Imprisonment, community sanctions and mortality by cause of þÿ d e a t h a m o n g p a t i e n t s w i t h s u b s t a n c e u s e d i s o r d follow-up using Finnish register data

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Imprisonment, community sanctions and mortality by cause of death among patients with substance use disorder – a 28-year follow-up using Finnish register data

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ABSTRACT

Background: The first few weeks' post-imprisonment are associated with high mortality, particularly among individuals with a history of substance use. Excess risk may vary by societal context due to a range of penal systems and substance use patterns. Using data on Finnish individuals who had sought treatment for substance use, we studied the association between criminal sanctions with cause-specific mortality.

Methods: The database contained 10887 individuals who had sought treatment between 1990 and 2009. Their treatment data were combined with register data on imprisonments and community sanctions and weekly mortality between 1992 and 2015. Mortality was analysed using discrete-time survival models. We controlled for age and sociodemographic factors, and analysed whether education, type of substance used and the type of latest sentence modified the associations.

Findings: Mortality was high in the first two weeks after sanctions (all-cause odds ratio [OR] 2.61, 95% confidence interval [CI] 1.67–4.07; drug-related deaths OR 8.52, 95% CI 4.64–15.7). Excess risk declined over time (OR after 12 weeks: 1.19, 95% CI 1.07–1.31). Most of the excess risk was attributable to external causes. Mortality was low during imprisonment, but not during community sanctions. The patterns were similar by level of education, substance use and the type of latest sentence.

Conclusions: Community sanctions were not associated with mortality among people with substance use disorders. Mortality was low during imprisonment, but high post-release. Criminal sanctions should be better utilised as intervention touchpoints and follow-up resources should target prisoners with substance use treatment history to reduce post-release mortality.

1. Introduction

The first two to four weeks after incarceration are a recognised risk period for former prisoners. For all-cause mortality, a 13-fold increase in the mortality rate compared to the general population has been reported (Binswanger et al., 2007). A threefold to eightfold increase in relative risk for a drug-related death has been reported when comparing the first two weeks to the subsequent ten weeks (Merrall et al., 2010). Known risk factors for death after release from prison are ethnicity (white; Testa et al., 2018), lower socioeconomic status (low education, unstable accommodation; Forsyth et al., 2018) and mental health problems (Testa et al., 2018). Substance use was associated with post-release mortality in a Swedish study (Chang et al., 2015) but not in an American study (Testa et al., 2018).

To date, no Finnish studies on all-cause mortality during imprisonment or community sanction have been made. Generally, little is known about the risk of death during community sanctions or probation. Wildeman and others (2019) documented the time on probation as being associated with higher all-cause mortality than imprisonment, and Sattar (2003) found an increased risk of suicide during probation. We did not find studies that would have explicitly analysed mortality during community service.

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Van Draanen and others (2020) showed that low level of education and other socioeconomic indicators for marginalization were associated with opioid-related overdose. For former prisoners and present parolees, lower education has been associated with increased mortality (Forsyth et al., 2018; Patterson, 2013, respectively). Rosen and others (2008) found lower mortality for former prisoners who had not graduated from high school than other non-graduated North Carolina state residents and higher mortality for the graduated ex-prisoners compared to other graduated state residents. They theorise this is attributable to changes in access to health care (Rosen et al., 2008). However, results concerning the association between socioeconomic indicators and mortality should be considered with care as the relative post-imprisonment mortality between socioeconomic groups might differ from changes in absolute mortality.

Mortality during imprisonment varies by cause of death. In a study undertaken in England and Wales, a reduced rate of mortality for natural causes of death during imprisonment was reported (Fazel and Benning, 2006). They also reported a threefold increase in all-cause mortality during imprisonment, partially driven by suicide mortality. An earlier Finnish study found threefold suicide mortality among Finnish male prisoners compared to the general male population (Joukamaa, 1997). An American study reported lower all-cause mortality for prisoners in local jails than the general population, but no differences in suicide, homicide or drug-related mortality rates (Kim et al., 2007).

Despite studies documenting increased mortality post-imprisonment, particularly among individuals with substance use history, it is not known how this excess risk depends on the context or by individual risk factors such as the socioeconomic status of the individual. For example, both the context of imprisonment and the nature of substance use may vary across countries. In Finland, the incarceration rate is comparatively low (for example, 53 prisoners per 100000 inhabitants in Finland cf. 639 prisoners per 100000 in the US (World Prison Brief, 2020)) and it has been at that level since the 1990 s (Pratt, 2007). Pratt (2007) describes the Finnish penal system as part of "Scandinavian exceptionalism" whereby the sentence is recognised as the punishment so that living conditions in the facilities can be humane. The objective of the Criminal Sanctions Agency in Finland is to prepare the offenders for a crime-free life and improve their life management (Laki Rikosseuraamuslaitoksesta 953/, 2009, 2010). The sentences are also short, 42% of imprisonments were for less than three months with an average length of 11.2 months (Statistics Finland, 2018).

