprivation of liberty/ false imprisonment (ANZSOC 511-521), stalking (ANZSOC 291), and harassment and private nuisance and threatening behaviour (ANZSOC 531-532). For the purposes of this analysis we exclude offenders who receive a custodial penalty for the index offence, on the grounds that separate risk assessments are conducted for this group.

Independent variables

We used a series of automated stepwise modelling strategies to identify correlates of violent DV-related recidivism, beginning with a range of offender, index offence and criminal history variables available on the ROD database.

Offender demographic characteristics

Gender: whether the offender was recorded in ROD as male or female.

Age: the age category of the offender at the index court finalisation was derived from the date of birth of the offender and the date of finalisation for the index court appearance.

Indigenous status: recorded in ROD as ‘Indigenous’ if the offender had ever identified as being of Aboriginal or Torres Strait Islander descent, otherwise ‘non-Indigenous’ if they had not identified as being of Aboriginal or Torres Strait Islander descent.

Disadvantage areas index (quartiles): measures disadvantage of an offender’s residential postcode at the index offence. Based on the Socio-Economic Index for Areas (SEIFA) score (Australian Bureau of Statistics, 2006).

Index conviction characteristics

Concurrent offences: Number of concurrent proven offences, including the principal offence, at the offender’s index court appearance.

AVO breaches: Number of proven breach of Appended Violence Order (AVO) offences at the index court appearance.

Criminal history characteristics

Prior juvenile or adult convictions: Number of Youth Justice Conferences or finalised court appearances with any proven offence(s) as a juvenile or adult prior to the index court appearance.

Prior serious violent offence conviction past 5 years: Number of Youth Justice Conferences or finalised court appearances in the 5 years prior to the reference court appearance with any proven homicide or serious assault.

Prior DV-related property damage offence conviction past 2 years: Number of Youth Justice Conferences or finalised court appearances in the 2 years prior to the reference court appearance with any proven DV property damage offence.

Prior bonds past 5 years: Number of finalised court appearances within 5 years of the reference court appearance at which given a bond.

Prior prison or custodial order: Number of previous finalised court appearances at which given a full-time prison sentence/ custodial order.

METHOD OF ANALYSIS

Analysis proceeded in three stages following procedures previously employed to assess models intended to predict the risk of recidivism (Hilton et al., 2004; Smith & Jones, 2008a; 2008b). First, using chi-square tests of association we examined bi-variate relationships between possible explanatory variables and the dependent variable – violent DV-related reconviction. Variables not yielding statistically significant bivariate relationships with the dependent variable were dropped from further consideration in the model.

Next, we estimated a multivariate logistic model predicting the likelihood of violent DV-related reconviction using the full sample (n = 14,660). To select the most powerful set of explanatory variables from the range of those available in the ROD dataset we compared models using different automated modelling procedures – stepwise selection, forward selection and backward elimination. We tested the accuracy of models using the Hosmer-Lemeshow test statistic and the Receiver Operating Characteristics (ROC) Curve analysis (Hosmer & Lemeshow, 2000).

Finally, we used three cross-validation procedures to test the external predictive validity of the model. First, we employed a cross-validation procedure used by Smith and Jones (2008a, 2008b) in which logistic regression was performed using a 50/50 training and test random sample. Second, we used a 10-fold cross-validation procedure to evaluate the logit model's generalisability for out-of-sample or "real world" data sets (Friedman, Hastie & Tibshirani 2009, pp. 241-245). Third, we examine whether the final model maintains predictive accuracy in smaller subsamples of offenders. Here we report on predicted and observed reconviction rates using 10-fold cross-validation for three key demographic variables – age, Indigenous status and disadvantage areas index.

