

The association of prison security level with mortality after release from prison: a retrospective national cohort study (2000–16)



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Summary

Background Incarceration might contribute to increased mortality in an already marginalised population. A better understanding of the prison-related factors that are associated with mortality is important for preventing the negative health consequences of incarceration. We aimed to investigate all-cause and cause-specific mortality following release from high-security and low-security prisons.

Methods In this retrospective national cohort study, we used data from the Norwegian Prison Release study (nPRIS), which includes complete national register data for 96 859 individuals from the Norwegian Prison Register linked to the Norwegian Cause of Death Register from Jan 1, 2000, to Dec 31, 2016. The study cohort included all people in Norway released from a high-security or low-security prison unit. Cause of death was categorised into internal causes (infectious, cancerous, endocrine, circulatory, respiratory, digestive, nervous system diseases, and mental health disorders) and external causes (accidents, suicides, and homicides) according to the 10th revision of the International Classification of Diseases. We calculated crude mortality rates (CMR) and estimated Cox proportional-hazards models.

Findings There were 151 790 releases in the study period (68·4% from low-security and 31·6% from high-security prisons) from 91 963 individuals. The overall CMR was 854·4 [95% CI 834·7–874·2] per 100 000 person-years (436·2 [422·1–450·3] per 100 000 person-years for internal causes and 358·3 [345·5–371·1] per 100 000 person-years for external causes). The overall post-release mortality rate was higher in those released from high-security prisons (1142·5 [95% CI 1102·6–1182·5] per 100 000 person-years) than in those released from low-security prisons (714·6 [692·6–736·6] per 100 000 person-years). Our results suggest an association between release from high-security prisons and elevated mortality due to both external causes (adjusted hazard ratio [aHR] 1·75 [95% CI 1·60–1·91]) and internal causes (1·45 [1·33–1·59]), compared to release from low-security prisons.

Interpretation Imprisonment and the post-release period can be an important point for public health interventions. Particular attention to health is warranted for individuals incarcerated in and released from high-security prisons. The potential impact of both individual-level characteristics of people incarcerated in high-security facilities, and of the prison environment itself, on mortality outcomes, should be investigated further.

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Introduction

The global prison population has reached 11 million people and continues to grow.¹ Individuals who have been incarcerated have disproportionately poor health, with an over-representation of lifetime substance use, mental health disorders, and physical illness.² In addition, these individuals are marginalised in a number of social domains, such as education, employment, housing, and finances.³ The incarceration of poor, marginalised individuals both produces and reinforces social and health inequalities generating disparities in mortality.⁴ A publication including retrospective data (1987–2017) found that jail incarceration rates were potential drivers of many causes of death in 1094 US counties, indicating how incarceration is harmful not

only to the health of the incarcerated individuals but also to public health more broadly.⁵

High rates of post-release mortality among prison populations have been documented in several studies.^{6–10} The most common cause of death is overdose,^{11,12} with risk often peaking in the early post-release period.^{7,11,13} Other common external causes of death include injury, suicide, homicide, and accidents.^{13–16} Several internal causes of death are also common, such as cardiovascular disease, cancers, infectious diseases, and liver disease.^{13–16}

The causal and mitigating factors related to post-release mortality are complex and the effects of the conditions of incarceration are not well understood.¹⁷ The explanation could be related to the social and health-related marginalisation that existed before incarceration; to

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Research in context

Evidence before this study

We searched PubMed for articles on mortality after release from prison published between Jan 1, 2000, and Dec 7, 2021. We restricted search results to research that included relevant terms from each of these three categories: population (in the title; using the search terms: inmate*, prison*, incarcerat*, penal, detention*, detain*, convict*, jail, penitentiary*, correction*, felon*, or custod*); time period after release from prison (in the title or abstract; using the search terms: release*, parole*, or discharge); and outcomes related to mortality (in the title or abstract; using the search terms: death, mortality or fatalit*). This search produced 359 results. Of these results, 155 papers were not related to the relevant target population and 182 were concerned with health outcomes other than mortality, did not concern the time after release from prison, or addressed only a specific cause of death. The studies that focused on specific causes of death mostly focused on mortality related to overdose, suicide, and other external causes of death. After exclusion of these studies, we found 22 studies that addressed all-cause mortality after release from prison. The majority of these studies were retrospective cohort studies

based on registry data. Only two of the 22 studies considered exposure to isolation during incarceration. We found no studies that investigated differences in mortality between low-security and high-security prison.

Added value of this study

Our study used high-quality data, covering the full population of prisoners admitted to and released from prison in Norway during 2000–16. Our findings show that prison security level is an important factor for understanding the negative health consequences of incarceration.

Implications of all the available evidence

Physical and mental health during incarceration and following release are important targets for reducing mortality rates after release from prison. Particular attention to health is warranted for individuals incarcerated in and released from high-security prison units. More needs to be understood about the causal mechanisms behind the association between prison security level and mortality risks, and how risk changes over time, to inform the implementation of more effective public health strategies for this population.

factors, settings, and conditions related to the incarceration itself;² or to factors surrounding the release and transition to society outside the prison.¹²

The security level of the prison facility can affect the conditions related to the incarceration and the release from prison, with high-security prisons being more controlling and restrictive of individuals than low-security prisons^{18,19} and being less likely to have a gradual transition from the prison setting to the society on the outside of the prison. In addition, inmates selected for high-security prisons are, in general, characterised by more serious convictions,¹⁸ which contributes to the burden of high-security environments.

