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Abstract | Finding effective ways to prevent crime is important. This project was designed to demonstrate the feasibility of combining data from a 12-year Australian longitudinal study (N=2,885) with prevention strategy investment data to estimate potential returns, including a reduction in intimate partner violence and prison entry. The project investigated the return on investment achievable in Victoria with a \$150 million investment in a mix of six evidence-based prevention strategies.

The study estimated that the 10-year lag effect of investing an extra \$150 million was a five percent reduction in incarceration and a four percent reduction in cases of intimate partner violence involving physical force. The net return from the \$150 million investment in prevention was conservatively estimated at \$191 million. It appears feasible and cost-effective to prevent intimate partner violence, while also reducing incarceration rates.

Prevent crime and save money: Return-on-investment models in Australia

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Crimes such as violence, theft and dealing in illegal drugs are serious and costly issues internationally, including in developed countries such as Australia and the United States (eg Hemphill et al. 2009; Hemphill et al. 2010). These behaviours peak during adolescence and early adulthood (Baker 1998; Bond et al. 2000; Rutter & Giller 1983). Estimates of the rates of adolescent antisocial behaviour vary depending on how it is defined and measured; however, they are generally between five and 20 percent (Hemphill et al. 2006; Vassallo et al. 2002) with similar rates in the United States, the United Kingdom (Costello et al. 2003; Sawyer et al. 2001) and Australia (Vassallo et al. 2002). The cost of crime in Australia is estimated to be \$47.6 billion per year, or 3.4 percent of gross domestic product (Smith et al. 2014) and rates of crime are highest among those aged 15 to 24 years (Australian Institute of Criminology 2014). The occurrence of crime impacts greatly on community members' feelings of safety and enjoyment of their local environments (Australian Institute of Criminology 2014).

Risk and protective factors for adolescent antisocial behaviour

A range of predictors for adolescent antisocial behaviour (referred to here as risk and protective factors) have been identified in the research literature. A risk factor increases the likelihood of a person developing problematic behaviours such as antisocial behaviour (Hawkins et al. 1992; National Crime Prevention Unit 1999). Protective factors reduce the likelihood of problematic behaviours or moderate the effects of risk factors on behaviour (Hawkins et al. 1992; National Crime Prevention Unit 1999). Risk and protective factors relate to the social context of the young person, including the peer group, family, school, community, and characteristics of the young person (Catalano et al. 2011).

Extant research has confirmed a wide range of risk and protective factors for youth antisocial behaviour (Catalano et al. 2011; Hemphill et al. 2009; Hemphill et al. 2006; Stiglitz 2012). The sections that follow describe evidence that the following risk factors for youth violent behaviour (Toumbourou et al. 2013; Toumbourou et al. 2015) have been increasing in Australia in recent decades:

socio-economic inequality, family problems, school problems, and alcohol availability and early age alcohol use. The increase in these risk factors has been posited as part of the explanation for the increasing levels of violent behaviour among youth in Australia in recent decades (Toumbourou et al. 2015; Toumbourou et al. 2013).

Socio-economic inequality

International studies have demonstrated that violence and crime tend to be more common in societies with larger income differences (Stiglitz 2012). Williams et al. (2009) demonstrated in a large Australian study that rates of youth violence were significantly higher in disadvantaged communities. In longitudinal research, community disorganisation, perceived availability of drugs and peer antisocial involvement (all indicators of community disadvantage) have each been shown to predict future antisocial behaviour in adolescents and young adults (Hemphill et al. 2009; Hemphill et al. 2006). Income inequality has increased in Australia in recent decades (Organisation for Economic Co-operation and Development 2015) and is reflected in location differences whereby some suburbs and neighbourhoods have high numbers of disadvantaged families living in close proximity (Williams et al. 2009). Growing up in these neighbourhoods can increase the likelihood of children experiencing a number of predictors of antisocial behaviour, including low social cohesion, witnessing and experiencing violence and being in situations with low environmental security and where there are high rates of alcohol and drug use.

Family problems

Family problems are known to contribute to youth antisocial and violent behaviour (Hawkins et al. 2000; Herrenkohl et al. 2000). Rates of child neglect and abuse notifications and substantiations have been steadily rising in most Australian jurisdictions in recent decades (Australian Institute of Health and Welfare 2012). Longitudinal research shows that both family conflict and early adolescent antisocial behaviour are cross-nationally stable risk factors that predict future youth violence (Hemphill et al. 2009; Hemphill et al. 2006). Early family risk factors are considered to be particularly important in early-onset antisocial pathways (Moffitt 1993) and in this way, predict increased antisocial behaviour.