RESULTS

DISTRIBUTION AND BIVARIATE RELATIONSHIPS

Among the 14,660 offenders who had a DV conviction during the index period, roughly 8% (n = 1,109) reoffended violently with a DV-related offence within two years of the finalisation of their index offence. The distributions of offender characteristics and bivariate relationships between offender characteristics and violent DV-related reconviction are presented in Table 1. Consistent with other research (Philips & Vandenbroek, 2014) a large majority (83%) of offenders in the sample were male. The median age of offenders in the sample was 34 years. Indigenous offenders accounted for nearly one-fifth of offenders (19%) – a large over-representation relative to their roughly 2% share of the NSW adult population in 2011 (ABS, 2011). Most (63%) resided in areas of moderately high to high socio-economic disadvantage at the time of the index conviction. Most had either one (52%) or two (25%) concurrent index offences, and about one-third (34%) had an AVO breach at the index conviction. The median number of prior convictions was two, and for 30% of offenders the index conviction was a first offence. Most (88%) had not been convicted of a serious violent offence – including homicide and serious assault – within the past five years. Most (97%) also had not been convicted of a DV-related property damage offence in the past two years. Most (70%) had not received a bond penalty in the past five years, and most (85%) had not received a prison or custodial order at any time before the index conviction.

An examination of bivariate relationships indicated that there were statistical differences in the rate of reconviction for each of the offender characteristics (Table 1). Offenders who were proportionately more likely to have a violent DV-related reconviction within two years included those who were male, younger (18-24 years), Indigenous, and from more highly disadvantaged areas; those whose index conviction was characterised by a greater number of concurrent offences (five or more), with one or more AVO breaches; and those whose criminal histories included multiple prior juvenile or adult convictions, a past five-year conviction for a serious violent offence, a past two-year conviction of a DV-related property damage offence, two or more past five-year convictions in which they received a bond, and one or more prior prison or custodial orders.

FINAL LOGISTIC REGRESSION MODEL

Table 2 presents the final logistic regression model results based on the full sample (n = 14,660). The dependent variable in this model is the dichotomous outcome – violent DV-related reconviction within two years versus no violent DV-related reconviction within the period. The model was adjusted for the full set of explanatory variables described in Table 1. Net of the other variables, the results indicate that the odds of a violent-DV reconviction were higher by a factor of 1.45 for male offenders than for female offenders. This was also the case for younger offenders – in particular, relative to the oldest age category, 45 years and older. The odds of reconviction for the youngest age group (18 to 24) years were greater by a factor of 2.13. Indigenous offenders had higher odds of reoffending than non-Indigenous offenders. Relative to the least disadvantaged residential areas, offenders from high and moderately high areas of disadvantage also had higher odds of reconviction, however there was no statistical distinction between moderately low and low areas of disadvantage and their chances of reconviction.

The odds of reconviction were also significantly different across the range of index offence characteristics. Offenders with five or more concurrent offences had higher odds of reconviction than those with only one index offence (the reference group). Having one or more AVO breaches was associated with higher odds than not having these offences.

Table 1. Offender characteristics for n = 14,660 unique offenders with a DV-related offence conviction between 1 Jan 2011 and 30 June 2012, Total n (%), and proportion reconvicted

	N	%	Violent DV reconviction[1] (%)
Gender			
Male	12,186	83.1	8.1
Female	2,474	16.9	5.1
Age (median = 34 years)			
18-24	2,973	20.3	9.8
25-34	4,575	31.2	8.6
35-44	4,179	28.5	7.3
45+	2,933	20.0	4.2
Indigenous status			
Non-Indigenous	11,884	81.1	6.1
Indigenous	2,776	18.9	13.8
Disadvantage areas index (quartiles)			
High	4,778	32.6	8.7
High moderate	4,437	30.3	8.2
Low moderate	3,508	23.9	6.8
Low	1,937	13.2	4.6
Concurrent offences			
One	7,559	51.6	6.3
Two	3,669	25.0	7.5
Three to four	2,450	16.7	9.2
Five or more	982	6.7	13.4
AVO breaches			
None	9,723	66.3	6.0
One or more	4,937	33.7	10.6
Prior juvenile or adult convictions			
None	4,418	30.1	3.4
One	2,379	16.2	5.6
Two	1,652	11.3	7.1
Three	1,291	8.8	8.0
Four	946	6.5	11.6
Five or more	3,974	27.1	12.5
Prior serious violent offence conviction past 5 years			
None	12,833	87.5	6.5
One or more	1,827	12.5	14.9
Prior DV-related property damage past 2 years			
None	14,142	96.5	7.3
One or more	518	3.5	15.6
Prior bonds past 5 years			
None	10,219	69.7	5.6
One	2,936	20.0	10.3
Two or more	1,505	10.3	15.9
Any prior prison or custodial order			
None	12,445	84.9	6.5
One or more	2,215	15.1	13.8

[1] Chi-square tests of association between violent DV reconviction and potential predictor variables. All tests showed statistically significant bivariate relationships between reconviction and predictors (p<.001).

