Dual diagnosis of mental illness and substance use disorder and injury in adults recently released from prison: a prospective cohort study

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Summary

Background People with mental illness and substance use disorder are over-represented in prisons. Injury-related mortality is elevated in people released from prison, and both mental illness and substance use disorder are risk factors for injury. Effective care coordination during the transition between criminal justice and community service providers improves health outcomes for people released from prison. However, the health outcomes and support needs of people with dual diagnosis (co-occurring mental illness and substance use disorder) released from prison are poorly understood. Here we aim to examine the association between dual diagnosis and non-fatal injury in adults released from prison.

Methods Pre-release interview data collected between Aug 1, 2008, and July 31, 2010, from a representative sample of sentenced adults (≥18 years) in Queensland, Australia, were linked, retrospectively and prospectively, to person-level, state-wide emergency department and hospital records. We identified dual diagnoses from inpatient, emergency department, and prison medical records. We modelled the association between mental health status and all injury resulting in hospital contact by fitting a multivariate Cox regression, adjusting for sociodemographic, health, and criminogenic covariates, and replacing missing covariate data by multiple imputation.

Findings In 1307 adults released from prison, there were 2056 person-years of follow-up (median 495 days, IQR 163–958). The crude injury rates were 996 (95% CI 893–1112) per 1000 person-years for the dual diagnosis group, 538 (441–657) per 1000 person-years for the mental illness only group, 413 (354–482) per 1000 person-years for the substance use disorder only group, and 275 (247–307) per 1000 person-years for the no mental disorder group. After adjusting for model covariates, the dual diagnosis (adjusted hazard rate ratio 3·27, 95% CI 2·30–4·64; p<0·0001) and mental illness only (1·87, 1·19–2·95; p=0·0071) groups were at increased risk of injury after release from prison compared with the group with no mental health disorders.

Interpretation People released from prison experience high rates of injury compared with the general population. Among people released from prison, dual diagnosis is associated with an increased risk of injury. Contact with the criminal justice system is a key opportunity to prevent subsequent injury morbidity in people with co-occurring mental health disorders. Engagement with integrated psychiatric and addiction treatment delivered without interruption during the transition from prison into the community might prevent the injury-related disparities experienced by this vulnerable group. The development of targeted injury prevention strategies for people with dual diagnosis released from prison is warranted.

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Introduction

Injury is a major cause of death and morbidity globally.[1,2] In Australia, injury accounts for 9% of the total health burden[3] and is the principal diagnosis in 25·2% of all emergency department presentations[4] and 6·4% of all hospital admissions,[5] representing substantial public expenditure. Although the rate of injury-related mortality is elevated in people recently released from prison,[6] non-fatal injury requiring hospital contact is more common than fatal injury and carries a risk of enduring morbidity.[7] However, studies of non-fatal injury in people released

from prison are scarce and have mostly been restricted to non-fatal overdose[8] and self-harm.[9]

Mental illness and substance use disorder are the leading causes of non-fatal burden of disease globally,[10] and are risk factors for injury.[11] Determinants of social exclusion such as homelessness, unemployment, and multimorbidity have been shown to interact and exacerbate the risk of injury mortality among people who experience incarceration.[12] The co-occurrence of mental illness and substance use disorder is often described as dual diagnosis.[13] The prevalence of dual diagnosis is high

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Research in context

Evidence before this study

We did a title and abstract search of PubMed for papers published up to Nov 30, 2017, using the following search terms: prison* OR ex-prison* OR offend* OR jail OR gaol OR custod* AND injur* OR accident* OR assault* OR self-harm* OR "self harm*" OR overdos* OR poison* OR hospital* OR emergenc* OR trauma* OR fracture* OR wound* OR burn* OR "toxic effects" AND "dual diagnos*" OR co-occur* OR comorbid*. Our search yielded 115 results. After removing duplicates, 114 potential articles were identified. We excluded articles that were not peer-reviewed (n=1), were not written in English (n=8), did not examine the relationship between dual diagnosis (co-occurring mental illness and substance use disorder) and injury (n=42), and were not conducted in adults released from prison (n=63). After full-text screening, no study fulfilled our inclusion criteria. Two prior studies have examined the association between dual diagnosis and a history of suicide attempts or ideation in adults in prison. These studies had no specific focus on injury or outcomes after release from prison. Three prior studies have investigated the relationship between dual diagnosis and emergency department presentation or hospitalisation in adults released from prison. However, none of these studies disaggregated by cause of the hospital contact. Our literature search indicated that no study has explicitly investigated the relationship between dual diagnosis and injury in adults released from prison and, thus, it remains poorly understood.

Added value of this study

To our knowledge, this is the first study to investigate the association between dual diagnosis and injury in a representative sample of adults released from prison. Using a unique combination of baseline survey, prison medical records, and person-level, prospectively linked administrative data, we have shown that adults released from prison are at high risk of injury. Compared with those without a mental health disorder, we found that people with dual diagnosis had a three-times higher risk of injury, with a rate of injury resulting in hospital admission that is 12 times higher than in the general population. Importantly, our study provides evidence that adults with dual diagnosis are disproportionately at risk of drug-related injury within the first 30 days after release from prison, accounting for eight out of ten drug-related injuries in our cohort within this period. However, we also found that the burden of preventable injury after release from prison is principally due to causes other than drug overdose, even in adults with substance use disorder or dual diagnosis. Furthermore, our findings provide evidence that people released from prison with dual diagnosis might be at risk of more severe injuries compared with those with mental illness only, substance use disorder only, or no mental disorder.

