

# BMJ Open Identifying significant contributors for smoking cessation among male prisoners in Australia: results from a randomised clinical trial

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## ABSTRACT

**Introduction** In Australia, an estimated 90% of those entering prison are current tobacco smokers and three-quarters of current prisoners are tobacco smokers.

**Aims** To identify factors and their relative contributions to smoking cessation among male prisoners.

**Methods** A total of 425 male tobacco smokers with a median age of 32 years in Australian prisons. The primary outcome was continuous abstinence at 3, 6 and 12 months. We measured various sociodemographic characteristics, drug use, psychological distress and the mental and physical health status of the participants. Multivariate logistic regression models and population attributable risks (PAR%) were used to identify the significant factors and their contributions to smoking cessation rates.

**Results** The median age of participants was 32 years (IQR 25–41 years). High smoking cessation rates were collectively associated with not using drugs, lower psychological distress, good mental health scores and better physical health (PAR%: 93%, 98% and 88% at 3, 6 and 12 months).

**Conclusion** Our study suggests that not using drugs and being in good mental/physical health are the important contributors to continuous abstinence among prisoners. Thus, effective smoking cessation programmes require a multicomponent approach that includes addressing drug problems and mental health functioning.

**Trial registration number** 12606000229572.

## INTRODUCTION

Smoking is a major public health problem globally and is responsible for approximately 5 million deaths worldwide and 19 000 deaths in Australia annually.<sup>1–4</sup> Nationally, costs associated with tobacco use were estimated to be over \$30 billion.<sup>5</sup> Successful public health campaigns (including bans on indoor smoking in public venues) have contributed to a reduction in smoking rates among the Australian general population from 30% in 1985<sup>3</sup> to 12.2% in 2016.<sup>6</sup> However, this reduction has not been mirrored among marginalised populations including

## Strengths and limitations of this study

- The strengths of the study include data that relate to a large prison sample from a randomised control trial.
- Conducting the study in a prison setting reduced loss to follow-up.
- A limitation of the study is that the data relates to New South Wales and therefore might not be generalisable to international jurisdictions.

prisoners of whom 84% in Australia report being tobacco smokers prior to prison with almost all reporting daily smokers status.<sup>7–9</sup> High rates of tobacco use are observed among key groups over-represented in the criminal justice system such as those with a mental illness (70% men, 60% women),<sup>10</sup> Indigenous people (82%)<sup>11</sup> and injecting drug users (71%).<sup>7</sup> Illicit drug use is particularly high in the prison population (84%) compared with the general population (38%).<sup>6 8 12 13</sup> Compounding the already high rates of tobacco use among disadvantaged groups is they are less likely to access preventive health services in the community such as smoking cessation programmes.<sup>14</sup>

In Australia, prisoners and those with mental health problems have both been independently identified as priority populations for smoking cessation efforts.<sup>15</sup> In an attempt to reduce smoking (firsthand and secondhand) and avoid potential legal action by non-smoking prison staff and prisoners, total smoking bans have been introduced in four states: Northern Territory, Queensland, Victoria and New South Wales,<sup>11</sup> while prisons in South Australia and the Australian Capital Territory will be smoke free in 2 years.<sup>11 16 17</sup> Research into the long-term effectiveness of smoking bans is limited where one study on postrelease in Queensland correctional

facilities reported a 95% relapse within 2 months of release.<sup>18</sup> Similar studies in the USA have reported that total smoking bans alone are ineffective in reducing smoking rates in this population following release from a prison.<sup>19–23</sup>

Thus, 56% of the prisoners started smoking on the day they were released and more than 85% were smoking within 6 months of their release.<sup>24 25</sup> While various factors, including mental health status and illicit drug use, have been associated with smoking, their relative contributions to smoking cessation rates among prisoners may differ from the general population. In order to develop more effective prevention programmes, it is important to understand the degree to which these factors impact on longer term smoking cessation.