Further, the context of substance use may vary. Globally, mortality from substance use disorders (SUDs) in the general population has increased while mortality from alcohol use disorder (AUD) has decreased (GBD 2015 Mortality and Causes of Death Collaborators, 2016). In Finland, however, both mortality and years of life lost due to AUDs continue to be high (GBD 2015 Mortality and Causes of Death Collaborators, 2016). Problematic drug use has also developed from a rather small-scale and amphetamine focused phenomenon in the 1990 s (Partanen et al., 2000) to a larger phenomenon including both amphetamines and opioids (Rönkä et al., 2020). In Finland, buprenorphine is the most commonly misused opioid (Impinen and Rönkä, 2020). A review by Yokell and others (2011) noted that buprenorphine has a lower potential for overdose mortality and that its use is associated with safer injection practices. The prevalence of SUDs in Finnish prisoners is comparatively high (Lintonen et al., 2011) and almost ten-fold than the prevalence in the general population (Joukamaa et al., 2010).

Generally, using register-based data when analysing SUDs and AUDs is problematic. In Finland it is known that AUDs are poorly recorded in registers and when they are, they have already evolved into a more serious form (Rautiainen et al., 2018). The *Register-based follow-up study on criminality, health and taxation of inpatients and outpatients entered into substance abuse treatment* (RIPE; Pitkänen et al., 2016) was initiated to follow the life course of patients entering substance use treatment. Use of data on people with a history of substance use provides important implications for the development of substance use treatment and the cooperation of authorities responsible of those services.

The aim of this study was to use register-based data on people who have sought treatment for SUD to analyse the association of criminal sanctions, including imprisonment and community sanctions (ICS), and mortality by cause of death. We also analysed suicide-specific mortality and whether education, type of last sentence or the type of substance used moderated the amount of excess mortality during the first weeks after release.

We hypothesized that post-release mortality would not be as high as reported in other countries due to lower heroin use. Previous descriptive results on these data did not report a high number of deaths following incarceration (Pitkänen et al., 2016). We did not have a strong hypothesis on in-prison mortality; Fazel and Benning (2006) reported a threefold mortality rate when external causes such as suicides were included, and a similar proportion of suicides from all deaths as found by Joukamaa in Finnish data (Joukamaa, 1997). Joukamaa reported a threefold suicide mortality rate compared to general population (Joukamaa, 1997), implying increased all-cause prison mortality rate.

2. Material and methods

2.1. Data

The RIPE data contains information on 10887 patients who had sought treatment from any of three treatment units of the A-Clinic Foundation in 1990–2009. The A-Clinic Foundation is a non-profit non-governmental organisation providing both in- and outpatient treatment for AUDs, SUDs and behavioural addictions. In 1990 the foundation had a little under 19000 patients with roughly 125000 visits for treatment. The study data come from three treatment units: the Järvenpää addiction hospital (JAH) and two outpatient clinics in Helsinki (clinics in Arabianranta and Kettutie). The treatment contacts of the patients varied from single visits to longer treatments. The outpatient clinics provided low-threshold social services in addition to health care. Data and the clinics have been described more extensively by Pitkänen et al. (2020).

Permission from Statistics Finland, the National Institute for Health and Welfare and the Criminal Sanctions Agency was obtained for the use of their data regarding education, mortality, hospitalisations and sentences. The National Institute for Health and Welfare gave their permission for us to combine the datasets, after which the data were linked using the government-issued personal identity number. The data were anonymised before analysis. The ethics committee of A-Clinic Foundation approved the study protocol.

2.1.1. Patient data

Data on the day of first clinic visit, gender, time of birth, place of residence (Helsinki or other) and substance use diagnoses were collected from the treatment records for all the patients. Patients were categorised into five groups based on known diagnoses of their substance use. The *Alcohol Only* group contains patients having a diagnosis only of AUD (ICD-10: F10.1 or F10.2x). Patients who received a diagnosis of substance use were divided into three groups: opioid users who also had initiated opioid substitution treatment (Opioid-OST), other opioid users (Opioid-other) and other substance users (Other substance). The *Undiagnosed* group included outpatients who had used walk-in services and psycho-social treatment without appointments with a medical doctor and not been diagnosed with SUD or AUD in any Finnish hospital between 1990 and 2009. Individuals in the Opioid-OST group who had started opioid substitution treatment during the mortality analysis follow-up were assigned to the Opioid-other group prior to the initiation of the opioid substitution treatment.

2.1.2. Sentence data

The Criminal Sanctions Agency provided the sentence data from their client data system. This system contains information on the types

and dates of the sentences. Additionally, information on the reason for release was used to check whether deaths occurred during sentences. Accurate records were available from 1992 until August 2015. Earlier records were entered manually from paper archives and with possible errors which is why the mortality analysis was undertaken from 1992.

The main types of community sanctions in the data were community service and monitoring sentence. Imprisonment can be converted into community service if the sentence does not exceed eight months of imprisonment and the person consents to serve it. Community service is served by working without pay under supervision for 3–4 h at a time usually twice a week. Finland introduced the monitoring sentence in 2011 and it is served usually from home wearing a monitoring device and by participating in an assigned activity for 10–40 h per week (Laki yhdyskuntaseuraamusten täytäntöönpanosta 400/2015, 2015). The use of intoxicating substances is prohibited and is monitored during the sanctions.