Implications of all the available evidence

Our findings show the extent and the time-dependent risk of injury in adults released from prison and highlight the disproportionate risk of injury in adults with dual diagnosis in an already highly marginalised population. Our results can be used to target scarce clinical resources to those at greatest risk of injury, and in time periods when this risk is greatest, after release from prison. Furthermore, our findings indicate a need for systemic changes to ensure greater continuity of care between forensic and community services, and foster deeper integration between mental health and addiction services.

among people in prison, ranging from 18% to 56%.[14,15] When compared with people with mental illness only, substance use disorder only, or those without any mental disorder, a dual diagnosis has been associated with increased risk of suicidal ideation, suicide attempts, interpersonal violence, hospitalisation, traumatic brain injury, poorer treatment outcomes, criminal justice system involvement, and premature death.[16,17] Evidence suggests that mental disorders are common causes of hospitalisation following release from prison.[18] An Australian data-linkage study[19] found that mental disorders and injury were the two most prevalent causes of hospital admission after release from prison, and accounted for most bed-days and total costs.

Recently, National Institute for Health and Care Excellence (NICE) guidelines in the UK have highlighted the profound scarcity of evidence on the physical health and support needs of people with dual diagnosis in the criminal justice system, and how this impedes effective care coordination during the transition between criminal justice and community service providers.[20,21] Improved understanding of the clinical needs of people with dual diagnosis released from prison is therefore a key research priority.[22] However, the relationship between dual diagnosis and injury in people released from prison remains poorly understood.

In a large, representative cohort of adults released from prison in Queensland, Australia, we aimed to determine three key things: (1) the association between dual diagnosis and injury; (2) rates of drug-related and other-cause injury over time and by mental health status; and (3) the clinical characteristics of hospital contacts for injury.

Methods

Study population

We used cohort data from the Passports study,[23] a randomised controlled trial of a service brokerage intervention for people released from prison. The sample is representative of adults released from prison in Queensland in terms of demographic and criminal justice variables, except that women were intentionally over-sampled to increase power for sex-stratified analyses.[23]

Briefly, 1325 sentenced adult (≥18 years) prisoners were administered a baseline interview within 6 weeks of their expected release from one of seven prisons in Queensland between Aug 1, 2008, and July 31, 2010.

The prison sentence during which participants were recruited is hereafter referred to as the index prison sentence. Informed, written consent was obtained from all participants.

The study was approved by the University of Queensland Behavioural and Social Sciences Ethical Review Committee (#2007000607), Queensland Health Human Research Ethics Committee (HREC/11/QHC/40), and Australian Institute of Health and Welfare Ethics Committee (EC2012/4/58).

Baseline measures

Self-report measures at baseline included sex; age; Indigenous status; relationship status (stable or unstable); years of school completed (<10 or ≥10); social visits in prison in the past month (none or at least one); participation in transitional programmes such as brief financial, health-care, or employment case management prior to release from prison (yes or no); pre-incarceration accommodation (stable or unstable); pre-incarceration employment status (employed or unemployed); and history of juvenile detention (yes or no).

Validated screening tools administered at baseline included the Hayes Ability Screening Index[24] for identification of probable intellectual disability; the Kessler Psychological Distress Scale (K10)[25] for predicting severe mental illness; the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST)[26] for ascertaining harmful substance use; the Patient Activation Measure (PAM)[27] for measuring capacity to self-manage health care; the Enriched Social Support Inventory[28] to quantify perceived social support; and the Short-Form 36 Health Survey version 2 (SF-36v2),[29] from which we derived the physical component summary (PCS) score, a standardised measure of physical health-related functioning and quality of life. Further detail on measures is provided in the appendix (p 1).

Health records

Prison medical records were coded by two trained graduate researchers using the International Classification of Primary Care, second edition (ICPC-2),[30] which codes for problems and diagnoses managed, date of contact, and type of health professional seen.

Baseline data were probabilistically linked, retrospectively and prospectively, to person-level, state-wide emergency department and hospital records. Variables obtained from emergency department records included International Classification of Diseases, 10th edition, Australian Modification (ICD-10-AM)[31] diagnosis code (representing the principal discharge diagnosis), triage category,[32] time and date of emergency department arrival and departure, departure destination, and departure status. Length of stay was calculated as the total time between arrival and departure timestamps. Variables obtained from hospital records included primary and secondary diagnoses (up to 20 were coded),

external cause of morbidity ICD-10-AM codes, dates of admission and discharge, and number of hospital bed-days.

From deterministic linkage with correctional records, we obtained data on prior adult prison sentences (first or repeat), length of index prison sentence (<90 days, 90–365 days, or >365 days), parole on release (yes or no), risk of re-offending score (from a screening tool administered by corrections), and dates of reincarceration during follow-up. Deaths during follow-up were identified through probabilistic linkage with the National Death Index.

Emergency department records were linked from June 1, 2002, to July 31, 2012, and hospital records were linked from July 1, 1999, to July 31, 2012; the starting dates were chosen on the basis of when data from these sources began to be recorded in a consistent and robust manner. Correctional records included all prison admissions and releases from Sept 1, 2008, to Dec 31, 2013. Death records were linked from the date of index prison release to May 31, 2013. Follow-up was censored at July 31, 2012, to ensure complete coverage of all data sources.

For the observation period prior to, and time spent in prison during the index prison sentence, we used ICD-10-AM codes to identify emergency department presentations and hospital admissions in which mental illness (F01–09 and F20–99) or a substance use disorder (F10–19) was recorded as a primary or secondary diagnosis.[31] Diagnoses of both mental illness and substance use disorder in the same hospital admission or emergency department presentations for mental illness and substance use disorder, respectively, were considered evidence of dual diagnosis.

We used ICPC-2 codes to identify prison health service contacts in which a general practitioner, psychologist, or psychiatrist had made a diagnosis of mental illness (P70–76, P79–82, P86–98, and P99) or substance use disorder (P15, P18, and P19).[30] A diagnosis of both mental illness and substance use disorder during the index prison sentence was considered evidence of dual diagnosis.

We aggregated pre-release ICD-10-AM diagnoses and ICPC-2 diagnoses in prison to create a composite exposure variable with exclusive categories for no mental disorder, substance use disorder only, mental illness only, and dual diagnosis.