Table 2. Final logistic regression model predicting violent DV-related reconviction within two years of the index DV-related conviction (n = 14,660)

	Parameter estimate	Std. Error		Odds ratio	95% Confidence interval
Intercept	-4.488	(0.18)	***	0.01	
Gender					
Female[1]				1.00	
Male	0.373	(0.10)	***	1.45	(1.19, 1.77)
Age					
45+[1]				1.00	
18-24	0.757	(0.12)	***	2.13	(1.70, 2.68)
25-34	0.533	(0.11)	***	1.70	(1.38, 2.11)
35-44	0.385	(0.11)	**	1.47	(1.18, 1.83)
Indigenous status					
Non-Indigenous[1]				1.00	
Indigenous	0.470	(0.07)	***	1.60	(1.38, 1.85)
Disadvantage areas index (quartiles)					
Low[1]				1.00	
High	0.388	(0.12)	**	1.47	(1.16, 1.88)
High moderate	0.361	(0.12)	**	1.43	(1.13, 1.83)
Low moderate	0.203	(0.13)		1.23	(0.95, 1.58)
Concurrent offences					
One[1]				1.00	
Two	0.037	(0.08)		1.04	(0.89, 1.22)
Three to four	0.100	(0.09)		1.11	(0.93, 1.31)
Five or more	0.319	(0.11)	**	1.38	(1.11, 1.71)
AVO breaches					
None[1]				1.00	
One or more	0.258	(0.07)	**	1.29	(1.13, 1.48)
Prior juvenile or adult convictions					
None[1]				1.00	
One	0.350	(0.12)	**	1.42	(1.11, 1.81)
Two	0.468	(0.13)	***	1.60	(1.23, 2.07)
Three	0.478	(0.14)	**	1.61	(1.22, 2.13)
Four	0.866	(0.14)	***	2.38	(1.80, 3.15)
Five or more	0.690	(0.13)	***	1.99	(1.55, 2.56)
Prior serious violent offence conviction past 5 years					
None[1]				1.00	
One or more	0.333	(0.08)	***	1.40	(1.18, 1.65)
Prior DV-related property damage past 2 years					
None[1]				1.00	
One or more	0.296	(0.13)	*	1.34	(1.04, 1.74)
Prior bonds past 5 years					
None[1]				1.00	
One	0.066	(0.09)		1.07	(0.90, 1.26)
Two or more	0.285	(0.10)	**	1.33	(1.09, 1.63)
Prior prison or custodial order					
None[1]				1.00	
One or more	0.191	(0.09)	*	1.21	(1.01, 1.45)

[1] Reference category.

*** p<.001; **p<.01, *p<.05

Notes: Hosmer-Lemeshow statistic = (9.768, df 8, p = .282); Area under ROC curve = 0.701.

Finally, odds of reconviction were influenced by criminal history. Having one or more prior juvenile or adult convictions increased odds relative to having no prior convictions. Having been convicted of one or more serious violent offences in the past five years or one or more DV-related property damage offences in the past two years increased odds of reconviction over having not committed one of these offences. Having received two or more bond penalties in the five years prior to the index conviction raised odds over not having received a bond, and having received a prison or custodial order at any time prior to the index conviction raised odds of reconviction.

MODEL ACCURACY

To test model fit and accuracy we estimated the Hosmer-Lemeshow test statistic which divides cases into deciles based on predicted probabilities and then computes an overall chi-square value from observed and expected frequencies. The test value was not statistically significant (χ^2 9.768, *df* 8, $p = .282$), indicating that there were no significant differences between the observed and expected frequencies within each of the deciles. As a result, we conclude that the model adequately fits the data.

The area under the Receiver Operating Characteristic (ROC) curve provides another test of model accuracy. The area under the curve (AUC) for the full model was 0.701 (with a 95% confidence interval ranging from 0.684 to 0.717). This AUC value for the final model was significantly better than a non-informative AUC value of 0.5 where a model's predictive power would be no better than chance, but lower than an AUC value of 1.0 where a model's predictive power would be perfect. The AUC (0.701) in this case suggests that the model is fair – providing an 'acceptable' level of discrimination between true positives and false positives (Hosmer & Lemeshow, 2000).