The sentence data were cleaned before the mortality analysis. Records with wrong start and end dates or missing type were removed (0.11% of records). Overlapping terms of imprisonment were merged and other overlaps were corrected so that imprisonments were prioritised. If imprisonment started while serving a community sanction, the end of the preceding community sanction was corrected to be the start of the imprisonment (see supplement for details).

2.1.3. Education and mortality data

Statistics Finland provided the data from the national Register of Completed Education and Degrees on the highest attained education of the patients between 1990 and 2018. The register did not contain information on completed basic education, so missing educational level (n = 5308, 48.7%) was categorised as *No education or basic education*. Other levels were categorised by length of education required: *upper secondary education* (12 years), *bachelor's degree* (15 years) and *master's degree or higher* (17 years). Statistical modelling assumed that education was obtained prior to substance use.

Statistics Finland also provided the causes and dates of death of the patients up to the end of 2018. Causes of death were coded before 1995 using the National Cause of Death Classification which was matched to the corresponding ICD-9 coding (see supplement for details). Then the ICD-9 and ICD-10 codes were used to create a binary variable indicating a drug-related death defined per Selection B of the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2012). EMCDDA (2012) defines a drug-related death to be "caused directly by the consumption of drugs of abuse" and that they occur shortly after consumption. Formally, the definition is based on multiple ICD underlying causes of death codes. Causes of death were also available for the whole follow-up with the 54-class classification system used by Statistics Finland (Statistics Finland, 1998). Cause of death was missing for 14 deaths.

2.2. Statistical analysis

The follow-up of each patient was divided into one-week episodes from January 1, 1992 to August 31, 2015. An incomplete episode at the end was discarded, resulting in a maximum of 1234 episodes for one patient. Patients entered the study cohort and were considered to be at risk of death at the time of first known treatment contact, their 18th birthday or January 1, 1992, whichever was the latest. Time before 18th birthday was excluded because the criminal justice system for juvenile delinquents is different. Time before first treatment contact was removed to avoid immortal time bias. Since seven patients were excluded due to a missing opioid substitution treatment initialisation date, and 46 had died before 1992, 10834 patients were included in the mortality analysis. Using the sentence data, an episode was coded as community sanction or imprisonment time if at least four days of the episode were in this category. If the patient had died during their sentence, that person was marked as having served that sentence for that episode even if the four days were not reached. Conversely, if the patient had died after their sentence, they were marked as not having served a sentence, even if the four days were reached. We observed 3479 deaths during the follow-up.

Death during an episode was the response variable. For drug-related mortality, other causes of death were censored. Due to the large number of suicides during sentences, a supplementary *post-hoc* analysis on suicide-specific mortality was performed. Results of this analysis are in the supplementary material.

Weekly mortality was analysed using a discrete-time survival model with logistic regression (Steele, 2011) and implemented with speedglm-package (Enea, 2017) of R program (v. 4.0.2; R Core Team, 2020). In the cross-tabulations, the p-values were computed with logistic regression. All p-values are uncorrected for multiple comparisons.

We implemented four successive models. Model 1 is purely descriptive and includes only gender, age and calendar time as controls. Model 2 introduces the key variables of interest: imprisonment, community sanction, and time since imprisonment. Mortality in these states is estimated with respect to a reference group that is patients who did not experience imprisonment or community sanctions. Model 3 further controls for sociodemographic factors and substance use. In Model 4, we introduced interactions between substance use and calendar time to investigate violations of the assumption of proportional hazards. The estimated sizes and directions of associations in Model 4 were similar to those in Model 3 for all-cause and drug-related mortality and have been placed into the supplementary material.

Additional interaction models were fitted to explore hypotheses concerning interactions of education, substance use grouping and type of latest sentence (imprisonment vs community sentence) with the immediate time of release. Education was binarised before modelling interaction with the categorised week variable to avoid separation. The interaction was also further analysed by stratifying the data set according to the binarised education. The statistical significance of adding the interactions was examined with likelihood ratio tests. This extensive modelling of education enables a comprehensive understanding of the differences in post-release excess relative risk for people with different levels of education.

In the mortality analysis, weeks following ICSs were separated to three classes (weeks 1–2, 3–12 and weeks after the 12th week). We did not observe any drug-related deaths during weeks 3–12 following community sanctions. This prevented the convergence of models estimating drug-related mortality when time after community sanctions and imprisonments was separated. Coefficients for estimating mortality in weeks 3–12 and > 12 were combined in the analysis to enable convergence. The observed mortality risk patterns were similar in terms of effect size and direction for both post-imprisonment time and time after community sanctions and have been placed in the appendix. In the results section, time following imprisonments and community sanctions have been combined for clarity of presentation and to enable comparisons between all-cause and drug-related mortality.

Sensitivity analysis was performed in multiple ways. First, age was specified with a linear and a quadratic transformation. For drug-related mortality, we used only linear age because regression with quadratic age did not converge. Second, the categorisation of the week-variable was changed, and it was included in the model as continuous with inverse exponential transformation. Third, calendar time was included in the model in three ways: piecewise with six-year intervals, with a linear and a quadratic transformation. Fourth, the three substance use groups (Opioid-other, Opioid-OST and Other substance) were grouped together. Fifth, the three highest educational levels were grouped together. Results were qualitatively robust to these changes.