School problems

School problems have increased among students in disadvantaged communities in recent decades and this may also contribute to youth antisocial behaviour. For example, many Australian schools use suspension to address student behavioural problems, with rates higher in disadvantaged communities (Hemphill et al. 2010). School suspension has been found in longitudinal research to be a unique and cross-nationally stable predictor of future youth antisocial behaviour (Hemphill et al. 2009; Hemphill et al. 2006). Important geographic trends in Australian schools are that the lowest rates of school completions are in non-metropolitan areas, and lower rates of school completions occur in schools in outer ring compared to middle ring suburbs (Access Economics 2008). Risk factors such as disengagement from school, suspension and exclusion can increase both early- and late-onset antisocial pathways and in this way, predict increased antisocial and violent behaviour (eg Hemphill et al. 2006).

Alcohol availability and use

Alcohol availability and early age alcohol use have increased in Australia and are known risk factors for youth antisocial behaviour. Alcohol outlet densities have increased in recent decades, which helps explain the increasing rates of alcohol-related harm and violence (Livingston, Chikritzhs & Room 2007). Williams et al. (2009) found that early adolescent alcohol use was strongly associated with adolescent violence. Hemphill et al. (2009) found community norms favourable to alcohol and drug use increased the risk of future youth violent behaviour. According to the National Drug Strategy Household Survey report in 2010, there were statistically significant increases between 2007 and 2010 in the proportion of victims of physical abuse whose abuse was alcohol-related, from 4.5 percent to 8.1 percent (Australian Institute of Health and Welfare 2011).

Evidence based approaches for reducing risk factors for youth antisocial behaviour

Finding effective ways to reduce the developmental pathways to youth antisocial behaviour is important. An area of increasing importance relates to the costs and benefits of effective crime prevention models. Return-on-investment analyses suggest that investment in prevention and early intervention strategies is cost-effective and can reduce crime and incarceration (Aos et al. 2011). It is important that information of this kind is available to policymakers to guide their decision-making about government spending.

Several primary and secondary prevention strategies have been shown to be effective or promising in reducing one or more of the abovementioned risk factors and in preventing youth antisocial behaviour. These strategies are supported for Australian implementation and are summarised below.

Nurse Family Partnerships

Nurse Family Partnerships are secondary (selective targeted) prevention programs that offer assistance pre- and post-birth to young mothers to reduce the risks to children of unskilled parenting and socio-economic disadvantage. Professional home visitors are trained to build a trusted relationship to support parents to access services and ensure problems can be dealt with early.

Triple P Positive Parenting Program

The Triple P Positive Parenting Program is a primary prevention parent education program that aims to reduce family and child behaviour problems by enhancing parents' family management skills using interventions based on cognitive-behavioural and social learning theories. There are five levels of the program provided at different intensities to accommodate the differing levels of severity in disrupted family functioning or child behaviour problems. Randomised trials consistently find the program to improve parenting behaviours, and lower rates of child behaviour problems (eg Bodenmann et al. 2008; Prinz et al. 2009; Sanders, Bor & Morawska 2007).

Tutoring by Peers

Tutoring by Peers is a prevention approach that aims to reduce school risk factors. Youths and adults are trained to tutor students experiencing learning difficulties or school adjustment problems. Randomised trials have shown that this program is effective at improving student outcomes and in reducing behavioural problems (Rimm-Kaufman, Kagan & Byers 1998; Rodick & Henggeler 1980).

Drug and alcohol reduction strategies

Strategies to reduce alcohol and drug availability, early age alcohol use and heavy young adult alcohol use include approaches such as volumetric alcohol taxation, alcohol industry regulation, community mobilisation and alcohol sales monitoring, legislated age restrictions on alcohol use and purchase, interventions in entertainment precincts (Hemphill & Smith 2010; Stockwell et al. 2005) and screening and brief interventions with young adults (Tanner-Smith & Lipsey 2015). There is evidence that a number of these strategies can reduce early age and frequent adolescent alcohol use, progression to illicit drug use and alcohol-related violence among young adults (Toumbourou et al. 2015; Toumbourou et al. 2013).

Crime reduction versus expenditure: Return on investment

The costs associated with youth antisocial behaviour and crime are extensive and include costs related to physical and mental health services for young offenders, law enforcement, and youth justice services (Hemphill 1996; Smith et al. 2014), as well as costs related to the criminal justice system, victim assistance and security services (Smith et al. 2014).