EVALUATION OF THE MODEL

The area under the curve (AUC) statistic resulting from the final model (Table 2) is useful to evaluate the internal validity of the model; however, it does not provide any indication of how the model might perform on new or different samples of offenders. In order to better evaluate model performance from this perspective, three cross-validation techniques were used to test how well the model was able to predict recidivism in 'out-of-sample' or test data – which refers to a portion of the full sample that is reserved to retest the model. These procedures allowed us to approximate how well the model would perform using different 'real world' samples.

The first technique bisected the data set into a training and test sample, using a 50/50 randomised split, also known as 2-fold cross-validation. For this test, a logistic model was 'trained' using the training sample (n=7,330) and 'tested' on the test sample (n=7,330), providing the predicted probabilities of recidivism for observations that were not included in the model calculation. As Table 3 shows, the AUC values were 0.701 for the training sample and 0.691 for the test sample, which were very close to the AUC of 0.701 for the full sample internal validation.

The second technique used 10-fold cross-validation to further evaluate model performance for out-of-sample error. In this way, the full sample was randomly split into 10 sub-samples or 'folds' of equal size. For each fold k, logistic regression was performed using the k as the test or 'validation' set and the remaining nine folds as the training sample. This resulted in 10 models, where each fold was used once as a validation sample. The mean of the AUC derived from these 10 models provides an average indication of model performance. As Table 3 shows, the mean AUC was 0.694 for 10-fold cross-validation, which is also close to the AUC derived for the full sample (0.701).

Table 3. Area under the curve (AUC) statistics for three methods of obtaining predicted probabilities across the entire sample (N=14,660)

	N	AUC	(95% CI)
Internal validation process			
Full sample	14,660	0.701	(0.684, 0.717)
External validation processes			
Two-fold validation			
50% training sample	7,330	0.701	(0.681, 0.726)
50% test sample	7,330	0.691	(0.669, 0.714)
Ten-fold validation			
10-fold cross validation (average training sample size)	13,194	0.694	(0.643, 0.742)

Notes: AUC: Area under the Receiver Operating Characteristic curve. CI: confidence interval.

Table 4. Observed rates of violent DV-related reconviction for selected subgroups of the training (n ~ 13,194) and test samples (n ~ 1,466) using the average results from 10-fold cross-validation

	Average training sample (90%)			Average test sample (10%)		
		Observed	Predicted		Observed	Predicted
	N	%	%	N	%	%
Total	13,194	7.6	7.5	1,466	7.6	7.4
Age Subgroup						
18-24	2,676	9.8	15.4	297	9.8	15.6
25-24	4,118	8.6	9.0	458	8.6	8.7
35-44	3,761	7.3	5.2	418	7.2	5.2
45+	2,640	4.2	0.4	293	4.2	0.4
Indigenous status						
Non-Indigenous	10,696	6.1	2.3	1,188	6.1	2.3
Indigenous	2,498	13.8	29.8	278	13.7	29.4
Disadvantage areas index (quartiles)						
High	4,300	8.7	10.6	478	8.7	10.3
High moderate	3,993	8.2	8.7	444	8.2	8.9
Low moderate	3,157	6.8	5.2	351	6.8	5.2
Low	1,743	4.7	0.9	194	4.7	0.9

Overall, the results of cross-validation show that model performance (measured by AUC) is relatively stable, suggesting performance that is consistently at the bottom of the 'acceptable' range (Hosmer & Lemeshow, 2000).

The final technique of cross-validation examined the model performance for predicting rates of recidivism across sub-groups of individuals. The aim is to ensure that the model is equally as predictive when smaller target groups of offenders are considered (Smith & Jones, 2008a). Three subgroup variables were selected, namely: age (four categories from younger to older); Indigenous status (no or yes); and the disadvantage areas index (four quartiles from most to least disadvantaged).

Ten-fold cross-validation was used again as a validation technique, providing the average rates of observed and predicted recidivism resulting from 10 logit models. In this way, the full sample (n=14,660) was randomly split into 10 equally-sized sub-samples, and 10 logistic models were fitted using each sub-sample once as the 'test' sample and the remaining 9 folds as the 'training' sample (a 90%/10% split). We then take the average results from all 10 models, which were applied to both the test sample and the training sample (to internally validate the model).