3. Results

The data contained 10887 patients and 7284205 episodes. The mortality analysis included on average 672 episodes (13 years) per

person. One third of the patients had a history of ICS (Table 1). Men, opioid users and patients with low levels of education were more likely to have had ICSs than women, those with only alcohol use, and with higher education. By the end of 2018, a total of 4098 (37.6%) patients had died, with a similar proportion dying in both ICS groups.

3.1. Deaths by cause

Of the 4098 deaths, 2810 were among individuals with no recorded ICSs and 1288 among individuals with an ICS history (Table 2). Drug-related death was more common among patients with an ICS history than among those without ICS (15% cf. 5% of all deaths). External causes of death were 53% of all deaths among those with ICS history, and 58% among those without. Among non-external causes, diseases of the circulatory system and neoplasms were both more common for patients without an ICS history. We also identified 33 patients who died during their sentence, all of whom were men (Table 2).

Fig. 1 presents the proportions of causes of death for the patients relative to their last sentence, proportions for patients without ICSs are presented on the left. Deaths are from January 1, 1992 to August 31, 2015 due to the extent of the sentence data. External causes of death were more pronounced during and after sentences with the effect lasting 2–5 years. Cardiovascular diseases covered a constant proportion of the deaths while the proportion of neoplasms was lower during and immediately after the sentences.

Fig. 2 presents the proportion of drug-related deaths over the time since last sentence for January 1, 1992 to August 31, 2015. The proportion of drug-related deaths increased only after the sentences with the increased proportion remaining for 2–5 years. Most of the drug-related deaths were classified as poisonings without alcohol (cause of death 48, ICD-10: X40-X44, X46-X49, Y10-Y15) in the 54-class classification system used by Statistics Finland.

3.2. All-cause mortality

Regression analysis of the association between ICS and all-cause mortality is presented in Table 3 and visualised in Fig. 3. Descriptive Model 1 shows the overall association of mortality with gender, age and calendar time. The coefficients are in line with expectations, as male gender, higher age, and earlier calendar time are associated with higher mortality.

Model 2 introduces the key variables of interest. Time in prison was associated with strongly decreased mortality (OR 0.215, 95% CI 0.126–0.364) however time of community sanctions was not statistically significantly associated with mortality (OR 1.29, 95% CI 0.815–2.03). The first two weeks after the sentence were a time of elevated risk (OR 2.74, 95% CI 1.76–4.28) and the increased risk remained even beyond the first 12 weeks (OR 1.26, 95% CI 1.14–1.39). Having ICS history prior to treatment predicted a minor increase in mortality.

Model 3 further controls for sociodemographic factors and type of substance use. As expected, lower levels of education and residence in Helsinki were associated with increased mortality. All groups other than Opioid-OST had increased mortality when compared to the Undiagnosed group, in line with previous research. The coefficients of the key variables remained fairly stable after this addition, although association of ICS history with mortality disappeared. A violation of proportional hazards assumption was observed in Model 4, but the sizes and directions of the effects were similar to those in Model 3 and have been placed into the supplementary material.

3.3. Drug-related mortality

Results of analysis for drug-related mortality are presented in Table 4 and visualised in Fig. 3. As for all-cause mortality, Model 1 is purely descriptive and shows expected results for drug-related mortality as male gender and younger age are associated with increased mortality. An increasing drug-related mortality over the follow-up is also observed.

Again, Model 2 introduces the key variables of interest and shows that time of imprisonment is associated with decreased mortality (OR 0.094, 95% CI 0.013–0.678) and how time of community sanctions is not associated with mortality (OR 0.795, 95% CI 0.195–3.24). The first two weeks show an 11-fold increase in mortality (OR 11.2, 95% CI

Table 1
Demographics by gender and imprisonment and community sanction (ICS) information. Information on ICSs was retrieved from the client management system of Criminal Sanctions Agency Finland. Drug-related death was defined per Selection B of European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2012). (10887 individuals).