We ascertained prescribed and illicit drug-related poisoning events from emergency department diagnoses and from primary and secondary hospital diagnoses (appendix p 3). We categorised the body region and nature of injury using the Barell Injury Diagnosis Matrix[33] (appendix p 4). We identified traumatic brain injury using a standard set of ICD-10-AM codes (appendix p 5). We ascertained external cause of injury codes (V00–36) for each injury-related hospital admission according to ICD-10-AM subchapter groupings (appendix p 6).[5]

	No mental disorder (n=617)	Substance use disorder only (n=314)	Mental illness only (n=99)	Dual diagnosis (n=277)	All participants (n=1307)	p value*
Sex	..	..	..	..	..	<0·0001
Male	525 (85%)	236 (75%)	69 (70%)	200 (72%)	1030 (79%)	..
Female	92 (15%)	78 (25%)	30 (30%)	77 (28%)	277 (21%)	..
Age, years	33·5 (12·8)	31·6 (8·9)	35·5 (11·5)	31·1 (7·9)	32·7 (11·0)	0·0004†
Indigenous status	..	..	..	..	..	<0·0001
Non-Indigenous	478 (77%)	204 (65%)	83 (84%)	211 (76%)	976 (75%)	..
Indigenous	139 (23%)	110 (35%)	16 (16%)	66 (24%)	331 (25%)	..
Stable relationship at baseline	..	..	..	..	..	0·0469
No	335/611 (55%)	186/312 (60%)	58/98 (59%)	178/275 (65%)	757/1296 (58%)	..
Yes	276/611 (45%)	126/312 (40%)	40/98 (41%)	97/275 (35%)	539/1296 (42%)	..
Years of school completed	..	..	..	..	..	0·1076
≥10	367/616 (60%)	164/313 (52%)	60/98 (61%)	149/276 (54%)	740/1303 (57%)	..
<10	249/616 (40%)	149/313 (48%)	38/98 (39%)	127/276 (46%)	563/1303 (43%)	..
Accommodation at baseline	..	..	..	..	..	0·0021
Unstable	82/614 (13%)	64/311 (21%)	13 (13%)	61 (22%)	220/1301 (17%)	..
Stable	532/614 (87%)	247/311 (79%)	86 (87%)	216 (78%)	1081/1301 (83·1%)	..
Employment status at baseline	..	..	..	..	..	<0·0001
Unemployed	251 (41%)	185 (59%)	45 (45%)	163/276 (59%)	644/1306 (49%)	..
Employed	366 (59%)	129 (41%)	54 (55%)	113/276 (41%)	662/1306 (51%)	..
Social visits in the past month in prison	..	..	..	..	..	0·0002
None	292 (47%)	180 (57%)	57 (58%)	172 (62%)	701 (54%)	..
One or more	325 (53%)	134 (43%)	42 (42%)	105 (38%)	606 (46%)	..
Participation in transitional programmes	..	..	..	..	..	0·2351
No	488/616 (79·2%)	261 (83%)	74 (75%)	226 (82%)	1049/1306 (80%)	..
Yes	128/616 (20·8%)	53 (17%)	25 (25%)	51 (18%)	257/1306 (20%)	..
Intellectual disability	..	..	..	..	..	0·9187
No	548/598 (92%)	280/308 (91%)	87/97 (90%)	246/271 (91%)	1161/1274 (91%)	..
Yes	50/598 (8%)	28/308 (9%)	10/97 (10%)	25/271 (9%)	113/1274 (9%)	..
K10 psychological distress	..	..	..	..	..	<0·0001
Low–moderate	498/613 (81%)	233/313 (74%)	55 (56%)	177 (64%)	963/1302 (74%)	..
High–very high	115/613 (19%)	80/313 (26%)	44 (44%)	100 (36%)	339/1302 (26%)	..
ASSIST risk of harmful substance use						
Alcohol	..	..	..	..	..	0·0039
Low	371/616 (60%)	177/312 (57%)	66 (67%)	136 (49%)	750/1304 (58%)	..
Moderate–high	245/616 (40%)	135/312 (43%)	33 (33%)	141 (51%)	554/1304 (42%)	..
Methamphetamine	..	..	..	..	..	<0·0001
Low	446/616 (72%)	148/313 (47%)	75 (76%)	135 (49%)	804/1305 (62%)	..
Moderate–high	170/616 (28%)	168/313 (53%)	24 (24%)	142 (51%)	501/1305 (38%)	..
Heroin	..	..	..	..	..	<0·0001
Low	577/616 (93·7%)	209/313 (66·8%)	93 (94·0%)	193/276 (70%)	1072/1304 (82%)	..
Moderate–high	39/616 (6·3%)	104/313 (33·2%)	6 (6·1%)	83/276 (30%)	232/1304 (18%)	..
PAM activation score	69·7 (17·9)	66·1 (16·9)	68·2 (16·7)	64·8 (16·4)	67·7 (17·4)	0·0003†
Enriched Social Support Inventory	24·2 (6·1)	23·3 (6·4)	22·3 (7·2)	21·9 (7·2)	23·3 (6·6)	<0·0001†
SF36v2–PCS score	54·4 (8·9)	53·8 (9·3)	51·7 (11·1)	54·6 (9·2)	54·1 (9·3)	0·0398†
Juvenile detention history	..	..	..	..	..	<0·0001
No	470/611 (76·9%)	203/312 (65%)	75/98 (77%)	185/273 (67·8%)	933/1294 (72%)	..
Yes	141/611 (23·1%)	109/312 (35%)	23/98 (23%)	88/273 (32·2%)	361/1294 (28%)	..
					(Table 1 continues on next page)	