As Table 4 shows, there was a high degree of concordance between the observed and predicted rates of violent DV-related reconviction overall. However, there was some variability in the observed and predicted rates within subgroups. For example, observed and predicted rates for age groups 25 to 34 and 35 to 44 were similar, and held across training and test samples. This was not the case for the youngest and oldest age groups where there was an over prediction of reconviction among those aged 18 to 24 years, and an under prediction among those aged 45 years and older that was consistent across training and test samples. Similar variability could be observed in the highest and lowest quartiles of the disadvantage areas index. Indigenous status also showed relatively large discrepancies in the test sample between the observed and predicted rates of violent DV reconviction. This variation may result from the smaller sample size of this particular subgroup, which is further compounded by the relatively small size of the test sample (i.e. ~10% of the full sample). The Indigenous subgroup results in this study show that care must be taken in attempting to apply this model to all subgroups. Recent studies have highlighted the racial bias that can be associated with various kinds of tools used to predict the risk of reoffending (e.g. Monahan & Skeem, 2016).

DISCUSSION

The aim of this study was to investigate the viability of an administrative dataset (ROD) for predicting the future risk of violent DV offending among a specific cohort of individuals convicted of any DV offence (regardless of whether it is violent or not) who had not served a custodial index sentence. Whereas there has been greater focus on the development of risk assessment tools for offenders serving custodial sentences (Corrective Services NSW, 2014), one rationale for this study was to examine the future risk of violent DV recidivism among a less researched cohort of offenders who have initially garnered less serious – non-custodial – sentences. To undertake this research, we employed a strategy to first identify a model and then test its internal and external validity using diagnostic tests and cross-validation procedures. That method has been used in previous research aimed at developing models to predict the risk of recidivism (Hilton et al., 2004; Smith & Jones, 2008a; 2008b)

In the current study, 11 variables served as the most useful set of explanatory factors to predict the likelihood of violent DV reconviction. Several of these variables have been demonstrated to be predictive of recidivism more generally (Gendreau, Little & Goggin, 1996; Payne, 2007; Ringland, 2013). For example, the results showed that being younger, having multiple prior convictions, multiple concurrent index offences, and a history of serious violent offending all served to elevate the chances of violent DV-related reconviction. Further, the results suggested that a specific history of DV offending was important in two ways. First, prior DV-related property damage offences served to increase the odds or reconviction. This type of offending may reflect non-violent abuse that research suggests can be part of a package of behaviours used to employ 'coercive control' or behaviour that aims to harm, punish, humiliate or intimate the victim (Stark, 2007). Second, in this study AVO breaches were a significant predictor of future violent DV offending. Given evidence that the successful identification and prosecution of these breaches may be less likely to occur than is the case for other types of criminal offences (Douglas, 2008,p. 47), the precise nature of the relationship between breaches and subsequent violent DV offences requires further investigation.

From a broader intervention perspective, these results also highlighted the need to improve policing and services aimed at Indigenous offenders, whose odds of reconviction were significantly higher than their non-Indigenous counterparts. In addition, the higher odds of reconviction for offenders who resided in the most socio-economically disadvantaged areas coincides with research indicating that DV support services can vary in effectiveness and even be absent in locations that are often in most need (Owen & Carrington, 2015). The results presented here support the case for imagining improved ways of delivering domestic violence services in disadvantaged areas. Finally, the nearly 40% higher odds of violent DV reconviction for males than females is consistent with Australian survey data underscoring the gendered nature of domestic violence (ABS, 2006).

Overall the model predicted violent DV recidivism (base rate = 8%) with a relatively high degree of accuracy. The AUC for the full model was 0.70, an acceptable level of discrimination, and similar to other validated violent risk assessment tools (Rice, Harris & Hilton, 2010). Cross-validation procedures also demonstrated that the model was able to reasonably discriminate between violent DV recidivist and non-recidivist offenders. However, further tests to examine the ability of the model to discriminate recidivism within subgroups of the population indicated that some caution must be applied. In particular, the model did not hold up well in its ability to predict Indigenous recidivism possibly due to the smaller proportion of Indigenous offenders in the population. We return to the issue of subgroups below.