The use of systematic literature reviews and economic modelling can encourage key constituencies to adopt evidence-based approaches that may require long-term political will to implement effectively. Economic modelling offers the advantage that the relative monetary benefits of different combinations of programs and policies can be compared. An example of economic modelling being used effectively occurred in Washington state in the USA, where a unique return-on-investment model was developed to estimate the economic returns of various policy options. Using this model, a complex range of scientific information has been synthesised in a form that is comprehensible to non-expert audiences within the Washington state legislature. A major achievement has been the steady reduction in Washington state's crime rate over recent decades and the reduction in incarceration.

The International Youth Development Study

The International Youth Development Study (IYDS) is a longitudinal, cross-national study that aims to investigate the development of adolescent behaviours, including antisocial behaviour and substance use, as well as the influence on these behaviours of risk and protective factors within the adolescents' individual, peer, family, school and community domains (Hemphill et al. 2006).

The IYDS was designed to recruit state-representative samples in 2002 of public and private school students in years 5, 7 and 9. A more detailed description of the IYDS methods is available in McMorris et al. (2007). Retention rates have remained high, with 85 percent retention in 2008, 84 percent in 2010–11, 83 percent in 2012–13 and 87 percent in 2014–15.

In Victoria, students in the year 5 cohort were reassessed (resurveyed) in 2003–04, 2006–08, 2010–11, 2012–13 and 2014–15. Participants in the year 7 and 9 cohorts were resurveyed in 2003–04, 2010–11, 2012–13 and 2014–15. Hemphill et al. (2016) describe sample size and retention rates across the assessment periods.

Aims

This article presents new analyses from the Victorian IYDS cohort, designed to demonstrate the feasibility of combining Australian longitudinal data with prevention strategy investment data to specify investment options to prevent intimate partner violence and incarceration in Australia. The aims of the current project are:

- to report population rates in Victoria of different forms of antisocial outcomes at different points in the life course, with a specific focus on rates of young adult incarceration and intimate partner violence;
- to estimate effect sizes for modifiable risk factors for young adult incarceration and intimate partner violence;
- to estimate the return on investment in Victoria of a \$150 million investment in a mix of six evidence-based prevention strategies; and
- through the above steps, to pilot a new method for prevention investment modelling that integrates longitudinal data with return-on-investment estimates.

Baseline data were obtained in the Victorian IYDS as each cohort reached average age 15. Follow-up data were obtained at ages 23 and 25 in 2012–13 and 2014–15 respectively. The evidence-based prevention strategies modelled were: Nurse Family Partnerships, Triple P Universal and Triple P Level 4 groups, Secondary School Age Alcohol Supply Reduction, Tutoring by Peers and Brief Alcohol Screening and Intervention of College Students (BASICS) for young adult alcohol problems.

Aim 1: Population rates of antisocial outcomes

The analyses conducted in this section examined population rates of:

- established risk factors for antisocial outcomes (family problems, child behaviour problems, substance use and school problems at age 15)
- alcohol problems at age 21; and
- intimate partner violence at age 23 and incarceration at age 25 years.

Rates of risk factors, intimate partner violence and incarceration are presented in Table 1. The rate of incarceration was 3.5 percent. Across subtypes of intimate partner violence, rates of psychological aggression were greater than rates for physical assault or acts causing physical injury, with 17 percent of participants reporting perpetration of psychologically aggressive behaviour towards their partner. The rate of physical assault was 8.5 percent and the rate for acts causing physical injury was 3.0 percent.

Table 1: Risk factors at age 15 years, intimate partner violence (age 23) and incarceration (age 25) in the IYDS (%)	
Risk factors at age 15	%
Socio-economic inequality (low SES) (Based on parent-reported levels of family income and education, measured using a composite scale combining parent education and family income. SES was dichotomised to identify the 10% of children in the highest decile for disadvantage)	10.26
Family problems: Conflict and parenting (Composite scale comprising adolescent-reported family conflict, poor family management and family history of antisocial behaviour [eg expressing disagreement with statements such as ‘The rules in my family are clear’]). Students in the top 24% were coded as high family risk (1) and the remaining group coded to the comparison or reference sample (0).	23.98
Child behaviour problems (Adolescent-reported engagement in antisocial behaviours over the past year: carrying a weapon, stealing something worth more than \$10, being arrested, attacking someone with the idea of seriously hurting them, and beating someone so badly that they probably needed to see a doctor or nurse). Students above one standard deviation from the mean (top 17%) were coded as having serious conduct problems and involvement in crime (1) and the remaining students as comparisons (0).	17.24
Substance use (Adolescent-reported age of first substance use and rates of substance use: alcohol and illicit drug consumption). Students in the top 18% of this scale (those who used substances) were coded as high substance use risk (1) and the remaining coded as comparisons (0).	18.20
Age 21 alcohol problems (Alcohol Use Disorders Identification Test (AUDIT; Saunders et al. 2013; eg ‘How often do you have 6 or more drinks on one occasion?’). Based on international conventions a cut-off of eight or more symptoms was used to define alcohol problems and 41% of young adults were assessed to be at risk (1) with the remainder coded as comparisons (0).	40.81
School problems (Adolescent-reported school attendance indicated by truancy, expulsion, and suspension and low school commitment; eg. ‘During the last four weeks how many whole days have you missed because you skipped or “cut/wagged”?’). Students with any truancy or suspension (27% on this scale) were coded as high risk of non-attendance and non-completion (1) and the remaining students as comparisons (0).	26.96