Norway is characterised by having low rates of imprisonment. In 2021, 54 per 100 000 of the national population were in prison, compared with 639 per 100 000 in the USA and 130 per 100 000 in the UK.¹ In total, Norway has a capacity of just over 3800 cells distributed in 58 prisons,¹ a form of prison organisation that allows most prisoners to preserve geographical closeness to friends and family. Women constitute a minority in Norwegian prisons—representing around 5% of the annual prison population.¹

In Norway, all prisons are publicly funded, with universal health care available for all inmates. Prisons are rehabilitation oriented and progression through a sentence should be aimed at re-entry to the community. The ideal is a gradual progression towards release from high-security prisons to low-security prisons, thereafter to halfway houses, and finally to completion of the sentence outside of prison. In Norway, about 30% of the prison capacity and almost 65% of all entries in Norway

are to low-security prisons, often characterised by shorter sentences.¹⁹

The contrast in environment between the high-security and low-security prisons in Norway is substantial; with high-security prisons being characterised by more external security precautions, including controlled entrances and exits. Inmates in low-security prisons are deprived of their liberty and autonomy to a lesser extent than those held in high-security prisons.¹⁹

In this study, we aim to contribute to the literature on the relationship between imprisonment, release, and mortality by understanding how incarceration in terms of security level might be associated with post-release mortality. Using high-quality, up-to-date data, covering a national population of people admitted to and released from prison in Norway during 17 years of follow-up, we aimed to: describe all-cause and cause-specific mortality in all people released from Norwegian prisons between 2000 and 2016; investigate all-cause and cause-specific mortality among people released from high-security and low-security prisons; and investigate factors associated with all-cause and internal and external-cause mortality among people released from prison.

Methods

Study design

In this retrospective national cohort study, we used data from the Norwegian Prison Release study (nPRIS). We included 96 859 individuals contributing 167 068 releases over a 17 year period (Jan 1, 2000, to Dec 31, 2016) collected from the Norwegian Prison Registry. The data

were linked to the Norwegian Cause of Death Register using a unique 11-digit Norwegian personal identification number, given to people who are born in Norway, have a valid residence permit for at least 6 months, or have officially moved to Norway.

The study was approved by the Regional Committees for Medical Research Ethics South East Norway (2012/140). The Norwegian Institute of Public Health linked the files and stored the linkage code. The study was approved exempt from informed consent.

Data sources

The Norwegian Prison Registry serves administrative and statistical purposes and includes personal data on all people imprisoned in Norway, including age, gender, convictions, and sentences.²⁰ The registry also includes date of admission and date of release, including time spent on pretrial detention, and a code describing the release circumstances.

The Norwegian Cause of Death Register (NDR) includes complete death certificates reported by medical doctors after examination of the deceased. Death certificates are collected by the NDR at the Norwegian Institute of Public Health. All deaths in the NDR are coded using the 10th revision of the International Classification of Diseases (ICD-10).²¹ The NDR includes information about the date of death, the underlying cause of death (the disease or injury that initiated the chain of events leading directly to death), immediate causes of death (the terminal event or complication at the time of death), the setting where the person died or was found (eg, hospital, outdoors, in their home), and the actual date of death.²² The coverage and the completeness of the NDR are high; it comprises all Norwegian residents and includes medical information on more than 98% of all deaths.²²

Study population

The study population was defined as all people holding a valid personal identification number incarcerated between Jan 1, 2000, and Dec 31, 2016. Individuals were included if released from a high-security or low-security unit.

Procedures

On the basis of the underlying ICD-10 codes of death,²¹ and the literature,²³ causes of death were categorised into two main categories: internal (A00–R95) and external causes (V09–Y98). We also examined several sub-categories: infectious diseases (A00–B99); cancers (C00–C97); disease of the endocrine system (E00–E89); mental and behavioural disorders (F00–F99); diseases of the nervous system (G00–H95); diseases of the circulatory system (I00–I99); diseases of the respiratory system (J00–J99); diseases of the digestive system (K00–K93); accidents (V01–X59); suicides (X60–X64); and homicides (X85–Y09). ICD-10 codes not included

here were defined as other internal or other external causes. Sudden unexplained deaths (R96.0), unattended deaths, and deaths of unknown cause (R98–99) were not categorised as either internal or external. The subgroups of substance use-related deaths (F11–F12, F14–F16, and F19) and poisonings (X40–X44) were included as these are common in the prison population.

The security level of the facility from which the person was released was coded as low or high security on the basis of how the facilities are categorised by the Norwegian Correctional Services.

We categorised imprisonments according to the main conviction related to the current prison sentence (defined as the most severe conviction in cases in which the person was convicted of several offences). The main convictions were collapsed into five categories: drug and alcohol-related offences; sexual offences and violence (including maltreatment); public order (includes traffic offences, public order and integrity violations, criminal damage, and other offences); offences for profit (includes property theft and other offences for profit); and homicide or attempted homicide.

The time at risk was defined as all time spent outside of prison. Time at risk was either the period between release and death, the period from release to another imprisonment, or the period from release to the end of the study (Dec 31, 2016). One person might have had several releases from both high-security and low-security prisons during the observation period and, in those cases, all post-release periods were included in the analysis.

Statistical analysis

Descriptive statistics were done with SPSS (version 26). We calculated crude mortality rates (CMRs; per 100 000 person-years) and 95% CIs. Missing data were reported per variable in the tables.

Survival analyses were done in R (version 4.0.1). To visually examine the association between security level and mortality, we plotted the cumulative hazard functions by high-security or low-security level and by internal or external cause of death (including 95% CIs).