	No mental disorder (n=617)	Substance use disorder only (n=314)	Mental illness only (n=99)	Dual diagnosis (n=277)	All participants (n=1307)	p value*
(Continued from previous page)						
Adult prison sentence	..	..	..	..	..	<0·0001
First	273/616 (44%)	54/313 (17%)	47 (47%)	44/276 (16%)	418/1304 (32%)	..
Repeat	343/616 (55·7%)	259/313 (83%)	52 (53%)	232/276 (84%)	886/1304 (68%)	..
Length of index prison sentence	..	..	..	..	..	0·0975
>365 days	143/615 (23%)	50/311 (16%)	22 (22%)	50/275 (18%)	265/1300 (20%)	..
90–365 days	311/615 (51%)	157/311 (51%)	52 (53%)	147/275 (53%)	667/1300 (51%)	..
<90 days	161/615 (26%)	104/311 (33%)	25 (25%)	78/275 (28%)	368/1300 (28%)	..
Released on parole	..	..	..	..	..	0·0422
No	411 (67%)	181 (58%)	63 (64%)	167 (60%)	822 (63%)	..
Yes	206 (33%)	133 (42%)	36 (36%)	110 (40%)	485 (37%)	..
Risk of reoffending score	9·7 (6·1)	13·3 (4·9)	9·9 (6·4)	13·1 (5·1)	11·3 (6·1)	<0·0001†
Passports intervention	..	..	..	..	..	0·0529
No	319 (52%)	165 (53%)	51 (52%)	118 (43%)	653 (50%)	..
Yes	298 (48%)	149 (47%)	48 (48%)	159 (57%)	654 (50%)	..

Data are n (%), n/N (%), and mean (SD). ASSIST=Alcohol, Smoking And Substance Involvement Screening Test. K10=Kessler 10. PAM=Patient Activation Measure. PCS=physical component summary. SF-36v2=Short form health survey, version 2. *By Pearson χ² test. †By unadjusted linear regression.

Table 1: Cohort characteristics by pre-release mental health exposure group

Outcomes

The primary outcome was hospital contact (ie, emergency department presentation or hospital admission) for all injury (ICD-10-AM codes S00–99, T00–79, and T89) after release from prison. We included all emergency department presentations with external cause of injury ICD-10-AM codes, and injuries from both principal and secondary diagnoses in hospital records in our definition of injury. Further information regarding our definition of injury is provided in the appendix (p 1).

Statistical analyses

We compared crude differences between mental health exposure groups at baseline using χ² tests for categorical measures and unadjusted linear regression for continuous measures.

We calculated crude incidence rates of injury during all follow-up and piecewise for 0–30 days, 31–90 days, 91–180 days, 181–365 days, and 1–2 years after release from prison, separately for each mental health exposure group. Time at risk started on the date the participant was released from their index prison sentence and was censored at reincarceration, date of death, or the last day of the study observation period, whichever occurred first.

We modelled the association between pre-release mental health status and recurrent injury by fitting a multivariate Cox regression using the Andersen-Gill model,[34] an extension that accommodates multiple event data. We modelled the underlying distribution by fitting a flexible parametric survival model.[35] Models were adjusted for sex, age, Indigenous status, years of school completed, relationship status, accommodation, employment status, participation in transitional programmes, intellectual disability, K10 score, ASSIST scores (for alcohol, methamphetamine, and heroin), PAM score, SF-36v2 PCS score, history of juvenile detention, prior adult incarceration, duration of index prison sentence, parole on release, risk of reoffending score, and receipt of the Passports intervention.[23] To compare the risk of drug-related poisonings versus all other injury, we plotted the predicted hazard rates over time separately, stratified by mental health exposure group.

We replaced missing covariate data by multiple imputation (with 100 imputed datasets) using multivariate chained equations.[36] We did sensitivity analyses to examine assumptions made in ascertaining our outcome and to investigate the possibility of informative censoring (see appendix pp 1–2 for further details).

We did all analyses using STATA version 14.2.

Role of the funding source

The funder of the study had no additional role in the research design; data collection, analysis, or interpretation; the writing of the manuscript; or the decision to submit the article for publication. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.
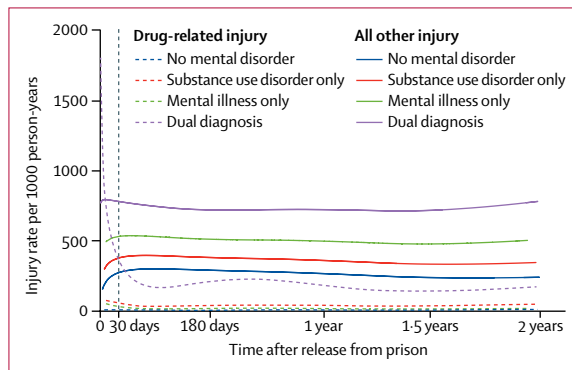
Results

1307 (99%) of the 1325 participants were included in analyses after excluding data from eight participants who were not released from prison during the study period
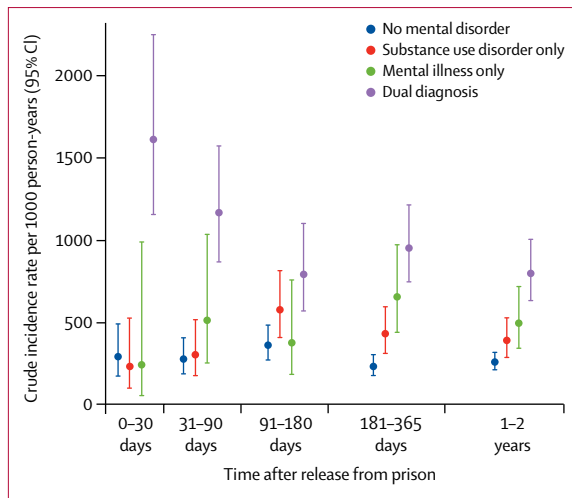
Figure 1: Piecewise incidence rate of injury within 2 years of release from prison by mental health exposure group

Figure 2: Predicted injury rate per 1000 person-years after release from prison, according to type of injury (drug-related vs all other) and mental health exposure group

and ten who were not linked to administrative health records.