Table 1: Risk factors at age 15 years, intimate partner violence (age 23) and incarceration (age 25) in the IYDS (%) (continued)

Intimate partner violence at age 23 and incarceration at age 25 (%)	
Intimate partner violence	
(Perpetration of intimate partner violence was examined using three scales comprised of items from the Conflict Tactics Scale (CTS; Straus, Hamby, Boney-McCoy & Sugarman 1996)). Participants who reported not being in an intimate relationship were coded as: 'This has never happened/this has happened but not in the past year' (0).	
Psychological aggression (eg 'I insulted, swore, or yelled at my partner.')	16.99
Physical assault (eg 'I pushed, grabbed, slapped, shoved my partner, or threw something at my partner that could hurt')	8.52
Acts causing physical injury (eg 'My partner had a physical injury, sprain, bruise, or small cut because of a fight with me')	2.99
Incarceration	
('Over the past year...What is the total amount of time you have been detained in a prison or a correctional facility?'; recoded to form a dichotomous measure: never been incarcerated (0) and been incarcerated once or more (1)).	
	3.50

Note: Sample sizes vary from 2,166 to 2,884.

Aim 2: Estimated effect sizes for modifiable risk factors

The influence of family, individual, substance use and school-level risk factors at age 15 years and alcohol problems at age 21 on intimate partner violence at age 23 and incarceration at age 25 were examined using logistic regression analyses. The selected risk factors were explicitly selected because they are targeted by the evidence-based prevention approaches examined in the return-on-investment analyses conducted in Aim 3.

Predictors of incarceration and intimate partner violence

In the multivariate model presented in Table 2, two significant risk factors were evident as predictors of incarceration. The risk for incarceration was tripled where young people reported having alcohol problems at age 21 and not attending school at age 15 years. Two significant predictors for physically assaulting one's partner were evident: family and school problems. Specifically, family problems (high conflict, poor family management and family history of antisocial behaviours) increased the odds of this behaviour 1.5 times, while school problems (not attending school because of truancy, suspension or expulsion) doubled the odds of this behaviour.

Table 2: Logistic regression models longitudinally predicting incarceration at age 25 (n=2,297) and intimate partner violence (physical assault) at age 23 (n=2,166) from earlier risk factors

Risk factors	Incarceration (OR, 95% CI)	IPV (Physical Assault) (OR, 95% CI)
Cohort recruited in year 7	1.48 [0.85, 2.58]	1.27 [0.87, 1.84]
Cohort recruited in year 9	1.12 [0.56, 2.24]	1.00 [0.66, 1.52]
Urbanicity Middle cohort	0.63 [0.31, 1.31]	0.88 [0.58, 1.34]
Urbanicity Oldest cohort	1.06 [0.63, 1.80]	0.93 [0.66, 1.29]
Socio-economic inequality (low SES)	1.85 [0.80, 4.29]	1.02 [0.58, 1.80]
Family problems: Conflict and parenting	1.15 [0.60, 2.19]	1.60* [1.06, 2.41]
Child behaviour problems	1.65 [0.88, 3.08]	1.09 [0.68, 1.75]
Substance (including alcohol) use	1.70 [0.92, 3.16]	0.73 [0.45, 1.19]
Age 21 alcohol problems	3.29*** [1.92, 5.65]	1.34 [0.97, 1.83]
School problems	3.19*** [1.76, 5.78]	2.42*** [1.67, 3.52]
Pseudo R ²	19.88%	5.12%

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Analyses compared high risk versus low risk for socio-economic inequality at age 15 (family problems, child behaviour problems, substance (including alcohol) use, and school problems) and alcohol problems at age 21. Analyses adjusted for all variables in the table plus gender. IPV=intimate partner violence. SES=socio-economic status. OR=odds ratio. CI=confidence interval.