The current study was motivated by the complex and potentially multifactorial nature of the associations between smoking cessation behaviour and mental and physical health indicators as well as illicit drug use. Study participants comprised male prisoners recruited into a multicomponent randomised controlled trial (RCT) of an intervention for smoking cessation.<sup>25</sup> This was the first RCT for smoking cessation among men in prison setting; results showed that adding an antidepressant medication such as nortriptyline (NOR) to a smoking cessation treatment package, which included cognitive behavioural and nicotine replacement therapy, did not have a significant impact on long-term abstinence rates. To develop more effective smoking cessation programmes that endure postrelease, there is a need to understand the dynamic interaction between the specific factors and smoking cessation rates in prison setting.

The primary objective of this study was to investigate the factors associated with continuous abstinence at 3, 6 and 12 months. Besides standard statistical techniques, we used a novel statistical approach to estimate the relative contributions of the factors after accounting for their correlated nature in the analysis.<sup>26</sup> Predicted probabilities for short-term and long-term smoking cessation behaviours across the mental and physical health levels were also presented in order to provide guidance to the future smoking cessation research.

While many risk factors have been associated with tobacco smoking, their individual and combined contributions have not been investigated in prisoners. The current study expands and brings greater insight into previous research by identifying the most relevant factors that may impact smoking cessation using data from the first randomised clinical trial among male prisoners.<sup>25</sup> As the number of prisons with 'smoking bans' are increasing both locally and internationally, it is important to identify influential factors that may impact on prisoners' decision to quit smoking. This knowledge will assist the development of effective smoking cessation programmes both in prison and following release back into the community.

## METHODS

### Study design

Data for this analysis come from a randomised controlled trial of a multicomponent smoking cessation intervention conducted among male prisoners in New South Wales (NSW) and Queensland by the authors. The study population has been described elsewhere.<sup>25</sup> Briefly, 425 prisoners were recruited from 18 prisons between August 2006 and September 2009. Participants were assessed at 3, 6 and 12 months following randomisation. Loss to follow-up subjects were treated as continuing smoking. Inclusion criteria in the trial included male sex; age over 18 years; incarcerated for more than 1 month and with at least 6 months of the current sentence remaining; a score of  $\geq 6$  on the Fagerström Test for Nicotine Dependence (indicating moderate/high nicotine dependence)<sup>27</sup>; and a readiness to quit (as determined by the Crittenden criteria).<sup>28</sup> The treatment study group received brief cognitive-behavioural therapy delivered face to face by staff from the NSW Quitline, active NOR, active transdermal patch, a booklet to assist prisoners at times of stress, a quit calendar developed by prisoners and access to the Quitline telephone counselling service. The booklet provided guidance to reinforce abstinence and steps for quitting and was developed to help prisoners stop smoking and maintain permanent abstinence. It includes sections suggesting ways to change daily habits and cope with their recovery symptoms.<sup>25</sup> The control study group received the same intervention; however, they received placebo NOR. In this secondary analysis, since the intervention arm did not show efficacy in smoking cessation, we considered the study population as a whole.

### Ethical considerations

Written consent was required to participate. As part of this process, prisoners were informed that participation was voluntary and that they could withdraw from the study at any time without consequence. Prisoners who experienced side effects during the course of the trial were referred to prison medical services for further assessment.

### Patient and public involvement

Prisoners were involved in the development of the intervention that yielded the data on which this paper is based.

### Measures

#### Demographics

We focused on several factors as potential predictors of continuous abstinence at 3, 6 and 12 months. Age at baseline was divided into four groups (<25 years, 25–29 years, 30–34 and 35+ years); Indigenous status (yes/no); first time in prison (yes/no); times in prison served since the conviction (<5 years vs 5+ years); sharing cell with a smoker (yes/no); and number of cigarettes smoked per day (<20 vs 20+) (prior to attempt to quit).

#### Smoking outcome measures

Prisoners who were current tobacco smokers were recruited to the study. The primary study outcome was

continuous abstinence at 3, 6 and 12 months, which was defined as not smoking from the quit day to any of the specified follow-up periods. Participants who reported any smoking, or whose expired carbon monoxide (CO) levels were 10 parts per million (ppm) or over, were classified as continuing smokers. Current abstinence from smoking was confirmed using a Micro II Smokerlyser (Bedfont scientific Ltd, Kent, UK). A breath CO level of <10ppm indicated that the subject had likely not smoked in the previous 8 hours.