	Gender								Total						
	Men				Women										
	No ICSs		ICSs		No ICSs		ICSs		No ICSs		ICSs		All		Birth year
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	Mean
Total	4352	59.4%	2979	40.6%	2695	82.0%	591	18.0%	7317	67.2%	3570	32.8%	10887	100.0%	1961.5
Substance use group															
Opioid-OST	188	4.3%	333	11.2%	115	4.3%	89	15.1%	303	4.1%	422	11.8%	725	6.7%	1975.5
Opioid-other	338	7.8%	739	24.8%	251	9.3%	167	28.3%	589	8.0%	906	25.4%	1495	13.7%	1973.0
Alcohol only	1548	35.6%	679	22.8%	992	36.8%	106	17.9%	2540	34.7%	785	22.0%	3325	30.5%	1954.1
Other substance	708	16.3%	688	23.1%	641	23.8%	171	28.9%	1349	18.4%	859	24.1%	2208	20.3%	1965.4
Undiagnosed	1570	36.1%	540	18.1%	966	35.8%	58	9.8%	2536	34.7%	598	16.8%	3134	28.8%	1958.0
Place of residence															
Elsewhere in Finland	1662	38.2%	1301	43.7%	1286	47.7%	310	52.5%	2948	40.3%	1611	45.1%	4559	41.9%	1964.7
Helsinki	2690	61.8%	1678	56.3%	1679	62.3%	281	47.5%	4369	59.7%	1959	54.9%	6328	58.1%	1959.2
Education															
No education or basic education	1819	41.8%	1874	62.9%	1232	45.7%	383	64.8%	3051	41.7%	2257	63.2%	5308	48.8%	1962.4
Upper secondary	1735	39.9%	985	33.1%	1106	41.0%	167	28.3%	2841	38.8%	1152	32.3%	3993	36.7%	1962.4
Bachelor's degree	515	11.8%	94	3.2%	469	17.4%	31	5.2%	984	13.4%	125	3.5%	1109	10.2%	1956.7
Master's degree or higher	283	6.5%	26	0.9%	158	5.9%	10	1.7%	441	6.0%	36	1.0%	477	4.4%	1956.2
Living 31.12.2018															
Living 31.12.2018	2384	54.8%	1823	61.2%	2123	78.8%	459	77.7%	4507	61.6%	2282	63.9%	6789	62.4%	–
Dead (incl. drug-related death)	1968	45.2%	1156	38.8%	842	31.2%	132	22.3%	2810	38.4%	1288	36.1%	4098	37.6%	–
Dead (only drug-related death)	104	2.4%	170	5.7%	42	1.6%	20	3.4%	146	2.0%	190	5.3%	336	3.1%	–

Table 2
Deaths by cause and by imprisonment and community sanction (ICS) information. Drug-related death was defined per Selection B of European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2012). Causes of death were classified with the 54-class classification system (Statistics Finland, 1998). Information on ICSs was retrieved from the client management system of Criminal Sanctions Agency Finland. Deaths by 31.12.2018. (4098 deaths).

	No ICSs		ICSs			Total		Death during sentence	
	n	%	n	%	*p*	n	%	n	%
Total	2810	100.0%	1288	100.0%		4098	100.0%	33	100.0%
Drug-related death									
No	2664	94.8%	1098	85.2%		3762	91.8%	30	90.9%
Yes	146	5.2%	190	14.8%	***	336	8.2%	3	9.1%
External cause of death									
Alcohol related diseases and poisonings (41)	716	25.5%	281	21.8%	*	997	24.3%	1	3.0%
Suicides (50)	284	10.1%	125	9.7%		409	10.0%	14	42.4%
Accidents, excl. poisonings (42–47, 49)	243	8.6%	107	8.3%		350	8.5%	0	0.0%
Poisonings other than alcohol (48)	217	7.7%	197	15.3%	***	414	10.1%	3	9.1%
Assault (51)	32	1.1%	34	2.6%	***	66	1.6%	4	12.1%
Non-external cause of death									
Diseases of the circulatory system (27–30)	540	19.2%	195	15.1%	**	735	17.9%	5	15.2%
Neoplasms (04–22)	349	12.4%	103	8.0%	***	452	11.0%	0	0.0%
Other cause of death or cause of death missing	429	15.3%	246	19.1%	–	675	16.5%	6	18.2%

- Not tested.
*** p < .001;
** p < .01;
* p < .05;

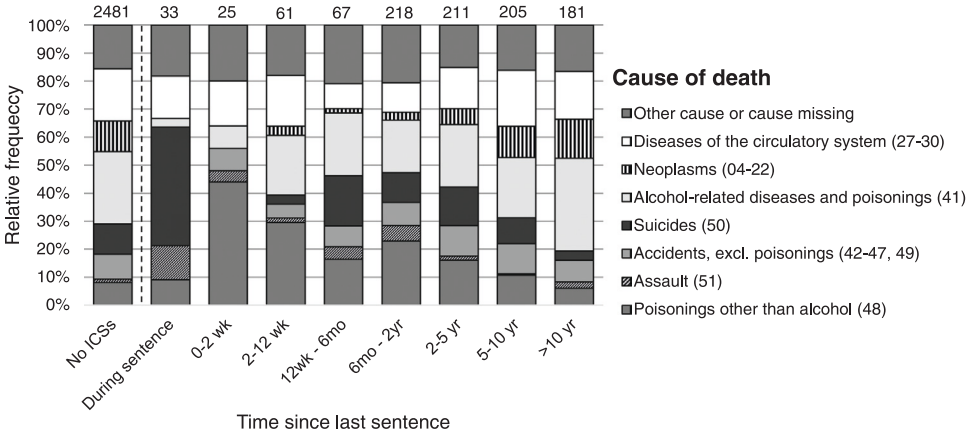

Fig. 1. Relative frequencies of causes of deaths over time since last sentence. Cause of death classification by Statistics Finland (Statistics Finland, 1998). Deaths from January 1, 1992 to August 31, 2015. (3482 deaths).