Although not presented here, a series of logistic regression analyses were completed investigating the hierarchical influence of risk (Hemphill et al. 2016). Briefly, findings showed a common cascading effect where risk factors operating at an early age (disadvantage, family problems) were associated with childhood behaviour problems and adolescent substance use. These effects then led to school problems and early adult alcohol use, which tend to be the most direct predictors of both intimate partner violence and incarceration.

Aim 3: Estimated return on investment from evidence-based strategies

The risk factor estimates obtained from the analyses conducted in Aim 2 were used to estimate the reduction in incarceration and intimate partner violence achievable in the state of Victoria if \$150 million was invested in a mix of the six previously described evidence-based prevention strategies. Findings are summarised in Table 3 and explained below.

Method

The IYDS risk factor prevalence estimates arising from Aim 1 (Column A) were aligned to the specific prevention strategies listed in Column B. With the exception of the Secondary School Age Alcohol Supply Reduction (SSAASR), the prevention strategies are as described by Aos et al. (2011; see Column B). SSAASR combines compliance checks for alcohol sales to underage youth (as described in Lee 2016) with brief behavioural communication to parents to discourage alcohol supply to adolescents (as described in Rowland et al. 2013).

Table 3: Reduced annual incarceration and intimate partner violence (physical assault) achievable through a \$150 million prevention strategy investment

Risk Factor	A	B	C	D	E	F	G	H	I	J
Socio-economic inequality (low SES)	0.10	Nurse Family Partnership	-0.04	\$15,493	0.03	\$34,599,870	-0.01%	8	-0.01%	12
Family problems	0.24	Triple P Universal	-0.08	\$231	0.17	\$34,229,805	-0.06%	132	-0.19%	404
Child behaviour problems	0.17	Triple P Level 4 groups	-0.13	\$853	0.40	\$51,190,177	-0.33%	499	-0.58%	876
Substance use	0.18	Secondary School Age Alcohol Supply Reduction	-0.05	\$53	0.30	\$13,900,488	-0.10%	165	-0.13%	204
Age 21 alcohol problems	0.41	Brief Alcohol Screening and Intervention of College Students (BASICS)	-0.09	\$111	0.24	\$9,466,176	-0.13%	461	-0.22%	775
School problems	0.27	Tutoring by peers	-0.13	\$176	0.15	\$6,1188,427	-0.15%	360	-0.33%	764
Total investment						\$149,574,944		1,624		3,034

A = Estimated risk factor prevalence (based on IYDS analyses)
 B = Prevention strategy
 C = Estimated risk factor reduction due to prevention strategy (as a Cox effect size)
 D = Program cost per individual
 E = Proportion of young people at-risk and involved in the prevention strategy (with increased cover at given prevention investment in F)
 F = Cost of delivering the prevention strategy to proportion E of the at-risk group
 G = Reduction in incarceration in at-risk group
 H = Number of incarcerations prevented in 2015
 I = Reduction in rate of intimate partner violence with physical assault in at-risk group
 J = Number of intimate partner violence with physical assault incidents prevented in 2015

The measures used to assess risk factors in longitudinal studies such as the IYDS are often the same measures used to evaluate the outcomes of prevention strategies (see Toumbourou et al. 2015). For the present analysis, risk factor constructs assessed in the IYDS were linked to the most closely aligned outcomes reported in the evaluations of the six prevention strategies (Lee 2016). The rationale for these decisions is described below.

Column C in Table 3 presents the estimated risk factor reduction achievable for each prevention strategy, expressed as a Cox effect size (ES). The ES value of -0.04 for Nurse Family Partnerships was calculated by averaging the secondary participant (parent) reported outcomes for employment (ES 0.036), high school graduation (0.035), and reduced food assistance (-0.054 ; see www.wsipp.wa.gov/BenefitCost/Program/35). These outcomes were selected as they most closely aligned with the risk factor construct of parental socio-economic status assessed from parent-reported family income and education in the IYDS (see Table 1).

The ES value of -0.08 for Triple P Universal was calculated by averaging the effects for 'child abuse and neglect' (-0.050) and 'out-of-home placements' (-0.108 ; see www.wsipp.wa.gov/BenefitCost/Program/79). The risk construct assessed in the IYDS was age 15 adolescent self-reports of family conflict, poor child management, and history of antisocial behaviour.