#### Assessment and classification of nicotine dependence, mental and physical health status

Nicotine dependence was assessed using the Fagerström Test for Nicotine Dependence on a scale from 0 to 10; scores of  $\geq 6$  and above indicate moderate to high nicotine dependence.<sup>27</sup> Anxiety and depression were assessed using the Kessler Psychological Distress Scale (K-10).<sup>29</sup> K-10 scores were classified into four groups: no or low psychological distress (score <16), moderate psychological distress (score: 16–21), high psychological distress (score: 22–29) and very high psychological distress (score: 30+). Because, most participants (>70%) scored less than 16, the K-10 score was used as a binary measure: no or low (<16) vs some ( $\geq 16$ ). Physical and mental health functioning were measured using the Short-Form 12 (SF-12).<sup>30</sup> Scores on the SF-12 range from 0 to 100 with higher score indicating better physical and mental health. SF-12 mental and physical health scores were treated as time-dependent variables and split into quartiles: first quartile to fourth quartile indicating poor to excellent levels, respectively.<sup>31</sup> Alcohol consumption before entering prison was measured using the Alcohol

Use Disorders Identification Test with scores of >8 indicating risky alcohol consumption in the year prior to incarceration or not risky ( $\leq 8$ ).<sup>32 33</sup>

#### Statistical analysis

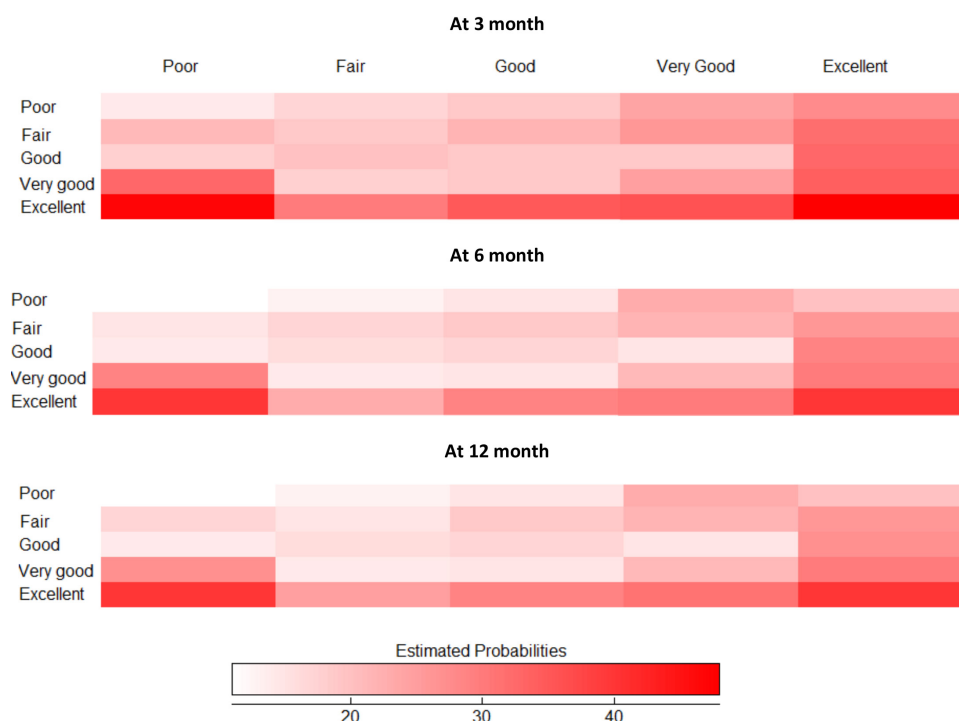
A composite illicit ‘drug score’ was created for each participant by assigning a score of 1 (regular drug use 12 months prior to the incarceration) and 0 (otherwise). Adding these scores allowed us to categorise drug scores into: no drug(s), one drug only, two drugs, three or more drugs; and injecting drug use (IDU) 12 months prior to incarceration (yes/no). We used descriptive statistics (percentages) to describe the study population. Heat maps were used to visualise the data across the study follow-up.