To investigate factors associated with internal and external causes of death, in addition to all-cause mortality among people released from prison, we fitted three separate Cox proportional-hazards models for internal causes, external causes, and all causes. Missing data were handled by complete case analysis in the models. In each multivariable model, we adjusted for age at release (continuous), gender (man or woman), main conviction (the five categories listed), length of incarceration (0–6 months, 6–12 months, 12–24 months, and >24 months) and security level (high or low). In addition, the interaction between the number of previous incarcerations (continuous) and security level (high or low) was added as a control variable in the models.

Our rationale for including these variables was that age and gender have a known association with mortality.

	Number of individuals, n	Proportion of individuals, %
Released individuals	91 963	100·0%
Releases	151 790	100·0%
Age at first incarceration*		
<18 years	674	0·7%
18–24 years	27 601	30·0%
25–34 years	26 755	29·1%
35–44 years	19 372	21·1%
45–54 years	11 478	12·5%
55–64 years	4839	5·3%
>65 years	1214	1·3%
Gender†		
Female	9272	10·1%
Male	82 672	89·9%
Number of releases, n		
1	64 558	70·2%
2	14 576	15·8%
3	5738	6·2%
4	2851	3·1%
≥5	4240	4·6%
Security level at latest release‡		
High security	29 064	31·6%
Low security	62 899	68·4%

*30 records missing age information. †19 records missing gender information.
‡Security level at the latest observed release in the study period.

Table 1: Background characteristics and security level of the study cohort (n=91 963) observed in 2000–16

Type of crime and length of incarceration are relevant due to their association with security level and mortality. These variables could be confounders or modifiers in the relationship between security level and mortality.

The proportional-hazards assumption was tested on the basis of Schoenfeld residuals and our hypothesis did not violate the proportional-hazards assumption (data not shown). The coefficients were interpreted in terms of mortality rate ratios with 95% CIs.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report.

Results

The original cohort population consisted of 96 859 unique individuals, of which we excluded 4896. 4177 were excluded because they were not released from a high-security or low-security unit (eg, people released from hospitals or institutions). 719 people were excluded as they had died in prison or other institutions, or because they re-entered prison before their release date. Our cohort consisted of 91 963 individuals (10·1% women) contributing 151 790 incarcerations (table 1). The median age at first incarceration was 31 (IQR 23–41) years, and

54 356 (59·1%) of 91 963 individuals were aged 18–34 years. 64 558 (70·2%) of 91 963 individuals had one incarceration during the observation period, and 12 829 (14·0%) individuals in the cohort had served three or more prison sentences. 62 899 (68·4%) of individuals in the cohort were released from low-security prisons and 29 064 (31·6%) from high-security prisons at their last observed release (table 1). The total observation time was 566 489 person-years following release from low-security units and 274 916 person-years following release from high-security units.

Of all releases, 84 964 (56·0%) were from low-security prisons and 66 826 (44·0%) were from high-security prisons (table 2). The proportion of sentences served by women was higher in low-security prisons (8087 [9·5%] of 84 964) than in high-security prisons (4664 [7·0%] of 66 826). The convictions of those people released from high-security prisons were more often related to severe criminality than those released from low-security prisons—for example sexual offences and violence (19 809 [29·6%] in high-security prisons vs 19 941 [23·5%] in low-security prisons) or homicide or attempted homicide (681 [1·0%] in high-security prisons vs 146 [0·2%] in low-security prisons).

In total, 7189 deaths were recorded during the study period; 3670 (51·1%) were categorised as internal-cause, 3015 (41·9%) as external-cause, and 478 (6·7%) were categorised as unexplained or unknown cause (table 3). The most frequent internal causes of death were diseases of the circulatory system (960 [13·4%] of 7189) and cancers (942 [13·1%]), and the most frequent external causes were accidental poisoning (1430 [19·9%]) and suicide (679 [9·4%]).

Among the internal causes of death, 2281 (56·3%) of 4048 deaths occurred after release from a low-security prison and 1389 (44·2%) of 3141 deaths occurred after release from a high-security prison (table 3). Among the external causes of death, 1462 (36·1%) of 4048 deaths occurred after release from low-security prisons and 1553 (49·4%) of 3141 deaths occurred after release from a high-security prison.

A total of 1430 (19·9%) of 7189 people died due to poisonings, 604 (14·9%) of 4048 after release from a low-security prison and 826 (26·3%) of 3141 after release from a high-security prison.

The CMR for all causes in the cohort was 854·4 (95% CI 834·7–874·2) per 100 000 person-years, 436·2 (422·1–450·3) per 100 000 person-years for internal causes, and 358·3 (345·5–371·1) per 100 000 person-years for external causes (table 4). When stratifying by prison security level, the CMRs for both internal and external causes were higher after release from high-security prisons (internal-cause CMR: 505·2 [478·7–531·8] per 100 000 person-years; external-cause CMR: 564·9 [536·8–593·0] per 100 000 person-years) than from low-security prisons (internal-cause CMR: 402·7 [386·1–419·2] per 100 000 person-years; external-cause