This research has focussed on the narrow question of the ability to predict violent DV recidivism defined as re-conviction, a high threshold for recidivism. While the model identified here produced acceptable levels of discrimination between recidivists and non-recidivists and as a result may make it possible to assess the risk of violence in DV cases, or perhaps more broadly to better understand the effect of various policing and intervention strategies, we also draw attention to a number of limitations in this research.

First, the propensity to engage in any kind of violent behaviour is not only a function of the individual offender, but also of a range of situational and lifestyle factors including family or relationship history, financial circumstances, alcohol and substance abuse, and available supports (Morgan & Chadwick, 2010) that may change over the offender's life course (Piquero et al., 2012). Research also underscores the importance of societal-level catalysts for DV in the form of gender inequality, violent masculinities, male peer support, weak sanctions, and lack of supports for victims (Douglas, 2008). Thus, evidence suggests that domestic violence involves a complex mix of offender, situational and social factors. Accurate information about these factors is challenging to capture in risk prediction instruments, particularly where they rely strictly on administrative data sources.

The model estimated here makes use of a well-established and comprehensive administrative dataset (ROD) comprising demographic and criminal history variables that have been demonstrated to be empirically associated with reoffending elsewhere (Dutton & Kropp, 2000). However, the predictive value of the resulting model is limited by its capacity to test the full range of empirically relevant factors related to offenders' circumstances. For instance, while research suggests that DV offenders may employ 'coercive control' behaviour (Stark, 2007), it is not possible to effectively capture the range of these tactics through administrative data sources. Rather, a combination of victim self-report, clinical assessment and police observation is required. In the absence of these data sources, Ringland, Weatherburn and Poynton (2015) have highlighted the benefits of linking administrative data to other departments within and beyond criminal justice in order to improve recidivism prediction. Links between DV offending and both child protection and federal family law courts may provide fertile ground in the future (Douglas & Fitzgerald, 2013).

A second commonly cited limitation of the type of data used in this study is the weakness of the 'criterion' variable – or dependent variable – which may inaccurately measure or undercount the phenomenon of interest (Dutton & Kropp, 2000). Strong evidence suggests that DV is significantly undercounted in criminal justice administrative data. In NSW, only about one-half of victims report their incidents of domestic violence to the police, and this under-representation increases as one moves further into the criminal justice system (Birdsey & Snowball, 2013). Conviction, the threshold for inclusion in this study, is the final stage of an 'attrition pyramid' (Johnson, 2012) and depends on discretion at many stages (Australian Law Reform Commission, 2010). Thus, the reliability of the dependent variable depends on victims (who are primarily women) reporting every violent event to the police, police responding to every complaint and laying charges, prosecutors proceeding, and judges convicting. Research shows that women may be deterred by police action or inaction in the past, by court action, lack of services, threats from partners, pressures from religious or cultural communities, fear of losing children, financial concerns (Birdsey & Snowball, 2013; Fitzgerald, 2006; Johnson, 2012). Prosecutors may also drop or reduce charges so that a charge for a violent offence results in a conviction for a non-violent offence (Australian Law Reform Commission, 2010). Taken together, this means that the results of this study are necessarily constrained to a very particular segment of the DV offender population that first comes to the attention of the criminal justice system, and second, receives a conviction.

Third, while the results of this study suggest that logistic regression is a satisfactory tool for predicting the risk of domestic violence recidivism in the overall population, its efficacy is reduced for predicting recidivism within some sub-groups of the population (e.g. Indigenous status). While it is clear that inaccurate targeting of resources can carry serious negative consequences such as racial bias and the reinforcement of inequalities (Monahan & Skeem, 2016), there can also be advantages to finding effective ways of targeting resources. Henman (2004) has argued that the ability to more accurately discriminate between segments of the broader population enables services and interventions to be targeted to those who most need or stand to benefit from them. Although the results from the present study did not perform at an acceptable level for all subgroups, the ability to target sub-groups of individuals from the overall sample who are more likely to re-offend presents a potentially useful tool for policy development and risk assessment in a practice context. In the future, these efforts to identify sub-groups of offenders could also be extended to better identify subgroups of victims so that appropriate safety plans can be put in place.

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