#### Factors associated with smoking cessation

We assessed the associations between factors described above and continuous abstinence rates using univariate/multivariate logistic regression models at 3, 6 and 12 months. We used a forward stepwise approach in order to determine the final multivariate models by including the statistically significant ( $p < 0.05$ ).

#### Population-level impacts of the risk factors

The population attributable risks (PAR%) were calculated to estimate the proportion of smoking cessation cases attributed to the factors identified as significant predictors for continuous abstinence at 3, 6 and 12 months, respectively.<sup>26</sup> Details of this methodology are presented in online supplementary appendix 1. We also estimated the probabilities of quitting across the categories of mental and physical functioning on the SF-12 (poor, fair,



**Figure 1** Estimated probabilities of quit smoking: mental health index (rows)  $\times$  physical health index (columns).

**Table 1** Factors associated with continuous abstinence at months 3, 6 and 12

	At month 3			At month 6		At month 12	
	%	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
<b>Age</b>							
18–24 years	27	1		1		1	
25–29 years	26	0.56 (0.24 to 1.34)	0.195	0.64 (0.24 to 1.72)	0.378	1.31 (0.53 to 3.25)	0.563
30–34 years	23	0.65 (0.26 to 1.60)	0.344	0.84 (0.31 to 2.25)	0.723	0.41 (0.11 to 1.56)	0.192
35+ years	24	1.96 (1.06 to 3.63)	0.032	1.92 (0.95 to 3.89)	0.069	1.54 (0.71 to 3.33)	0.278
<b>Aboriginality status</b>							
Aboriginal	15	1		1		1	
Non-Aboriginal	85	1.42 (0.69 to 2.91)	0.344	2.26 (0.87 to 5.87)	0.095	1.68 (0.64 to 4.41)	0.292
<b>First-time offender</b>							
No	64	1		1		1	
Yes	36	1.56 (0.96 to 2.53)	0.071	1.62 (0.94 to 2.78)	0.081	2.52 (1.38 to 4.57)	0.003
<b>Years since conviction*</b>							
<5 years	82	1		1		1	
5+ years	18	2.54 (1.50 to 4.30)	0.001	2.24 (1.25 to 4.00)	0.007	1.67 (1.44 to 4.96)	0.002
<b>Sharing the cell with a smoker</b>							
No	67	1		1		1	
Yes	33	0.80 (0.47 to 1.33)	0.383	0.64 (0.35 to 1.17)	0.146	0.75 (0.40 to 1.44)	0.389
<b>Attempted to quit past month</b>							
No	87	1		1		1	
Yes	13	2.07 (1.13 to 3.78)	0.018	1.47 (0.73 to 2.96)	0.278	2.02 (0.99 to 4.11)	0.054
<b>Number of cigarettes smoke</b>							
20+ cigarettes	70	1		1		1	
<20 cigarettes	30	1.66 (1.01 to 2.73)	0.045	1.21 (0.68 to 2.14)	0.517	1.52 (0.82 to 2.80)	0.184
<b>Alcohol consumption†</b>							
Risky levels	49	1		1		1	
Not risk levels	51	1.05 (0.65 to 1.69)	0.846	1.03 (0.61 to 1.77)	0.899	1.17 (0.65 to 2.12)	0.595
<b>Regular drugs used‡</b>							
None	25	3.75 (1.92 to 7.34)	<0.001	4.43 (1.98 to 9.90)	<0.001	4.43 (1.71 to 11.49)	0.002
1 drug	25	2.11 (1.04 to 4.27)	0.039	2.25 (0.95 to 5.33)	0.065	3.72 (1.41 to 9.83)	0.008
2 drugs	21	0.82 (0.34 to 1.97)	0.657	1.62 (0.63 to 4.18)	0.315	1.69 (0.55 to 5.20)	0.364
3+ drugs	29	1		1		1	
<b>Injecting drug use‡</b>							
Yes	64	1		1		1	
Never/not regular	44	1.97 (1.22 to 3.19)	0.006	2.15 (1.24 to 3.71)	0.006	2.06 (1.13 to 3.76)	0.019
<b>Dependence score‡</b>							
High	83	1		1		1	
Low	17	1.42 (0.78 to 2.58)	0.246	0.91 (0.44 to 1.89)	0.809	1.66 (0.82 to 3.36)	0.160
<b>Kessler-10*</b>							
High	29	1		1		1	
Low (good)	71	2.92 (1.49 to 5.74)	0.002	5.60 (2.48 to 12.62)	<0.001	5.40 (2.25 to 12.98)	<0.001
<b>Mental score*</b>							
First quartile	25	1		1		1	
Second quartile	27	5.04 (2.07 to 12.31)	<0.001	9.11 (2.64 to 31.42)	<0.001	3.33 (1.15 to 9.61)	0.026
Third quartile	23	3.59 (1.45 to 8.91)	0.006	11.19 (3.20 to 39.05)	<0.001	3.24 (1.14 to 9.73)	0.027