	Released from low-security units		Released from high-security units		All releases	
	Number, n	Proportion, %	n	Proportion, %	n	Proportion, %
Number of releases	84 964	56.0%	66 826	44.0%	151 790	100%
Age at admission*						
<18 years	130	0.2%	782	1.2%	912	0.6%
18–24 years	22 205	26.1%	16 457	24.6%	38 662	25.5%
25–34 years	25 508	30.0%	23 972	35.9%	49 480	32.6%
35–44 years	19 059	22.4%	16 544	24.8%	35 603	23.5%
45–54 years	12 044	14.2%	6 878	10.3%	18 922	12.5%
55–64 years	4 917	5.8%	1 763	2.6%	6 680	4.4%
>65	1 089	1.3%	391	0.6%	1 480	1.0%
Gender†						
Female	8 087	9.5%	4 664	7.0%	12 751	8.4%
Male	76 877	90.5%	62 143	93.0%	139 020	91.6%
Length of imprisonment						
0–6 months	79 136	93.1%	56 427	84.4%	135 563	89.3%
6–12 months	3 301	3.9%	6 531	9.8%	9 832	6.5%
12–24 months	1 616	1.9%	2 619	3.9%	4 235	2.8%
>24 months	911	1.1%	1 249	1.9%	2 160	1.4%
Type of crime, main conviction						
Drug and alcohol offences	28 498	33.5%	18 524	27.7%	47 022	31.0%
Sexual offences and violence	19 941	23.5%	19 809	29.6%	39 750	26.2%
Public order	14 369	16.9%	6 876	10.3%	21 245	14.0%
Offences for profit	13 449	15.8%	17 275	25.9%	30 724	20.2%
Homicide or attempted homicide	146	0.2%	681	1.0%	827	0.5%
Missing conviction information	8 561	10.1%	3 661	5.5%	12 222	8.1%

*51 records missing age information. †19 records missing gender information.

Table 2: Characteristic of people at each release from prison (n=151 790) in 2000–16 by security level

CMR: 258.3 [244.9–271.3] per 100 000 person-years; table 4).

Comparing mortalities after release from low-security prisons with high-security prisons, CMRs related to mental and behavioural diagnoses were substantially higher after release from high-security prisons than from low-security prisons (130.9 [95% CI 117.4–144.5] vs 51.2 [45.3–57.1] per 100 000 person-years), as well as CMRs from mortalities related to substance use (102.6 [90.6–114.5] vs 17.3 [13.9–20.7] per 100 000 person-years), infectious diseases (28.4 [22.1–34.7] vs 9.2 [6.7–11.7] per 100 000 person-years), accidents (431.0 [406.5–455.6] vs 184.2 [172.9–195.3] per 100 000 person-years), poisonings and overdoses (300.5 [280.0–320.9] vs 106.7 [98.1–115.1] per 100 000 person-years), suicides (113.1 [100.6–125.7] vs 65.0 [58.3–71.6] per 100 000 person-years), and homicide (14.2 [9.7–18.6] vs 5.6 [3.7–7.6] per 100 000 person-years; table 4). Mean age of death for all causes of death are shown in the appendix (p 1).

For those released from a high-security prison, the overall accumulated risk of death from both external and internal causes was higher than that of those released from low-security prisons (figure). For internal causes of

death, there was a gradual increase in accumulated risk of death with time since release from both security levels, although the mortality rate ratio was slightly lower for those released from low-security prisons throughout most of the follow-up period (figure). For external causes of death, the cumulative risk was higher in the early phase following release for high-security prisons compared with low-security prisons.

The unadjusted HRs for all models are shown in the appendix (p 2). The adjusted Cox proportional-hazards model showed that the mortality rate ratio of internal causes of death after release was associated with older age at release (HR 1.10 [95% CI 1.10–1.10]), being released from a high-security prison (1.45 [1.33–1.59]), and drug and alcohol offences (1.22 [1.11–1.34]). Being convicted for offences for profit (0.81 [0.72–0.91]) or sexual offences and violent crimes (0.80 [0.71–0.90]) or serving prison sentences longer than 24 months (0.55 [0.41–0.74]) were associated with a lower mortality rate ratio of death from internal causes (table 5). The number of previous incarcerations interacted significantly with security level (1.05 [1.02–1.09]; p=0.0016).

Mortality rate ratios for external causes after release were associated with older age at release (HR 1.01

See Online for appendix

	ICD-10 codes	Low security (N=4048)		High security (N=3141)		Total (N=7189)	
		Number, n	Proportion*, %	Number, n	Proportion*, %	Number, n	Proportion*, %
Internal causes of deaths							
Infectious diseases	A00–B99	52	1.3%	78	2.5%	130	1.8%
Cancers	C00–C97	663	16.4%	279	8.9%	942	13.1%
Disease of the endocrine system	E00–E89	76	1.9%	47	1.5%	123	1.7%
Mental and behavioural disorders	F00–F99	290	7.2%	360	11.5%	650	9.0%
Substance use related†	F11–F12, F14–F16, and F19	98	2.4%	282	9.0%	380	5.3%
Diseases of the nervous system	G00–H95	64	1.6%	36	1.1%	100	1.4%
Diseases of the circulatory system	I00–I99	654	16.2%	306	9.7%	960	13.4%
Diseases of the respiratory system	J00–J99	203	5.0%	136	4.3%	339	4.7%
Diseases of the digestive system	K00–K93	237	5.9%	126	4.0%	363	5.0%
Other disease-related causes‡	..	42	1.0%	21	0.7%	63	0.9%
Total internal-cause deaths	..	2281	56.3%	1389	44.2%	3670	51.1%
External causes of deaths							
Accidents	V01–X59	1043	25.8%	1185	37.7%	2228	31.0%
Poisoning, including overdose†	X40–X44	604	14.9%	826	26.3%	1430	19.9%
Suicide	X60–X84	368	9.1%	311	9.9%	679	9.4%
Homicide	X85–Y09	32	0.8%	39	1.2%	71	1.0%
Other external causes§	..	19	0.5%	18	0.6%	37	0.5%
Total external-cause deaths	..	1462	36.1%	1553	49.4%	3015	41.9%
Sudden unexplained death	R96.0	52	1.3%	26	0.8%	78	1.1%
Unattended death or unknown cause	R98–R99	235	5.8%	165	5.3%	400	5.6%
Total deaths	..	4048	100%	3141	100%	7189	100%

ICD-10=10th revision of the International Classification of Diseases. *Proportions were calculated within each subgroup (release from low security, high security, or total). †This a subgroup of the category above. ‡ICD-10 codes: D17, D35, D37–38, D43, D46–47, D58, D61, D68–69, D82, H70, L08, L89, L97, M00, M06, M16–17, M34–35, M45–46, M62, M72, M84, M86, Q21–24, Q28, Q62, Q64, R07, R09, R58, R63, R68, and R78. §ICD-10 codes: Y00, Y03, Y04, Y08, Y09, Y12, Y14, Y26, Y30, Y33, Y85, and Y86.