The ES value of -0.13 for Triple P Level 4 averaged outcomes for 'disruptive behaviour disorder symptoms' assessed at first (-0.17) and second follow-up (-0.081 ; see www.wsipp.wa.gov/BenefitCost/Program). The risk construct assessed in the IYDS was age 15 self-reported antisocial behaviour (delinquency).

The ES value of -0.05 for Secondary School Age Alcohol Supply Reduction was informed by the Lee (2016) outcome estimates for compliance checks for alcohol sales to underage youth. The ES for 'Alcohol use in high school' was estimated as -0.243 (Lee 2016). This rate was discounted on the assumption that effects will be lower in Australia, where laws and norms prohibiting underage alcohol use tend to be weaker (Hemphill et al. 2011). The risk construct assessed in the IYDS was age 15 self-reported alcohol and drug use.

The ES value of -0.09 for Brief Alcohol Screening and Intervention of College Students averaged outcomes for 'Problem alcohol use' assessed at first (-0.166) and second follow-up (-0.023 ; see www.wsipp.wa.gov/BenefitCost/Program). The risk construct assessed in the IYDS was age 21 self-reported alcohol problems.

The ES value of -0.13 for Tutoring by Peers averaged outcomes for 'Test scores' assessed at first (-0.159) and second follow-up (-0.095 ; see www.wsipp.wa.gov/BenefitCost/Program). The risk construct assessed in the IYDS was age 15 self-reported school problems and low school commitment.

Column D presents the program costs per individual as reported in US dollars by Lee (2016) for all cases except for SSAASR. Lee (2016) reported the costs per participant as follows:

- Nurse Family Partnerships—US\$10,049;
- Triple P Universal—US\$150;
- Triple P Level 4 groups—US\$553;
- Tutoring by Peers—US\$114; and
- Brief Alcohol Screening and Intervention of College Students—US\$72.

Australian cost estimates were sought for each of the prevention strategies but they were not available in most cases and appeared conservative (lower estimates) in the cases where they were available. The US dollar costs were first converted to Australian dollars in the same year that the costs were reported and then inflated to 2016 Australian dollars using the Australian health price deflator.

The estimates for SSAASR were based on Australian pilot study costings of A\$10,400 for 200 students. These costs are likely to be substantially lower per participant for scaled-up interventions.

Column E shows the proportion of the at-risk Victorian population that could be covered with each prevention strategy, given the overall budget. Adjusting the size of the population covered in Column E changed the overall cost of exposing the participants to each prevention strategy, presented in Column F. A range of alternatives were examined prior to finalising.

The percentage reduction in the incarceration rate in the at-risk group after treatment (Column G) was calculated as $(E \times R \times PC) \times 100$, where E is defined as in Table 3 above and R and PC are as defined below. R is the incarceration rate in the at-risk group = $(K / ((OR \times A) + (1 - A))) \times OR$, where K = the estimated proportion of the population incarcerated (0.035), OR = the Odds Ratio estimated for the relevant risk factor (from Column 1 of Table 2), and A is the proportion of the population exposed to the risk factor (from Column A in Table 3 above).

PC is calculated by transforming the Cox effect size to a percentage change (as reported in Aos et al. 2011) using the formula $((EXP(C \times 1.65) \times A) / (1 - A + A \times EXP(C \times 1.65))) / (A - 1)$, where A and C are as defined in Table 3 above. For example, the percentage reduction in the incarceration rate in the at-risk group after treatment was calculated for those exposed to low SES = $-0.01\% = (E \times R \times PC) \times 100 = (0.02 \times 0.0597 \times -0.096) \times 100$, where $E = 0.02$ (from Table 3); $R = 0.0597 = 0.035 / ((1.85 \times 0.1) + (1 - 0.1)) \times 1.85$; and $PC = -0.096 = (EXP(-0.0417 \times 1.65) \times 0.10) / (1 - 0.10 + 0.10 \times EXP(-0.0417 \times 1.65)) / (0.10 - 1)$.

The number of incarcerations prevented in 2015 is presented in Column H. This was calculated using the formula $H = A \times G \times P$, where A and G are estimated as in Table 3 and P is the population of Victoria aged 20 to 29 in 2014 ($n = 870,686$). For example, the percentage reduction in the number incarcerated (H) was calculated for those exposed to low SES = $8 = 0.10 \times 870,686 \times -0.01$.