Most of the cohort was male and a quarter identified as Indigenous (table 1). Overall, 277 (21%) participants had dual diagnosis, 99 (8%) had mental illness only, 314 (24%) had substance use disorder only, and 617 (47%) had no recent history of a diagnosed mental disorder. Mental disorder diagnoses are displayed by ICD-10-AM chapter and mental health exposure status in the appendix (p 7). 591 (45%) participants had a substance use disorder and the most common diagnosis was polydrug use and other psychoactive substance disorders (363 [28%] participants). The most common mental illness diagnoses were neurotic, stress-related, and somatoform disorders (175 [13%] participants); mood disorders (163 [12%] participants); and schizophrenia, schizotypal, and delusional disorders (135 [10%] participants; appendix p 7).

A principal diagnosis of injury was the leading cause of emergency department presentation (680 [31%] of 2173 presentations) and hospital admission

(199 [24%] of 819 admissions), and accounted for the largest and second largest proportion of emergency department hours (3524 [35%] of 10 052 h) and hospital bed-days (678 [24%] of 2784 days), respectively. Mental disorders accounted for the largest proportion of hospital bed-days (732 [26%] of 2784 days).

There were 2056 person-years of follow-up, with a median of 495 days (IQR 163–958). In total, 407 (31%) individuals had 898 injuries resulting in hospital contact during follow-up, giving a crude incidence rate of 436 injuries (95% CI 408–466) per 1000 person-years. The crude injury rates per 1000 person-years for each exposure group were 996 injuries (893–1112) for the dual diagnosis group, 538 (441–657) for the mental illness only group, 413 (354–482) for the substance use disorder only group, and 275 (247–307) for participants with no mental disorder. Overall, the rate of hospital admission for injury (ie, excluding emergency department presentations) was 97 injuries per 1000 person-years (95% CI 85–111). The rate of hospital admission for the dual diagnosis group was 263 injuries per 1000 person-years (214–323).

Overall, 111 (12%) injury events were drug related. The crude incidence of drug-related injury (ie, drug-related poisonings) was 54 injuries (95% CI 45–65) per 1000 person-years compared with 383 injuries (356–411) per 1000 person-years from all other causes. Piecewise incidence rates within 2 years of release from prison show that in the first 30 days after release, the rate of drug-related injury for the dual diagnosis group (1615 injuries per 1000 person-years, 95% CI 1160–2250) was significantly higher than for all other exposure groups (p=0·0010 for mental illness only and p<0·0001 for substance use disorder only and for no mental disorder; figure 1). After 30 days of release from prison (ie, from 31 days to 2 years after release) in the dual diagnosis group, the rate of drug-related injury decreased to 199 (154–257) per 1000 person-years compared with 752 (660–858) per 1000 person-years for injury from all other causes (figure 2). Drug-related injury accounted for 11% (91 of 840 events) of all injury events after 30 days of release from prison. Over the entire follow-up period, the rate of drug-related injury was 738 events (452–1205) per 1000 person-years compared with 877 injuries (559–1374) from all other causes per 1000 person-years for the dual diagnosis group.

Compared with all other mental health exposure groups, the dual diagnosis group had increased rates of drug-related injury during follow-up that peaked immediately upon release and declined quickly thereafter to plateau at around 45 days post release (figure 2). By contrast, the rate of injury from all other causes was consistently elevated within 2 years of release (figure 2).

After adjusting for covariate effects, the dual diagnosis and mental illness only groups were at increased risk of injury after release from prison compared with the no mental disorder group (table 2). The median survival

time to first injury event was 246 days (IQR 73–522) for the dual diagnosis group, 453 days (226–840) for the mental illness only group, 575 days (261–1213) for the substance use disorder only group, and 929 days (368–not reached) for the no mental disorder group. Being younger at release, released from an index sentence of less than 90 days, and poorer physical health (as measured by PCS) prior to release from custody predicted increased rates of injury in the community (table 2).

The dual diagnosis group had greater rates of injury diagnoses that were system wide or affecting multiple body regions, poisoning or toxic effects injury, and injury from self-harm than did all other mental health exposure groups (figure 3). The incidence of head or neck injuries, traumatic brain injury, amputations or open wounds, and injuries from exposure to mechanical force was particularly pronounced in the dual diagnosis group. Incidence rates by body region, nature of injury, and external cause of injury are presented in the appendix (p 8).

The dual diagnosis group, which made up 21% of the cohort, accounted for 226 (33%) of the 680 emergency department presentations for injury during follow-up; 45 (56%) of the 80 injuries that were classified as system wide or multiple body regions; 37 (69%) of the 54 self-harm injury events; 73 (50%) of the 147 emergency department presentations categorised as resuscitation