Table 3: Cause of death with ICD-10 codes for all observed mortalities (n=7189) in the cohort (n=91 963) in 2000–16 by security level

[95% CI 1.01–1.02]), being released from a high-security prison (1.75 [1.60–1.91]), prison sentences lasting 6–12 months (1.41 [1.23–1.61]), being convicted for drug and alcohol offences (1.46 [1.30–1.65]), and with homicide or attempted homicide offences (1.63 [1.05–2.52]). The number of previous incarcerations interacted significantly with security level (1.11 [1.09–1.13]; $p < 0.0001$). Serving a prison sentence longer than 24 months (0.54 [0.37–0.78]) was associated with a lower mortality rate ratio of death from external causes.

Discussion

In a 17 year observation period, we found a high rate for all-cause, internal-cause, and external-cause mortality following release from prison. The all-cause mortality rate was in line with those seen in international studies with similar study designs;^{8,12,13} however, it was lower than in one Swedish study (which reported 1205 deaths per 100 000 person-years).²⁴ Our study also supported previous findings^{6–10} of a high risk of death from diseases, such as cardiovascular disease and cancer, and from external causes, such as poisoning (overdose) and suicide

after release from low-security and high-security prisons. The novel finding in this study was that the all-cause mortality, and most cause-specific mortality risks, were even greater for people released from high-security prisons compared with those released from low-security prisons.

The high risk of death was still associated with release from high-security prisons when controlling for gender, age, length of incarceration, and type of crime. Furthermore, the risk of internal-cause and external-cause deaths were associated with older age and drug and alcohol-related offences. To our knowledge, this study is the first to examine the association between prison security level and post-release mortality with adjustment for other factors.

People who were released from high-security prisons had high mortality rates, both related to internal and external causes of death. The elevated risk of internal causes of death was stable throughout the entire period of observation. For external causes, the risk was highest during the first year after release. The difference in risk of external-cause deaths compared with internal

cause-cause deaths was largely driven by higher rates of poisoning (overdose) and suicide deaths among those released from high-security prisons, probably illustrating the known risk of overdoses in the period immediately after release.^{11,12}

Previous research has shown that the increased mortality risk after release could be related to individual characteristics of people who were in prison, such as lower education, unstable housing, and mental and physical health conditions, including substance use.⁶ It is possible that these risk factors could be more prevalent among those selected for high-security prisons than those selected for low-security prisons, similar to what has been seen among inmates placed in solitary confinement,²³ and, thus, could contribute to the explanation of the increased risk of mortality in this group.

The post-release mortality risk might also be related to conditions in the high-security prison itself. When inmates with the same risk assessments were randomly assigned to high-security or low-security prisons, assignment to high-security prison was associated with a 30% increase in the risk of recidivism.¹⁸ The authors pointed to peer influence and environmental strain theories as part of the explanation for their findings. Arguably, these types of mechanisms that might be present in high-security and other restricted prison settings, where activities and social interactions are restricted, could also be associated with health outcomes. Although we have found no studies on mortality when it comes to high-security and low-security prisons, placement in solitary confinement has been associated with increased development of psychiatric comorbidity²⁵ and with external cause of death up to 5 years following release.^{23,26}

We found that longer durations of imprisonment were associated with lower mortality risk of internal and external causes of death. The relationship between time served in prison and mortality appears to be complex. Research has previously found both a protective effect of time spent in prison and a dose-response relationship in which more time served in prison increased risk of death following release. However, this increased risk also diminishes over time following release.²⁷

The risk of mortality from both internal and external causes was higher for those whose main conviction was related to drugs. Although it is a robust finding, it is known that drug-related convictions are associated with increased risk of death shortly after release from prison,²⁸ the post-release association in the long term might be unclear.²⁷

In addition, the risk of mortality from external causes was related to convictions for homicide or attempted homicide. Previous studies have shown that conviction for a violent crime is associated with a higher risk of external-cause death. For example, an association between violent convictions and suicide²⁹ has been found, which is in line with our study's findings.