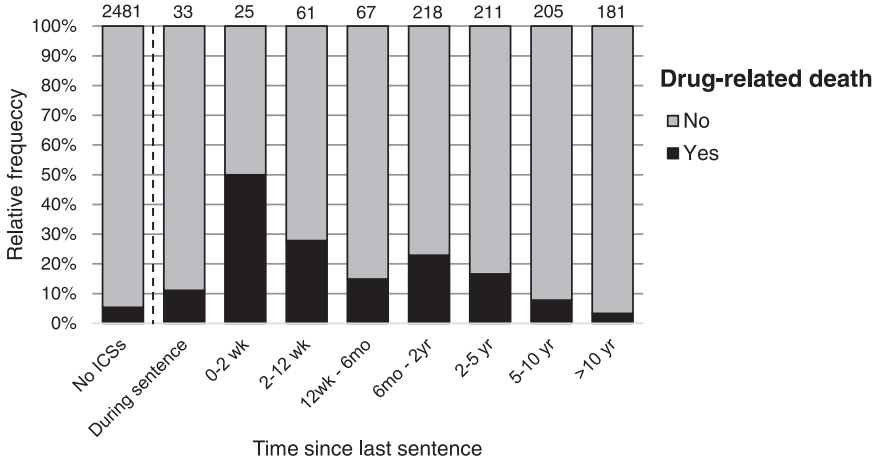

Fig. 2. Relative frequency of drug-related deaths over time since last sentence. Drug-related death was defined per Selection B of European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2012). Deaths from January 1, 1992 to August 31, 2015. (3482 deaths).

Table 3
Odds ratio (OR) estimates for all-cause mortality. Mortality was followed from January 1, 1992 to August 26, 2015. ICS = Imprisonment or community sanction. OST = Opioid substitution treatment. AIC = Akaike information criterion. (10834 individuals, 7284205 episodes).

	Model 1			Model 2			Model 3		
		95% CI bounds			95% CI bounds			95% CI bounds	
	OR	lower	upper	OR	lower	upper	OR	lower	upper
Male gender	1.73	1.60	1.87	1.64	1.51	1.78	1.66	1.53	1.80
Calendar year	0.98	0.98	0.99	0.98	0.97	0.98	0.98	0.98	0.99
Year in age	1.02	1.00	1.03	1.01	1.00	1.03	1.00	0.99	1.02
Year in squared age	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Time of community sanction				1.29	0.82	2.03	1.29	0.81	2.03
Time of imprisonment				0.21	0.13	0.36	0.20	0.12	0.34
Weeks 1–2 after sentence				2.74	1.76	4.28	2.59	1.66	4.04
Weeks 3–12 after sentence				1.70	1.31	2.22	1.61	1.23	2.10
Weeks > 12 after sentence				1.26	1.14	1.39	1.20	1.09	1.32
ICS history before treatment				1.12	1.02	1.24	1.07	0.97	1.18
Lives in Helsinki							1.22	1.14	1.32
Upper secondary education[a]							0.85	0.79	0.92
Bachelor's degree[a]							0.84	0.74	0.94
Master's degree or higher[a]							0.77	0.65	0.92
Opioid-OST[b]							0.94	0.74	1.21
Opioid-other[b]							1.31	1.14	1.52
Alcohol only[b]							1.75	1.60	1.90
Other substance[b]							1.68	1.51	1.88
Log-likelihood	-29473.02			-29406.79			-29293.69		
Rank	5			11			19		
AIC	58956.04			58835.58			58625.39		

[a] Reference *Basic education or no education*
[b] Reference *Undiagnosed*

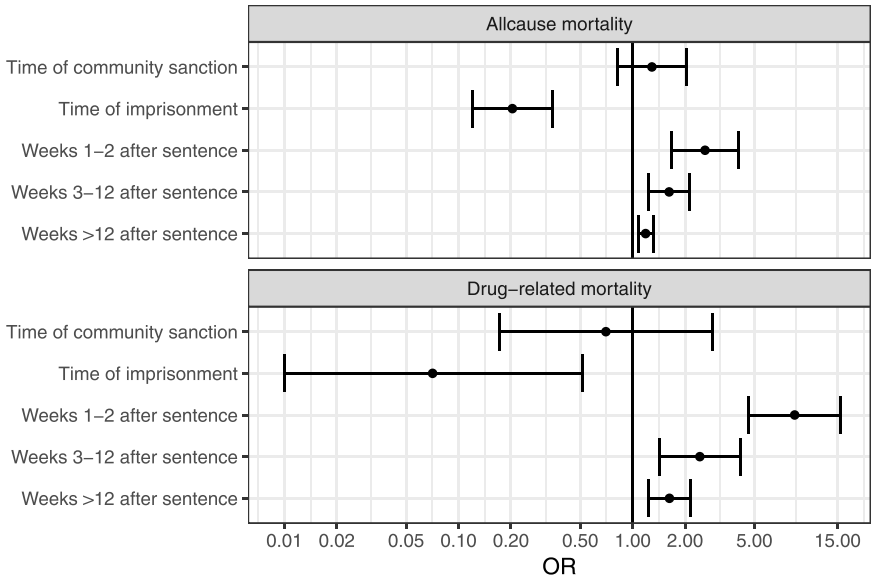

Fig. 3. Odds ratio (OR) estimates for all-cause and drug-related mortality. Drug-related death was defined per Selection B of European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2012). (10833 individuals, 7284205 episodes).