	Unadjusted HR (95% CI)	p value	Adjusted HR (95% CI)	p value	Adjusted HR (95% CI) with imputed values	p value
Pre-release mental disorder						
No mental disorder	1 (ref)	..	1 (ref)	..	1 (ref)	..
Substance use disorder only	1·55 (1·14–2·11)	0·0051	1·25 (0·88–1·78)	0·2092	1·22 (0·87–1·70)	0·2489
Mental illness only	2·09 (1·30–3·34)	0·0022	1·85 (1·15–2·97)	0·0108	1·87 (1·19–2·95)	0·0071
Dual diagnosis	3·96 (2·87–5·46)	<0·0001	3·31 (2·32–4·72)	<0·0001	3·27 (2·30–4·64)	<0·0001
Sex						
Male	1 (ref)	..	1 (ref)	..	1 (ref)	..
Female	1·00 (0·75–1·33)	0·9987	0·82 (0·58–1·18)	0·2833	0·78 (0·56–1·10)	0·1560
Age at release (vs 1 year younger)	0·98 (0·97–0·99)	0·0001	0·98 (0·97–0·99)	0·0234	0·98 (0·97–0·99)	0·0347
Indigenous status						
Non-Indigenous	1 (ref)	..	1 (ref)	..	1 (ref)	..
Indigenous	1·46 (1·07–1·99)	0·0157	1·15 (0·77–1·73)	0·4998	1·18 (0·80–1·74)	0·3964
Years of school completed						
≥10	1 (ref)	..	1 (ref)	..	1 (ref)	..
<10	0·70 (0·54–0·89)	0·0046	0·91 (0·68–1·21)	0·5084	0·86 (0·65–1·13)	0·2752
Relationship status						
Single	1 (ref)	..	1 (ref)	..	1 (ref)	..
Married or stable relationship	0·82 (0·64–1·04)	0·0986	0·82 (0·61–1·09)	0·1709	0·89 (0·67–1·18)	0·4055
Accommodation						
Unstable	1 (ref)	..	1 (ref)	..	1 (ref)	..
Stable	0·80 (0·57–1·11)	0·1798	0·98 (0·71–1·36)	0·9221	1·00 (0·72–1·37)	0·9771
Employment						
Unemployed	1 (ref)	..	1 (ref)	..	1 (ref)	..
Employed	0·75 (0·59–0·96)	0·0209	0·94 (0·72–1·22)	0·6391	0·95 (0·74–1·23)	0·7114
Social visits in prison						
No	1 (ref)	..	1 (ref)	..	1 (ref)	..
Yes	0·68 (0·54–0·87)	0·0019	0·90 (0·68–1·19)	0·4666	0·92 (0·70–1·20)	0·5246
Participation in transitional programmes						
No	1 (ref)	..	1 (ref)	..	1 (ref)	..
Yes	1·12 (0·84–1·49)	0·4302	1·18 (0·86–1·62)	0·3050	1·13 (0·84–1·53)	0·4233
Intellectual disability						
No	1 (ref)	..	1 (ref)	..	1 (ref)	..
Yes	1·35 (0·90–2·03)	0·1456	1·22 (0·74–1·99)	0·4367	1·14 (0·71–1·81)	0·5886
K10 psychological distress						
Low–moderate	1 (ref)	..	1 (ref)	..	1 (ref)	..
High–very high	1·38 (1·05–1·82)	0·0216	1·15 (0·88–1·50)	0·3025	1·13 (0·87–1·47)	0·3450
					(Table 2 continues on next page)	

	Unadjusted HR (95% CI)	p value	Adjusted HR (95% CI)	p value	Adjusted HR (95% CI) with imputed values	p value
(Continued from previous page)						
ASSIST harmful substance use						
Alcohol						
Low	1 (ref)	..	1 (ref)	..	1 (ref)	..
Moderate–high	1·28 (0·99–1·67)	0·0611	0·95 (0·69–1·31)	0·7610	0·99 (0·74–1·34)	0·9734
Methamphetamine						
Low	1 (ref)	..	1 (ref)	..	1 (ref)	..
Moderate–high	1·20 (0·93–1·55)	0·1504	0·93 (0·71–1·23)	0·6140	0·99 (0·76–1·28)	0·9123
Heroin						
Low	1 (ref)	..	1 (ref)	..	1 (ref)	..
Moderate–high	1·23 (0·91–1·66)	0·1685	0·97 (0·70–1·34)	0·8457	0·92 (0·67–1·26)	0·5981
PAM activation score	0·99 (0·99–1·00)	0·2242	1·00 (0·99–1·01)	0·2152	1·00 (0·99–1·01)	0·3383
Enriched Social Support Inventory	0·97 (0·96–0·99)	0·0105	0·99 (0·97–1·02)	0·4786	0·99 (0·97–1·01)	0·4559
SF-36v2: PCS score (per unit increase)	0·99 (0·98–1·01)	0·2732	0·98 (0·97–0·99)	0·0247	0·99 (0·97–0·99)	0·0309
Juvenile detention history						
No	1 (ref)	..	1 (ref)	..	1 (ref)	..
Yes	1·55 (1·14–2·12)	0·0056	1·24 (0·89–1·72)	0·2046	1·12 (0·82–1·53)	0·4645
Adult prison sentence						
First	1 (ref)	..	1 (ref)	..	1 (ref)	..
Repeat	1·78 (1·37–2·31)	<0·0001	1·26 (0·88–1·79)	0·2023	1·18 (0·85–1·65)	0·3237
Length of index prison sentence						
>365 days	1 (ref)	..	1 (ref)	..	1 (ref)	..
90–365 days	1·15 (0·83–1·60)	0·3964	1·20 (0·84–1·71)	0·3107	1·22 (0·88–1·71)	0·2367
<90 days	1·48 (1·05–2·08)	0·0267	1·70 (1·16–2·51)	0·0070	1·66 (1·15–2·40)	0·0069
Released on parole						
No	1 (ref)	..	1 (ref)	..	1 (ref)	..
Yes	1·16 (0·91–1·48)	0·2409	1·06 (0·82–1·37)	0·6539	1·05 (0·82–1·33)	0·7164
Risk of reoffending score	1·06 (1·04–1·08)	<0·0001	1·02 (0·99–1·06)	0·1530	1·03 (0·99–1·06)	0·1088
Passports intervention						
No	1 (ref)	..	1 (ref)	..	1 (ref)	..
Yes	1·04 (0·81–1·33)	0·7779	0·97 (0·76–1·25)	0·8334	1·02 (0·80–1·30)	0·8641

HR=hazard rate ratio. K10=Kessler 10. ASSIST=Alcohol, Smoking and Substance Involvement Screening Test. PAM=Patient Activation Measure. SF-36v2=Short Form Health Survey, version 2. PCS=physical component summary.

Table 2: Association between pre-release characteristics and injury resulting in hospital contact

(to be seen immediately) or emergent (to be seen within 10 min) at triage; and 123 (43%) of the 288 emergency department presentations that required a stay longer than 4 h in duration (appendix p 9).

Hospital admissions for injury accounted for 756 bed-days during the study period, 52 (7%) of which were psychiatric bed-days. The dual diagnosis group accounted for 372 (49%) of all hospital bed-days and 49 (94%) of all psychiatric bed-days during follow-up (appendix p 10).