	Low-security prisons CMR (95% CI), per 100 000 person-years	High-security prisons CMR (95% CI), per 100 000 person-years	Total CMR (95% CI), per 100 000 person-years
Internal causes of death			
Infectious diseases	9.2 (6.7–11.7)	28.4 (22.1–34.7)	15.5 (12.8–18.1)
Cancers	117.0 (108.1–125.9)	101.5 (89.6–113.4)	112.0 (104.8–119.1)
Disease of the endocrine system	13.4 (10.4–16.4)	17.1 (12.2–22.0)	14.6 (12.0–17.2)
Mental and behavioural disorders	51.2 (45.3–57.1)	130.9 (117.4–144.5)	77.3 (71.3–83.2)
Substance use related*	17.3 (13.9–20.7)	102.6 (90.6–114.5)	45.2 (40.6–49.7)
Diseases of the nervous system	11.3 (8.5–14.1)	13.1 (8.8–17.4)	11.9 (9.6–14.2)
Diseases of the circulatory system	115.5 (106.6–124.3)	111.3 (98.8–123.8)	114.1 (106.9–121.3)
Diseases of the respiratory system	35.9 (30.9–40.8)	49.5 (41.2–57.8)	40.3 (36.0–44.6)
Diseases of the digestive system	41.9 (36.5–47.2)	45.8 (37.8–53.8)	43.1 (38.7–47.6)
Other disease-related causes†	7.4 (5.2–9.7)	7.6 (4.4–10.9)	7.5 (5.6–9.3)
Total internal causes of death	402.7 (386.1–419.2)	505.2 (478.7–531.8)	436.2 (422.1–450.3)
External causes of death			
Accidents	184.2 (172.9–195.3)	431.0 (406.5–455.6)	264.8 (253.8–275.8)
Poisoning, including overdose*	106.7 (98.1–115.1)	300.5 (280.0–320.9)	170.0 (161.1–178.8)
Suicide	65.0 (58.3–71.6)	113.1 (100.6–125.7)	80.7 (74.6–86.8)
Homicide	5.6 (3.7–7.6)	14.2 (9.7–18.6)	8.4 (6.5–10.4)
Other external causes‡	3.4 (1.8–4.9)	6.5 (3.5–9.6)	4.4 (3.0–5.8)
Total external causes death	258.3 (244.9–271.3)	564.9 (536.8–593.0)	358.3 (345.5–371.1)
Sudden unexplained death	9.2 (6.7–11.7)	9.5 (5.8–13.1)	9.3 (7.2–11.3)
Unattended death or unknown cause	41.5 (36.2–46.8)	60.0 (50.9–69.2)	47.5 (42.9–52.2)
Total deaths	714.6 (692.6–736.6)	1142.5 (1102.6–1182.5)	854.4 (834.7–874.2)

CMR=crude mortality rate. *This a subgroup of the category above. †ICD-10 codes: D17, D35, D37–38, D43, D46–47, D58, D61, D68–69, D82, H70, L08, L89, L97, M00, M06, M16–17, M34–35, M45–46, M62, M72, M84, M86, Q21–24, Q28, Q62, Q64, R07, R09, R58, R63, R68, and R78. ‡ICD-10 codes: Y00, Y03, Y04, Y08, Y09, Y12, Y14, Y26, Y30, Y33, Y85, and Y86.

Table 4: Crude mortality rates for all causes of death in all observed mortalities (n=7189) in the cohort (n=91 963) in 2000–16, by security level

The use of mandatory national registries is a major strength of the study. The datasets are linked using unique identifiers, minimising the risk of linkage biases. Moreover, all deaths are classified according to the ICD-10 criteria²¹ and cause of death categories are reported according to individual ICD codes, minimising the risk of information bias. Having a large national cohort followed up for 17 years enables stratified analysis, which is another major strength of the study.

An important limitation is the absence of information on background demographic, ethnicity, sociocultural, and health variables in our dataset, which means we could not adjust for relevant pre-existing factors and conditions that might be related to mortality and prison security level. The differences in gender and age between people in high-security and low-security units could influence the observed difference in mortality rates. Although we included both gender and age at release as

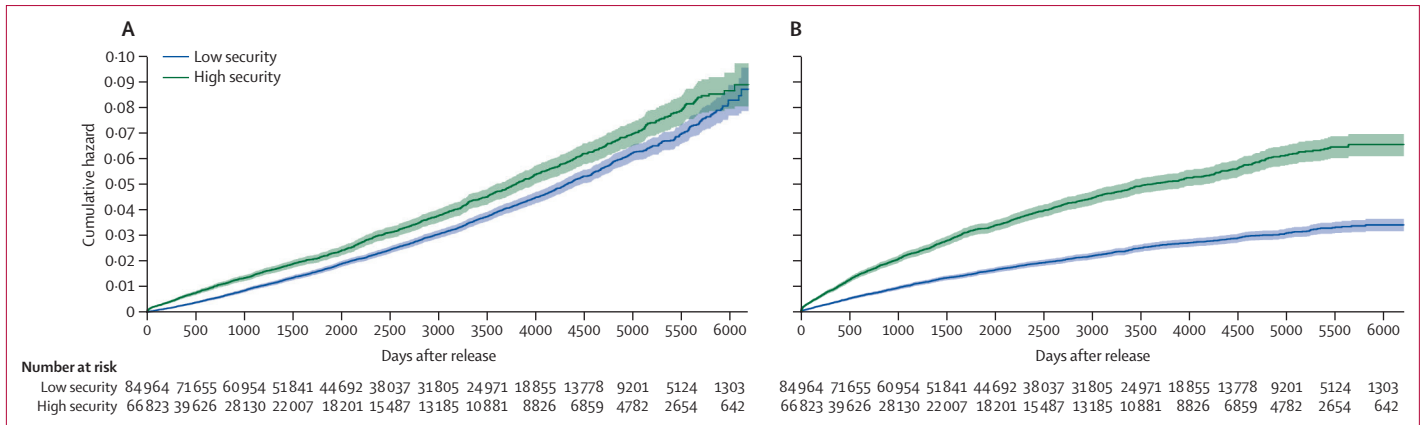


Figure: Cumulative hazard for causes of death after release from high-security and low-security prisons
Cumulative hazard for internal (A) and external (B) causes of death in Norway, stratified by prison security level.