The percentage reduction in IPV with physical assault in the at-risk group (Column I) was calculated in the same way as for incarceration (Column G), but substituting for K the estimated proportion of the population perpetrating IPV with physical force (0.85) and the OR for IPV from column 2 in Table 2. The number of IPV with physical assault incidents prevented in 2015 (Column J) was calculated in the same way as for incarceration (Column H), but substituting I for G.

Results

Findings from the first set of analyses revealed the 10-year lag effect of having invested \$150 million in evidence-based prevention strategies would have been an annual reduction of 1,624 cases of incarceration (a 5% reduction in the total Victorian youth population experiencing any incarceration) and 3,034 cases of intimate partner violence associated with physical assault (a 4% annual reduction across the total Victorian youth population).

The next analysis examined the estimated return on investment achievable through the prevention strategies: Nurse Family Partnerships, Triple P Positive Parenting Program, Tutoring by Peers, and the strategies to reduce alcohol availability, early age and heavy young adult use (Table 4).

Economic gains or losses from each prevention strategy were calculated based on the net benefit (total benefit minus total cost) estimated for each of the six chosen prevention strategies. Overall costs and benefits for each chosen prevention strategy were estimated for the at-risk population covered (Table 4). Overall costs and benefits were calculated as the program cost/benefit per individual multiplied by the number in the population covered. Costs and benefits presented in Table 4 are lifetime costs and benefits per participant, valued in 2016 Australian dollars. Benefits accrued by others (non-taxpayers, victims or the community) were not included.

Prevention Strategy	Cost of the proportion coverage in Column E	Benefits achieved per participant	Total benefits/ gains	ROI=(Total benefits – Total costs)/ Total costs
Nurse Family Partnership	\$34,599,870	\$10,048.87	\$22,442,228	–\$0.35
Triple P Universal	\$34,229,805	\$596.64	\$21,177,433	–\$0.38
Triple P Level 4 groups	\$51,190,177	\$615.14	\$36,934,685	–\$0.28
Secondary School Age Alcohol Supply Reduction	\$13,900,488	n/a	n/a	n/a
Tutoring by Peers	\$9,466,176	\$632.10	\$53,904,614	\$4.69
Brief Alcohol Screening and Intervention for College Students	\$6,188,427	\$5,868	\$206,606,596	\$32.39
Totals	\$149,574,944		\$341,065,556	
Net benefit			\$191,490,612.61	

Note: Adapted from Lee (2016). n/a: These problems are judged independent of the above causes so no discount was added. Column E=Proportion of those at risk with increased cover at given cost in F. ROI=return on investment

The analysis in Table 4 is based on economic costs and benefits reported by Lee (2016) and does not include the returns achievable through the Secondary School Age Alcohol Supply Reduction strategy. In brief, it is conservatively estimated that, based on the implementation of the prevention strategies listed above, the net return on a \$150 million investment in prevention strategies would be \$191 million. The implementation of these prevention strategies is also likely to reduce the non-monetised human suffering (eg the emergence and/or exacerbation of mental health problems) related to the lower number of incarcerations and reduced perpetration of intimate partner violence.

Discussion

This report presents new analyses from the International Youth Development Study, an ongoing longitudinal study of antisocial behaviour in Victorian young people which began in 2002. The analysis was designed to demonstrate the feasibility of combining Australian longitudinal cohort data with prevention strategy investment data to identify investment options to reduce crime versus expenditure on prisons in Australia. Internationally, antisocial behaviours, including violent offences such as causing injury to others and intimate partner violence associated with physical assault, are major health and social issues among adolescents and young adults. As one telling example of the public concern associated with this behaviour, the state of Victoria announced on 18 April 2016 a package of \$572 million in funding over two years in response to recommendations made by the state's Royal Commission into Family Violence. Finding effective ways to prevent both crime and incarceration is essential. Strategies addressing risk and protective factors that influence the development of antisocial behaviours may not only reduce the incidence of these behaviours but also have broader health, social and economic benefits (Hawkins, Catalano & Arthur 2002; Hawkins et al. 2000; Toumbourou et al. 2015).

This project is one of the first studies to use prospective cohort data and estimates of rates and predictors of antisocial behaviour from adolescence to young adulthood to forecast the potential outcomes of prevention strategy investment in Australia.

Previous research has shown that specific risk factors from within the individual, family and school contexts, as well as early age alcohol and drug use, are associated with young adult violent behaviour and incarceration (eg Farrington et al. 2001; Holt, Buckley & Whelan 2008; Jaffe, Lemon & Poisson 2003; Jung et al. 2015; Toumbourou et al. 2013). The findings of this study are consistent with those of the prior research.