Sensitivity analyses supported our primary analysis (appendix p 11); however, when restricted to hospital admissions only, a larger effect size was observed for the dual diagnosis group (adjusted hazard rate ratio without imputed values 5·31, 95% CI 3·39–8·32; p<0·0001) than when analysed for emergency department presentations

and hospital admissions combined. Conversely, when restricted to emergency department presentations only, a smaller effect size was observed for the dual diagnosis group (2·55; 1·74–3·72; appendix p 11).

Discussion

In a representative cohort of adults released from prison in Queensland, Australia, we found that those with dual diagnosis of mental illness and substance use disorder had approximately three times the rate of injury resulting in hospital contact after release from prison compared with adults without a mental disorder, whereas adults with mental illness and no substance use disorder had almost twice the rate of injury. Adults released from prison are at high risk of injury: injuries accounted for one in three emergency department presentations and

one in four hospitalisations during follow-up. Our findings show that risk is concentrated in people with a mental illness, particularly those with a co-occurring substance use disorder. Targeted preventive efforts are urgently needed to reduce the burden of injury in people with a dual diagnosis after release from prison. However, a recent review[37] of effective interventions in socially excluded groups highlighted the substantial gaps in our understanding of prevention strategies for people released from prison. Mental health service providers should be aware that young adults, those with poor physical health, and those serving sentences shorter than 90 days in duration are particularly vulnerable to injury after release from prison.

Compared with all other mental health exposure groups, the rate of injury within 30 days of release from prison was higher for the dual diagnosis group, and peaked within the first week after release from prison. However, the rate of injury from all other causes exceeded that from drug-related injury within 30 days of release for all exposure groups. Considerable research and policy attention has been devoted to the risk of acute, drug-related death after release from prison.[38] We observed an acutely elevated risk of drug-related injury in people with a recent history of dual diagnosis, who accounted for eight of ten drug-related injuries within the first 30 days of release from prison. Our findings provide new evidence to help to target the prevention of drug-related harm after release from prison and suggest that, rather than focusing on all drug users, scarce resources should be allocated to those with a recent history of dual diagnosis.

After adjusting for model covariates, the association between substance use disorder only and injury was attenuated. Injury from all other causes substantially exceeded drug-related injury after 30 days from prison release for all exposure groups, accounting for approximately nine of ten injuries resulting in hospital contact thereafter. Previous research and policy responses have predominantly focused on overdose in people released from prison.[38] Although drug-related harm is a substantial concern for people recently released from prison, our findings indicate that even among people with substance use disorder, the burden of preventable injury is primarily due to causes other than drug overdose.

The rate of hospital admission for injury after release from prison in our cohort was approximately four times greater overall and 12 times greater in the dual diagnosis group than in the general population, which is estimated
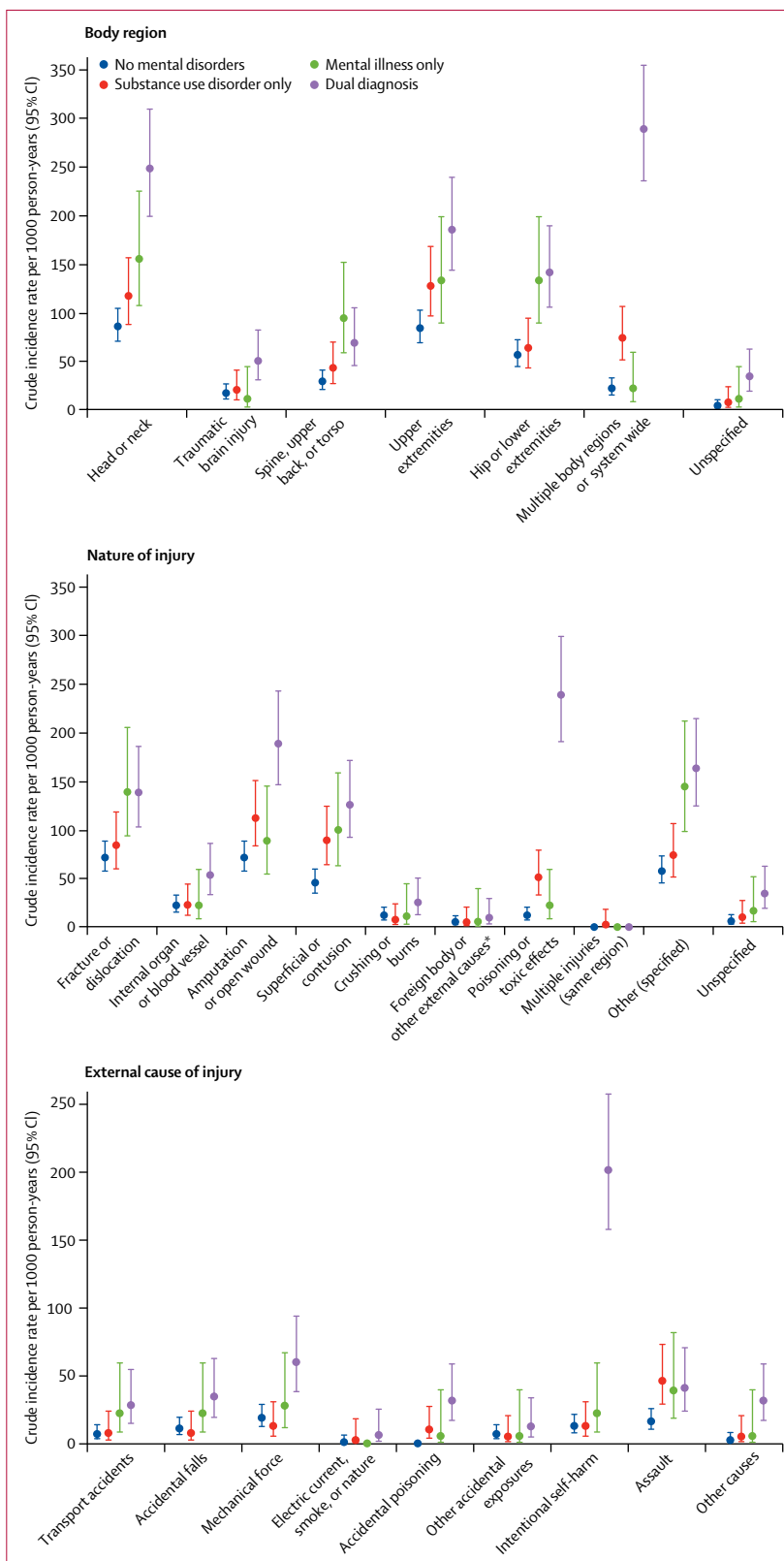
Figure 3: Crude incidence rates of injury resulting in hospital contact according to mental health exposure group, and by body region of injury, nature of injury, and external cause of injury