	Internal cause of death		External cause of death		Total	
	Adjusted HR (95% CI)	p value	Adjusted HR (95% CI)	p value	Adjusted HR (95% CI)	p value
Male (reference: female)	1.02 (0.91-1.15)	0.73	1.09 (0.95-1.25)	0.22	1.12 (1.02-1.22)	0.013
Age at release	1.10 (1.10-1.10)	<0.0001	1.01 (1.01-1.02)	<0.0001	1.06 (1.06-1.07)	<0.0001
Security level						
Low security (reference)	..	..	..	..	..	..
High security	1.45 (1.33-1.59)	<0.0001	1.75 (1.60-1.91)	<0.0001	1.53 (1.44-1.62)	<0.0001
Length of incarceration						
0-6 months (reference)	..	..	..	..	..	..
6-12 months	1.05 (0.90-1.23)	0.53	1.41 (1.23-1.61)	<0.0001	1.20 (1.09-1.33)	0.0003
12-24 months	0.94 (0.77-1.15)	0.53	1.14 (0.92-1.40)	0.22	1.03 (0.90-1.18)	0.69
>24 months	0.55 (0.41-0.74)	0.0001	0.54 (0.37-0.78)	0.0011	0.53 (0.42-0.66)	<0.0001
Type of crime						
Public order (reference value)	..	..	..	..	..	..
Drug and alcohol-related offences	1.22 (1.11-1.34)	0.0001	1.46 (1.30-1.65)	<0.0001	1.32 (1.23-1.41)	<0.0001
Sexual offences and violence	0.80 (0.71-0.90)	0.0001	1.11 (0.98-1.26)	0.11	0.95 (0.87-1.03)	0.21
Offences for profit	0.81 (0.72-0.91)	0.0005	1.10 (0.96-1.26)	0.17	0.90 (0.82-0.98)	0.013
Homicide and attempted homicide	1.37 (0.90-2.09)	0.14	1.63 (1.05-2.52)	0.029	1.43 (1.06-1.92)	0.018
Incarcerations and security level interaction	1.05 (1.02-1.09)	0.0016	1.11 (1.09-1.13)	<0.0001	1.09 (1.07-1.11)	<0.0001

Table 5: Factors associated with internal causes, external causes, and all-cause mortality based on an adjusted regression model

covariates in the regression models, data on gender-specific and age-standardised mortality rates were not available. The absence of these mortality rates should be taken into account when considering the validity of the results.

With regard to external validity, it is likely that people imprisoned in Norway and other countries characterised by low prison rates are more selected with regard to serious and violent crimes or have higher rates of mental illness than people imprisoned in countries characterised by high prison rates.³⁰ However, regardless of the prison population rate in a country, there are likely important similarities between low-security and high-security facilities. A study found that the

demographic profile of prisoners being held in open prisons in England and Wales and Norway was roughly similar.¹⁹ With these broad similarities in mind, our findings might be generalisable to other countries where there are distinctions made between high-security and low-security prisons.

Our results show high mortality rates in people released from prisons, with a substantial association between release from high-security prisons and external causes of death. Therefore, prison security level could be an important factor for understanding the negative health consequences of incarceration. Our results are important for the current debate on the health outcomes of prisoners, and specifically contribute knowledge of

how prison security level is associated with all-cause and cause-specific mortality.

The disparity in mortality outcomes show that prison could be an important point for public health interventions. Prison policies should promote initiatives that address the health needs of people in prison (eg, disease prevention programmes and health education). Important intervention points might include smoking cessation, physical activity, and nutrition. For health-care professionals, particular attention to health and opportunities for implementing health interventions might be warranted for individuals incarcerated in and released from high-security prisons. Prison provides a rare opportunity to screen for and treat both somatic and mental illness and thereby improve the short-term and long-term health for people in prison. Increased knowledge of the risk and causes of death after release from high-security prison could emphasise preventive efforts and guide policies to improve outcomes.¹³ Being released with community supervision has been found to reduce the risk of mortality compared with release with no support¹² and might be a way to improve transitional care for people released from high-security prisons. In addition, overdose prevention programmes, such as enrolment in opioid agonist treatment and take-home naloxone, should be introduced before release.^{31,32}

Contributors

AB and MRS designed the study. AB extracted the data and MRS prepared the data and did the analyses. MRS, AB, and IS contributed to the interpretation of the data. IS did the literature search. AB, MRS, and IS wrote the initial draft and contributed to writing the final manuscript. MRS, AB and IS had access to the data used in the study. MRS and AB accessed and verified the data.

Declaration of interests

We declare no competing interests.

Data sharing

This population study was based on individual-level data from The Norwegian Prison Registry (held by the Directorate of Norwegian Correctional Service) and the Norwegian Cause of Death Register (held by the Norwegian Institute of Public Health). The ethical approval of this research project does not include permission to publicly share the raw data. Qualifying researchers can apply for access to relevant data from the Norwegian Institute of Public Health and the Directorate of Norwegian Correctional Service on approval from the Regional Committees for Medical and Health Research Ethics.