Continued

Table 1 Continued

	%	At month 3		At month 6		At month 12	
		OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Fourth quartile (excellent)	25	6.50 (2.70 to 15.69)	<0.001	5.38 (1.49 to 19.43)	0.010	3.19 (1.10 to 9.31)	0.033
Physical score¶							
First quartile (Poor)	25	1		1		1	
Second quartile	26	0.60 (0.29 to 1.23)	0.160	3.37 (1.35 to 8.41)	0.009	1.52 (0.57 to 4.06)	0.401
Third quartile	25	0.93 (0.48 to 1.81)	0.834	2.82 (1.11 to 7.18)	0.029	2.14 (0.78 to 5.86)	0.138
Fourth quartile (excellent)	24	1.17 (0.61 to 2.25)	0.645	3.20 (1.27 to 8.03)	0.013	3.03 (1.19 to 7.70)	0.020

\*SF-12 mental health: score <40, score 40–45, score 46–50 and score >50.

†12 months prior to the imprison.

‡Time dependent; results further adjusted for age and Aboriginality status.

§SF-12 mental health: score <40, score 40–45, score 46–50 and score >50.

¶SF-12 physical health: score <50, score 50–55, score 56–60 and score >60.

SF-12, Short-Form 12.

good, very good and excellent) at 3, 6 and 12 months and present these graphically (figure 1).<sup>34</sup>

All analyses were performed using Stata V.14.0 and SAS statistical software V. 9.4, and R-Software V.3.13.

## RESULTS

The 425 prisoners who satisfied the inclusion criteria were recruited into the trial. The median age of participants was 32 years (IQR 25–41 years); 15% identified as being of Aboriginal heritage, around two-thirds (64%) had been previously incarcerated and less than 20% had been incarcerated for more than 5 years at the time of interview (table 1). Seventy per cent reported they currently smoked 20+ cigarettes per day; 33% shared a cell with a smoker. In the past 12 months prior to entering prison, nearly half (49%) consumed alcohol at risky levels, and 64% reported a history of injecting drug use (table 1).

### Predictors of continuous abstinence

Compared with the youngest age group (<25 years), those aged 35 years or older were more likely to have quit smoking early in the trial (ie, at 3 months) (OR 1.96, 95% CI 1.06 to 3.63,  $p=0.032$ ) (table 1). Although not statistically significant, older participants (>35 years of age) were more likely to have been continuously abstinent at 6 and 12 months compared with those in the youngest age group (<25 years old) (OR 1.92, 95% CI 0.95 to 3.89,  $p=0.069$ ; and OR 1.54, 95% CI 0.71 to 3.33,  $p=0.278$  respectively). Compared with men who had been previously imprisoned, ‘first time’ prisoners were more likely to be continuously abstinent at 12 months (OR 2.52, 95% CI 1.38 to 4.57,  $p=0.003$ ). Participants who had been in prison for 5 years or longer were more likely than those incarcerated for less than 5 years to be continuously abstained during the study follow-up (OR 2.54, 95% CI 1.50 to 4.30,  $p=0.001$ ; OR 2.24, 95% CI 1.25 to 4.00,  $p=0.007$  and OR 2.67, 95% CI 1.44 to 4.96,  $p=0.002$  at months 3, 6 and 12, respectively). Compared

with those who reported injecting drug use in the 12 months prior to incarceration, non-IDU prisoners were significantly more likely to continuously abstain at months 3, 6 and 12, respectively (adjusted OR (aOR) 1.97, 95% CI 1.22 to 3.19,  $p=0.006$ ; aOR 2.15, 95% CI 1.24 to 3.71,  $p=0.006$ ; and aOR 2.06, 95% CI 1.13 to 3.76,  $p=0.019$ ).