6.10–20.6) and the association remained even beyond the first 12 weeks (OR 2.10, 95% CI 1.58–2.78). Having a history of ICS prior to treatment did not predict an altered risk of death.

Model 3 controlled for sociodemographic factors and type of substance use. Living in Helsinki was not statistically significantly associated with mortality, and education was inversely associated with mortality. In line with expectations, substance use was associated with increased drug-related mortality and having only an AUD did not predict reduced mortality. Addition of these controlling variables further strengthened the protective association of imprisonment (OR 0.072, 95% CI 0.010–0.517), but decreased odds of death for post-imprisonment time (weeks 1–2; OR 8.59, 95% CI 4.67–15.8 and weeks >12; OR 1.65, 95% CI 1.24–2.18). Again, violation of proportional hazards was observed, but the sizes and directions of effects of Model 4 were similar to those in Model 3 and have been placed into the supplementary material.

3.4. Interaction models

We investigated three main interactions with post-sentence mortality by adding them to Model 4: education, type of sentence and substance use. None of these interacted statistically significantly with the week variable. This means that we did not find evidence of differences in change of post-release mortality for patients with different levels of education and for patients in different substance use groups. Similarly, we could not conclude that post-imprisonment mortality was different

Table 4
Odds ratio (OR) estimates for drug-related mortality. Mortality was followed from January 1, 1992 to August 26, 2015. Drug-related death was defined per Selection B of European Monitoring Centre for Drugs and Drug Addiction (EMCDDA, 2012). All other causes of death were censored. ICS = Imprisonment or community sanction. OST = Opioid substitution treatment. AIC = Akaike information criterion. (10834 individuals, 7284205 episodes).

	Model 1			Model 2			Model 3		
		95% CI bounds			95% CI bounds			95% CI bounds	
	OR	lower	upper	OR	lower	upper	OR	lower	upper
Male gender	2.33	1.72	3.15	1.89	1.38	2.58	1.88	1.37	2.56
Calendar year	1.05	1.03	1.08	1.04	1.02	1.07	1.03	1.00	1.05
Year in age	0.93	0.92	0.94	0.93	0.92	0.95	0.96	0.95	0.97
Time of community sanction				0.79	0.20	3.24	0.69	0.17	2.83
Time of imprisonment				0.09	0.01	0.68	0.07	0.01	0.52
Weeks 1–2 after sentence				11.21	6.10	20.58	8.59	4.67	15.77
Weeks 3–12 after sentence				3.20	1.87	5.48	2.45	1.43	4.19
Weeks > 12 after sentence				2.10	1.58	2.78	1.65	1.24	2.18
ICS history before treatment				1.21	0.91	1.61	1.02	0.77	1.36
Lives in Helsinki							1.22	0.95	1.56
Upper secondary education[a]							0.77	0.59	1.00
Bachelor's degree[a]							0.25	0.09	0.68
Master's degree or higher[a]							0.16	0.02	1.16
Opioid-OST[b]							2.44	1.45	4.11
Opioid-other[b]							3.47	2.30	5.25
Alcohol only[b]							0.92	0.54	1.57
Other substance[b]							2.67	1.76	4.06
Log-likelihood	-3041.82			-2992.54			-2951.97		
Rank	4			10			18		
AIC	6091.64			6005.07			5939.94		

[a] Reference Basic education or no education.
[b] Reference *Undiagnosed*.

from mortality after community sanctions.

4. Discussion

Criminal sanctions were strongly associated with mortality among patients who had sought treatment for substance use. While time of imprisonment was strongly associated with decreased risk of death, we did not find evidence of community sanctions being associated with mortality. The first few weeks after release from prison were associated with very high mortality, especially for a drug-related death even in Finland where heroin use is rare. These results provide important insights for the penal system that should be considered to reduce excess mortality among the highly vulnerable population of people with history of substance use treatment who have been incarcerated.

The mortality risk for all-cause or drug-related mortality was not reduced during the time in community sanctions regardless of monitoring and support measures. To our knowledge this was the first study to explore mortality during community sanctions in Europe. Our results of no lower mortality suggests that the monitoring and support measures implemented during community sanction do not help to prevent deaths. A maximum of 30 h of community service can be served by participating in programmes aimed at decreasing substance use (37 §, Laki yhdyskuntaseuraamusten täytäntöönpanosta 400/2015, 2015) providing a touch point to the offenders. The bi-weekly contact with authorities and co-workers at the service location seem unable to produce routines which could reduce mortality. Patients are also required to be sober during service hours, but these brief periods seem not to help in lowering mortality. These results suggest that cooperation between the authorities responsible for organising community service and aftercare of released prisoners should be enhanced.

The increased risk of all-cause or drug-related death after release did not interact with education, implying that the excess risk is not moderated by the socioeconomic status of the individual. Interpretation of this result requires care. The overall risk of death is strongly patterned by level of education, such that higher levels of education are associated with lower mortality. We studied changes in relative risk, and excess relative risk after release was similar for all education levels. However, given the overall lower absolute level of mortality among the better educated, the absolute excess risk was also lower among the better educated. This means that education continues to matter for the risk of death after release, but the relative excess risk is of similar magnitude across all levels of education. Prior studies on socioeconomic resources, for which education is a proxy, also paint a nuanced picture. For example, cash available at release has been reported to increase mortality (Forsyth et al., 2018). Rosen and others (2008) reported lower mortality for former prisoners with lower education and increased mortality for former prisoners with higher education.