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References

- World Prison Brief. International Centre of Prison Studies. 2021. https://www.prisonstudies.org/sites/default/files/resources/downloads/world_prison_population_list_13th_edition.pdf (accessed Oct 6, 2021).
- Dumont DM, Brockmann B, Dickman S, Alexander N, Rich JD. Public health and the epidemic of incarceration. *Annu Rev Public Health* 2012; **33**: 325–39.
- Friestad C. Socio-economic status and health in a marginalized group: the role of subjective social status among prison inmates. *Eur J Public Health* 2010; **20**: 653–58.
- The Lancet Public Health. US mass incarceration damages health and shortens lives. *Lancet Public Health* 2019; **4**: e311.
- Kajeepeeta S, Mauro PM, Keyes KM, El-Sayed AM, Rutherford CG, Prins SJ. Association between county jail incarceration and cause-specific county mortality in the USA, 1987–2017: a retrospective, longitudinal study. *Lancet Public Health* 2021; **6**: e240–48.
- Forsyth SJ, Carroll M, Lennox N, Kinner SA. Incidence and risk factors for mortality after release from prison in Australia: a prospective cohort study. *Addiction* 2018; **113**: 937–45.
- Kouyoumdjian FG, Kiefer L, Wobeser W, Gonzalez A, Hwang SW. Mortality over 12 years of follow-up in people admitted to provincial custody in Ontario: a retrospective cohort study. *CMAJ Open* 2016; **4**: e153–61.
- Zlodre J, Fazel S. All-cause and external mortality in released prisoners: systematic review and meta-analysis. *Am J Public Health* 2012; **102**: e67–75.
- Rosen DL, Schoenbach VJ, Wohl DA. All-cause and cause-specific mortality among men released from state prison, 1980–2005. *Am J Public Health* 2008; **98**: 2278–84.
- Kinner SA, Preen DB, Kariminia A, et al. Counting the cost: estimating the number of deaths among recently released prisoners in Australia. *Med J Aust* 2011; **195**: 64–68.
- Bukten A, Stavseth MR, Skurtveit S, Tverdal A, Strang J, Clausen T. High risk of overdose death following release from prison: variations in mortality during a 15-year observation period. *Addiction* 2017; **112**: 1432–39.
- Binswanger IA, Blatchford PJ, Mueller SR, Stern MF. Mortality after prison release: opioid overdose and other causes of death, risk factors, and time trends from 1999 to 2009. *Ann Intern Med* 2013; **159**: 592–600.
- Binswanger IA, Stern MF, Deyo RA, et al. Release from prison—a high risk of death for former inmates. *N Engl J Med* 2007; **356**: 157–65.
- Spittal MJ, Forsyth S, Borschmann R, Young JT, Kinner SA. Modifiable risk factors for external cause mortality after release from prison: a nested case-control study. *Epidemiol Psychiatr Sci* 2019; **28**: 224–33.
- Spittal MJ, Forsyth S, Pirkis J, Alati R, Kinner SA. Suicide in adults released from prison in Queensland, Australia: a cohort study. *J Epidemiol Community Health* 2014; **68**: 993–98.
- Haglund A, Tidemalm D, Jokinen J, et al. Suicide after release from prison: a population-based cohort study from Sweden. *J Clin Psychiatry* 2014; **75**: 1047–53.
- McLeod KE, Martin RE. Solitary confinement, post-release health, and the urgent need for further research. *Lancet Public Health* 2020; **5**: e74–75.
- Gaes GG, Camp SD. Unintended consequences: experimental evidence for the criminogenic effect of prison security level placement on post-release recidivism. *J Exp Criminol* 2009; **5**: 139–62.
- Mjåland K, Laursen J, Schliehe A, Larmour S. Contrasts in freedom: comparing the experiences of imprisonment in open and closed prisons in England and Wales and Norway. *Eur J Criminol* 2021; published online Dec 31. <https://doi.org/10.1177/14773708211065905>.
- Bukten A, Lund IO, Rognli EB, et al. The Norwegian Offender Mental Health and Addiction Study—design and implementation of a national survey and prospective cohort study. *Subst Abuse* 2015; **9** (suppl 2): 59–66.
- WHO. The ICD-10 classification of mental and behavioural disorders. Clinical descriptions and diagnostic guidelines. Geneva: World Health Organization, 1993.
- Pedersen AG, Ellingsen CL. Data quality in the Causes of Death Registry. *Tidsskr Nor Lægeforen* 2015; **135**: 768–70.
- Wildeman C, Andersen LH. Solitary confinement placement and post-release mortality risk among formerly incarcerated individuals: a population-based study. *Lancet Public Health* 2020; **5**: e107–13.
- Chang Z, Lichtenstein P, Larsson H, Fazel S. Substance use disorders, psychiatric disorders, and mortality after release from prison: a nationwide longitudinal cohort study. *Lancet Psychiatry* 2015; **2**: 422–30.
- Andersen HS, Sestoft D, Lillebaek T, Gabrielsen G, Hemmingsen R, Kramp P. A longitudinal study of prisoners on remand: psychiatric prevalence, incidence and psychopathology in solitary vs. non-solitary confinement. *Acta Psychiatr Scand* 2000; **102**: 19–25.

- 26 Brinkley-Rubinstein L, Sivaraman J, Rosen DL, et al. Association of restrictive housing during incarceration with mortality after release. *JAMA Netw Open* 2019; **2**: e1912516.
- 27 Patterson EJ. The dose-response of time served in prison on mortality: New York State, 1989–2003. *Am J Public Health* 2013; **103**: 523–28.
- 28 Ranapurwala SI, Shanahan ME, Alexandridis AA, et al. Opioid overdose mortality among former North Carolina inmates: 2000–2015. *Am J Public Health* 2018; **108**: 1207–13.
- 29 Radeloff D, Stoeber F, Lempp T, Kettner M, Bennefeld-Kersten K. Murderers or thieves at risk? Offence-related suicide rates in adolescent and adult prison populations. *PLoS One* 2019; **14**: e0214936.
- 30 Fazel S, Ramesh T, Hawton K. Suicide in prisons: an international study of prevalence and contributory factors. *Lancet Psychiatry* 2017; **4**: 946–52.
- 31 Moradmand-Badie B, Tran L, Oikarainen N, et al. Feasibility and acceptability of take-home naloxone for people released from prison in New South Wales, Australia. *Drug Alcohol Rev* 2021; **40**: 98–108.
- 32 Marsden J, Stillwell G, Jones H, et al. Does exposure to opioid substitution treatment in prison reduce the risk of death after release? A national prospective observational study in England. *Addiction* 2017; **112**: 1408–18.