Smoking less than 20 cigarettes per day and attempting to quit at least once in the past month were both associated with abstinence at 3 months (aOR 1.66, 95% CI 1.01 to 2.73,  $p=0.045$ ; aOR 2.07 95% CI 1.13 to 3.78,  $p=0.018$ ) but not at 6 and 12 months.

Lower psychological distress score (ie, K-10 score <16) was associated with an increased odds of smoking cessation at 3, 6 and 12 months compared with those with higher levels of psychological distress (ie, K-10 score  $\geq 16$ ) (OR 2.92, 95% CI 1.49 to 5.74,  $p=0.002$ ; OR 5.60, 95% CI 2.48 to 12.62,  $p<0.001$  at months 3, 6 and 12). Similarly, better mental health and physical health scores based on the SF-12 were associated with higher rates of short-term and longer term continuous abstinence. For example, prisoners with higher mental health scores (ie, second, third and fourth quartiles) had increased odds of being continuous abstinent at 3, 6 and 12 months (aOR 5.09, 95% CI 2.07 to 12.31 (second quartile); aOR 3.59, 95% CI 1.45 to 8.91 (third quartile), aOR 6.50, 95% CI 2.70 to 15.69 (fourth quartile)) compared with those in the lowest mental health quartile. Although not statistically significant at month 3, prisoners with higher SF-12 physical health scores were significantly more likely to be continuously abstinent at 6 and 12 months. Those who reported using fewer or no illicit drugs 12 months prior to incarceration were more likely to be continuously abstinent across all follow-up points compared with those who reported to being illicit drug user (table 1). In the multivariate analysis, longer duration of conviction, not using illicit drugs, lower psychological distress, better mental and physical health status were all significantly associated

**Table 2** Multivariate models only factors  $p < 0.10$  were considered for the multivariate analysis: continuous abstinence at months 3, 6 and 12; adjusted OR and 95% CI

	Multivariate analysis		Multivariate analysis		Multivariate analysis	
	At month 3		At month 6		At month 12	
	aOR (95% CI)	P value	aOR (95% CI)	P value	aOR (95% CI)	P value
Years since conviction						
<5 years	1		1		1	
5+ years	3.20 (1.71 to 6.00)	<0.001	2.60 (1.33 to 5.04)	0.005	2.40 (1.23 to 4.67)	0.01
Kessler-10*						
High (score 16+)	1		1		1	
Low (score <16)	2.08 (1.17 to 3.68)	0.012	3.31 (1.37 to 7.97)	0.008	2.83 (1.19 to 6.72)	0.019
Mental health score†						
First quartile	1		1		1	
Second quartile	8.67 (3.31 to 22.68)	<0.001	5.88 (1.81 to 19.11)	0.003	3.10 (1.11 to 8.63)	0.030
Third quartile	8.51 (3.10 to 23.41)	<0.001	5.77 (1.81 to 18.42)	0.003	4.11 (1.49 to 11.38)	0.006
Fourth quartile	10.23 (4.10 to 25.72)	<0.001	6.39 (2.00 to 20.54)	0.002	4.25 (1.53 to 11.80)	0.006
Physical health score‡						
First quartile	1		1		1	
Second quartile	0.64 (0.27,1.53)	0.314	3.02 (1.14 to 8.00)	0.026	1.53 (0.58 to 3.97)	0.391
Third quartile	1.10 (0.50 to 2.35)	0.842	2.57 (0.95 to 6.96)	0.063	2.21 (0.80 to 6.11)	0.127
Fourth quartile	2.43 (1.07 to 5.06)	0.033	3.64 (1.35 to 9.83)	0.011	4.47 (1.78 to 11.25)	0.001
Total drugs used §						
None	3.83 (1.84,8.00)	<0.001	4.44 (1.86 to 10.63)	0.001	4.91 (1.80 to 13.38)	0.002
1 drug	2.20 (1.03 to 4.72)	0.043	2.02 (0.81 to 5.03)	0.130	4.42 (1.58 to 12.37)	0.005
2 drugs	0.71 (0.28 to 1.80)	0.465	1.83 (0.67,5.01)	0.239	1.80 (0.56 to 5.78)	0.326
3+ drugs	1		1		1	

\*time dependent; results further adjusted for age and aboriginality status

†SF-12 mental health: score <40, score 40–45, score 46–50 and score >50.