The time in prison was associated with decreased risk of death. This lower risk of death was observed not only for all-cause mortality, but also for drug-related mortality, despite the prevalence of SUDs being high among prisoners. These results suggest that the Finnish penal system has successfully identified the prisoners with prior substance use treatment contact and supported their terms of imprisonment, thereby keeping prison mortality low. Mortality from external causes was especially low: in their study, Fazel and Benning (2006) reported a standardised mortality ratio of 0.70 for all natural causes, but a ratio of 2.93 when accidents, suicides and homicides were included.

Our results on strongly elevated risk of death after release are alarming, albeit in line with research in other contexts. Risk of death post-sentence is particularly high in the first few weeks after release, then declines, but stays elevated when compared to a reference group that is neither imprisoned nor serving community sanctions. Similar patterns have been reported in the literature (Binswanger, 2013; Bukten et al., 2017). It is worrying that even in the 'life-improving' Finnish penal system and in a country where the main misused opioid is buprenorphine, being released from prison constitutes a massive risk of death. In Norway, where the principles of the penal system are similar to those in Finland, post-release mortality is also high (Bukten et al., 2017), but the main opioid there is heroin. Our study explains how even in a context of comparatively low heroin use, a penal system that aims to follow the principles of "Scandinavian exceptionalism" fails to decrease post-release mortality without additional measures. Initiation of the opioid substitution treatment in prison settings began only at the end of the follow-up period in 2008 (EMCDDA, 2013) and there were many restrictions for the prisoners to receive opioid substitution treatment in prisons (e.g. The Parliamentary Ombudsman, 2005): these problems in

prison-based treatment can partly explain high mortality after the release. Easier access to opioid substitution treatment in prison settings, education, naloxone programs and other harm reduction measures and measures aimed at gradual reintegration into society directed for people released from prison with history of drug misuse (e.g. Grella et al., 2021) should be used more often and developed. Criminal justice system contacts have been identified in multiple studies as favourable time points for interventions preventing opioid overdose (e.g. Krawczyk et al., 2020; Larochelle et al., 2019) and should be used more frequently.

4.1. Strengths and limitations

The present study has many strengths. First, the personal identity number employed in Finland provided a reliable way to link register data so that associations between mortality, substance use treatment, imprisonments and education could be explored. Second, the quality of the data combined with the episode-based approach allowed us to model mortality on a weekly basis, and avoid multiple sources of bias resulting from focusing only on the last release (Kinner et al., 2013). The long time-window allowed us to observe potential time trends in the risk of death. The exceptionally detailed data also allowed us to consider incarceration and community service separately, which led to important insights regarding the lack of protective effect of community service.

The present study also has limitations. First, the study design compares the mortality of those with a history of substance use treatment who had been incarcerated or had served community service to those with only a history of substance use treatment. These populations differ. We mitigated the compositional differences by controlling for age, gender, place or residence, and sociodemographic characteristics, but there are likely further differences that we were unable to control for, such as risk-taking behaviour. The interpretation of the results thus needs to focus on not the specific level of mortality difference but on the pattern of mortality differences across various states of incarceration and community service. Second, we have a limited number of variables indicating the socioeconomic characteristics of the patients, and information on parity, marital status or homelessness would have been useful additional information that may be associated with the excess risk of death post-release. Third, the sentence data did not include the dates of the prison leaves, which might explain some deaths during incarceration and enable substance use during imprisonment. Fourth, the available data do not enable us to assess whether people had a diagnosed SUD at the time of criminal justice involvement. The patients might have received treatment for SUD from clinics other than the ones included in the study. Further, we could not ascertain the severity of their SUD at the time of criminal justice involvement from registries because AUDs and SUDs are long and chronic diseases with relapses occurring even years after the last treatment contact. Finally, there was no information on terminations of opioid substitution treatment which could bias the mortality estimates of opioid users. Initialisations of the treatment after 2010 would also not have been in the treatment records due to its time frame.

4.2. Conclusions

Among Finnish individuals with substance use history, mortality after imprisonment is very high. Communication between authorities responsible for the follow-up of prisoners with former SUD should be improved to lower excess mortality after release. The Finnish penal system has succeeded in keeping the prison mortality rate relatively low, but those in community service have higher rates of mortality than those in prison, suggesting that the monitoring and support measures should target service members with substance use treatment history.

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CRediT authorship contribution statement

RL searched the literature, designed and performed the statistical analyses and wrote the manuscript with MM. TP and TK collected and managed the data and made critical revisions to the manuscript. TP supervised the project. All authors accepted the final manuscript.

Declaration of Competing Interest

RL and TP have worked as independent researchers at the A-Clinic Foundation, and TK is currently working there. The A-Clinic is a non-profit, non-governmental organization in the field of addictions whose daughter company A-Clinic Ltd offers treatment and rehabilitation services.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.drugalcdep.2022.109327.

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