*Includes injuries due to frostbite, radiation, burns due to heat and light, hypothermia, effects of air or water pressure, asphyxiation, effects of deprivation such as hunger or thirst, maltreatment syndromes, and other external causes such as lightning, electric current, non-fatal submersion, and effects of vibration.

at 22 injuries per 1000 person-years, excluding complications of medical care and surgical care.[5] This observation is consistent with prior research that has found that injury was the leading cause of hospitalisation and accounted for the second-most bed-days within 12 months of release from prison.[19] Importantly, in our study we were able to identify the characteristics most strongly associated with injury in this population.

We found that one in five adults released from prison had a recent history of dual diagnosis, which is ten times higher than the estimated 12-month prevalence in the general Australian population.[39] The dual diagnosis group accounted for half of the most severe resuscitation or emergent emergency department presentations and half of all hospital bed-days. These findings suggest that individuals with dual diagnosis might be at particular risk of more severe injuries. Prior research in the general population has reported a high prevalence of traumatic brain injury, particularly severe and repeat traumatic brain injury, among people with dual diagnosis.[17] Among people with a history of incarceration, some forms of injury such as traumatic brain injury might increase the risk of future offending, providing a further reason to prioritise and invest in prevention for this marginalised group.

Recent NICE guidelines[20] have highlighted that incarceration provides a key public health opportunity to target clinical care and develop tailored care pathways for people with co-occurring disorders. People with dual diagnosis being released from prison have increased health and social service needs compared with those with one mental disorder alone,[40] and there is good evidence that coordinated and continuous care improves health outcomes for this population.[41] However, in most settings, care for people released from prison is neither coordinated nor continuous,[42] and services for dual diagnosis are typically limited both in prison and in the community.[43] Although appropriate care has resource implications, the financial cost of injury-related hospital contacts alone is substantial.[19] A randomised trial and economic evaluation of enhanced care for people with dual diagnosis transitioning from prison to the community is both feasible[44] and strongly needed.

Strategies to reduce injury in the community predominantly rely on a universal prevention approach. However, for groups at high risk of injury, such as adults with dual diagnosis released from prison, universal injury prevention strategies are probably not sufficient and such efforts should be complemented by intensive, tailored responses.[45] Although the association between Indigeneity and recurrent injury after release from prison was attenuated to the null after covariate adjustment, given that Indigenous Australians are over-represented in prison by an age-adjusted factor of 13,[46] incarceration remains an important driver of health disparities between Indigenous and non-Indigenous Australians. The development of tailored injury prevention strategies for Indigenous adults released

from prison could be an important component of efforts to reduce the health disparities experienced by Indigenous Australians.

Our study had several strengths. It was well powered to answer the research questions and the sample was broadly representative of all people released from prison in Queensland during the study period.[23] Our study included a unique combination of rich baseline survey, prison medical records, and person-level linked administrative emergency department, inpatient, and mortality data. To our knowledge, it is the first study to permit such comprehensive adjustment for potential confounders. Whereas prior studies have been limited by no access to private hospital records,[47] our study linked emergency department and hospital records with state-wide coverage using gold-standard probabilistic linkage methodology that has been validated previously to have false linkage rates of less than 0·1%.[48]

Our study also had several potential limitations. First, it was done in Australia, such that caution should be taken when generalising these findings to other countries, especially those with different health-care and correctional systems. Second, we ascertained mental illness and substance use disorder exposures from hospital, emergency department, and prison medical records. Psychiatric discharge diagnoses in hospital contacts have been found to have adequate reliability, particularly for broad categories of mental disorders.[49] However, common mental disorders such as anxiety and conditions of lower severity are often not reliably diagnosed in acute care settings[50] and it is thus likely that we under-ascertained these conditions in our mental health exposure, resulting in a conservative estimate of the association between mental disorder and injury. Third, our outcome was restricted to injury events resulting in hospital contact and as such we did not capture the entire burden of injury experienced by adults released from prison. Fourth, we ascertained injury events from state-based emergency department and hospital records, thus we did not capture events outside of the state of Queensland. However, for people residing in Queensland, interstate hospitalisations account for less than 1% of all hospital stays.[51] Fifth, to maximise power, we included both the intervention and control arms of the Passports study in our analyses. This low-intensity intervention was designed to increase contact with primary care[23] and had no effect on rates of emergency department or hospital contact. Furthermore, we observed no significant association between randomisation group and mental health exposure group (p>0·05). Our final model was nevertheless adjusted for randomisation group. Finally, we cannot eliminate the possibility of informative censoring due to reincarceration. However, sensitivity analyses made possible by our access to correctional records indicate that any such effect would be modest, and would attenuate the association between exposure and outcome, such that our estimates are likely conservative.

In conclusion, people with dual diagnosis are at increased risk of injury resulting in hospital contact after release from prison. Contact with the criminal justice system provides an opportunity to prevent subsequent injury morbidity in people with co-occurring disorders. Engagement with integrated psychiatric and addiction treatment, complemented by targeted injury prevention and delivered without interruption during the transition from prison into the community, might prevent the injury-related disparities experienced by this vulnerable group.

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