‡SF-12 physical health: score <50, score 50–55, score 56–60 and score >60.

§12 months prior to imprisonment.

SF-12, Short-Form 12.

with increased odds of being continuously abstinent at 3, 6 and 12 months (table 2).

#### Population-level contributions of factors on smoking cessation rates

In this analysis, we estimated the relative contributions of the factors identified in our multivariate models (see table 3). There was an association between better mental and physical health and higher smoking cessation rates. Higher mental health functioning (fourth quartile SF-12 score) was associated with PAR%: 84% (95% CI 79% to 88%) and PAR%: 80% (95% CI 70% to 87%) of continuous abstinence cases at 3 months and 6 months, respectively. High ORs from the multivariate logistic regression models were responsible for this large impact. Their combined impact was somehow lower at 12 months (PAR%: 65%, 95% CI 52% to 70%). These results were consistent with psychological distress with lower scores (ie, no/low psychological distress) associated with continuous abstinence, at 6 and 12 months (64% and 61%,

respectively). Better physical functioning was identified as the second most important factor associated with smoking cessation rates, particularly at 6 months and 12 months (61% and 55%, respectively). Never or non-regular illicit drug use in the 12 months prior to incarceration was associated with 36%, 34% and 25% of the all continuous abstinence at 3, 6 and 12 months, respectively. After adjusting for non-modifiable factors such as age and Aboriginal status, these four factors were collectively associated with >90% (at months 3 and 6) and 88% (at 12 months) of the continuous abstinence.

#### Mental and physical health status and smoking cessation probabilities

Prisoners with better mental and physical health scores were significantly more likely to be continuously abstinent in the short term (at 3 month) and longer term (at 12 month) (figure 1). Those with better mental health (ie, higher SF-12 mental health scores – excellent category) were more likely to be abstinent regardless of their

**Table 3** Population level impacts of demographic and sociomental and physical health indicators associations on continuous abstinence

	At month 3 PAR% (95% CI)	At month 6 PAR% (95% CI)	At month 12 PAR% (95% CI)
<b>Kessler-10*</b>			
None (excellent) versus moderate/high/very high	34% (34% to 46%)	64% (50% to 76%)	61% (46% to 74%)
<b>Mental Health Score (SF-12)*</b>			
Fourth quartile (excellent) versus first, second, third quartiles (others)	84% (79% to 88%)	80% (70% to 87%)	65% (52% to 70%)
<b>Physical Health Score (SF-12)†</b>			
Fourth quartile (excellent) versus first, second, third quartiles (others)	14% (5% to 35%)	61% (47% to 75%)	55% (40% to 69%)
<b>Total illicit drugs used‡</b>			
No drugs versus 1+ drug(s)	36% (27% to 46%)	34% (25% to 45%)	25% (17% to 35%)
<b>Combined impact of modifiable factors</b>			
<b>Scenario 1</b>			
Kessler-10 (excellent) +mental health score (excellent)	90% (83% to 96%)	92% (86% to 95%)	75% (64% to 83%)
<b>Scenario 2</b>			
Anxiety/depression (excellent) +mental Health score (excellent) +physical health score (excellent) +no illicit drugs	93% (92% to 97%)	98% (96% to 99%)	88% (83% to 92%)

\*SF-12 mental health: score <40, score 40–45, score 46–50 and score >50.

†SF-12 physical health: score <50, score 50–55, score 56–60 and score >60.

‡12 months prior to the imprisonment.

SF-12, Short-Form 12.

physical health score. The probability of being continuously abstinent at 3 months was estimated as 10%–15% among those who had poor mental health and physical health, increasing to 40%–45% for those with excellent mental health but poor physical health.