The return-on-investment analyses revealed the total 10-year lag effect of having invested \$150 million would have been an annual reduction of 1,624 cases of incarceration (a 5% reduction in the total annual Victorian youth population experiencing any incarceration) and 3,034 cases of intimate partner violence associated with physical assault (a 4% annual reduction across the total Victorian youth population). In addition to these estimated one-year effects, benefits would also be observed in each of the prior nine years and in subsequent years. The prevention strategy investment mix investigated in this report was as follows:

- Nurse Family Partnership for low income families—\$35m;
- Triple P Universal—\$34m;
- Triple P Level 4 groups—\$51m;
- Secondary School Age Alcohol Supply Reduction—\$14m;
- Brief Alcohol Screening and Intervention of College Students in young adults—\$9m; and
- Tutoring by Peers—\$7m.

Projecting from US estimates, the net return from the \$150 million investment in prevention strategies is conservatively estimated at \$191 million.

Comparing the returns of each of the six prevention strategies, it may be attractive to seek efficiencies by dropping strategies such as Nurse Family Partnership, which are costly and contribute to few cases being prevented. The philosophy of this study has been to retain this investment and to calculate whether it may have benefits beyond the crime prevention focus.

The current study has demonstrated that it is feasible to produce the crime prevention investment models shown here. Hence, it is recommended that the prevention strategies investment analysis demonstrated in the present project be further developed as a method for strategically planning crime prevention investment in Australia.

This study has several notable strengths. The longitudinal design and comprehensive measures enabled the examination of a wide range of risk factors from early on in adolescence and their association with young adult engagement in antisocial behaviour. The recruited sample was state-representative at the commencement of the study in 2002, with strong retention over the study period. The survey administration method used from 2002 to 2015 enabled the analysis of risk factors and rates of antisocial behaviour across a 13-year period.

Several study limitations are acknowledged. The measures of antisocial behaviour (eg intimate partner violence and incarceration) are based on self-report data. However, the survey measures have been found to be reliable and valid predictors for use with Victorian adolescents (Hemphill et al. 2011) and the estimated rate of long-term incarceration (1%) was within the range for official Victorian data for 2014 (0.6%).

The estimates for intimate partner violence should be interpreted with caution. The Conflict Tactics Scale (CTS) is valid when compared against other observations of intimate partner violence. However, in over 200 prior studies the CTS has consistently identified higher rates of female reporting of both IPV perpetration and victimisation (Straus & Mickey 2012). The severity of the consequences of IPV are known to be greater for females, who are commonly victims of physically stronger perpetrators (State of Victoria 2016). It is recommended that future analyses using this method investigate separate estimation models for males and females.

Some limitations to the return-on-investment analysis apply. First, the cost and the benefit estimates applied here were adapted from US studies (Lee 2016). The estimates in this report were deliberately calculated to avoid overstating benefits relative to costs. Costs were calculated using the higher figures where more than one estimate was available. Benefits were calculated based on both Australian data and figures reported by Lee (2016), using the lowest estimate. The benefits of SSAASR were excluded due to limited data being available.

A further potential limitation of this analysis is the possibility that diminishing returns may arise as the recommended prevention strategies are more widely implemented. After reflecting on this possibility, it is concluded that the benefits of the proposed level of investment would not be heavily curtailed due to diminishing returns. Firstly, the scale of investment proposed targets less than a third of the population. For example, the highest population coverage would be 30 percent for SSAASR. Secondly, each of the interventions has clearly specified guidelines for effective implementation. Hence, it should be feasible for the government to set performance contracts to guarantee that the modest risk factor reduction targets listed in Column C in Table 3 are measurably achieved to ensure the forecast population reductions in incarceration and intimate partner violence.

Conclusion

Adolescent antisocial behaviour is a significant social and public health issue. The findings of the present study demonstrate there are several modifiable risk factors for antisocial behaviour that could be targeted in early intervention and prevention programs to reduce the developmental pathways that lead to youth perpetration of intimate partner violence and incarceration. The results of the current study demonstrate the importance of targeting effective prevention programs at children and adolescents with family and school-based problems, as well as those who have previously engaged in substance use (including alcohol use) or other antisocial behaviour. The present analysis reveals there is sound data to perform return-on-investment analyses of crime prevention programs in Victoria. It is recommended that the prevention strategy investment analysis demonstrated in the present project be further developed for preventing intimate partner violence, while also reducing incarceration rates.

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