## DISCUSSION

Our study highlights that prisoners with better mental health functioning and lower psychological distress are more likely to be continuously abstinent postrelease. We identified five factors (low psychological distress, better mental and physical health scores and none/low illicit drug use in the 12 months prior to prison) as significant correlates of continuous abstinence at 3, 6 and 12 months.

After adjusting for non-modifiable/background factors such as age, Aboriginal status and time served in prison, more than 80% of the continuous abstinence rates were exclusively associated with those who had better mental health during the study follow-up period. Lower levels of psychological distress were attributed to 34%, 64% and 61% of the all continuous abstinence cases at 3, 6 and 12 months, respectively. More than 90% of continuous abstinence cases were exclusively associated with these two factors at 3 and 6 months, while it declined to 75% at 12 months. High ORs (ranged from 5.77 to 10.23) and prevalences (approximately 25%) were responsible for

this significant impact at 3 and 6 months. The combined contributions of these two factors increased to 93%, 98% and 88% at 3, 6 and 12 months when the other two factors, that is, not using illicit drugs prior to prison and better physical functioning, were included in the models. These relatively small changes were primarily due to the correlated nature of these factors indicating that those who had one or more of these conditions might also be likely to also have the others. For example, individuals who had lower psychological distress and better mental health functioning were also less likely to be using illicit drugs and vice versa. The importance of mental health was further reinforced in our ancillary visual assessment using heat maps (figure 1) where better mental health scores were consistently associated with higher smoking cessation probabilities regardless of individuals' physical health status.

Results from our risk factor analysis are consistent with the published literature in finding tobacco use among people with poor mental health.<sup>35–37</sup> High rates of psychological distress and mental health problems are reported among smokers in the general population compared with non-smokers.<sup>38,39</sup> Unsuccessful quitters are also identified as having high levels of psychological distress compared with other groups.<sup>40,41</sup>



Although our risk factor analysis is broadly consistent with the published literature, the relative contributions of these factors are a novel finding of our study. Results from our analysis highlight the prisoners with no or low psychological stress and better mental health functioning are more likely to quit and stay abstinent compared with those with higher levels of psychological distress and mental and physical issues.

This raises questions about how to alleviate this distress, particularly during incarceration. It also raises questions of whether a 'smoking cessation maintenance package' would be useful and whether there is benefit in talking more to those who have quit successfully about their strategies. Taken in a broader public health context, the opportunity provided by incarceration to promote smoking cessation both in prison and following release back to the community should be optimised.<sup>42</sup> This should include the development of tailored interventions that are cognisant of mental health status of this population. While smoking bans in prison aim to reduce smoking to zero, evidence suggests this has not been the case,<sup>23 43–45</sup> and many continue to smoke tobacco or tobacco substitutes.<sup>43 44 46</sup> Furthermore, a longer time horizon should be taken by public health planners that goes beyond the incarceration period and continues into the community to have an individual benefit and benefits society in terms of reduced health costs from the harms caused by tobacco smoking. Such programmes would be useful as part of the prerelease planning for prisoners.

## LIMITATIONS

Our study has several limitations. Because study participants were mostly recruited from the same state, we cannot rule out a potential selection bias. However, broad characteristics of the study population were similar to the overall prisoner population in New South Wales. Therefore, our results are likely to be generalisable to other states both within Australia and internationally. However, since our study was restricted to the male prisoners only, results cannot be generalised to female prisoners. The trial targeted men as they comprise over 95% of the prisoner population. However, future studies could include women.

## CONCLUSION

There is a general acceptance of the need for smoking cessation programmes in the prison setting, but these need to consider mental health status. While cessation is the first step, these programmes need to consider how to maintain abstinence in the postrelease period. Our findings suggest that interventions to support smoking cessation take into account mental and physical health needs.

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**Patient and public involvement** Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

**Patient consent for publication** Not required.

**Ethics approval** This research was approved by the Human Research Ethics Committees of the University of New South Wales (HREC05044), Justice Health NSW (GEN 4/05), the NSW Department of Corrective Services (05/0881), the Aboriginal Health and Medical Research Council of NSW (664/08) and the Queensland Corrective Services Research Committee (NA).

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**Data availability statement** No data are available. Given the sensitive nature of the study (ie, prison population), the ethics committee will not permit the release of data.

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