

Supporting information

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Article information

Title

Suicide following a conviction, solitary confinement or transfer in people incarcerated: a comprehensive retrospective cohort study in France, 2017-2020

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Settings for multiple imputation

Missing data of fixed covariables were handled by multivariate imputation by chained equations (van Buuren, 2018). Covariables modelled as fixed with missing data were age, nationality, having a high school diploma, marital status and main offence and took the value recorded at the beginning of incarceration. The following imputation strategy was adopted for the criminal category, which was modelled as a time varying covariable: for a given incarceration 1) any period with a missing value takes the nearest non-missing value among the preceding periods, or failing that, among the following periods; 2) if the value is missing for the entire incarceration, then the value of the first period is estimated by multivariate imputation by chained equations and extrapolated to the entire incarceration.

Using multivariate imputation by chained equations, binary variables were imputed by logistic regression. Quantitative variables were imputed by predictive mean matching, which preserves non-linear relationships (van Buuren, 2018). Categorical variables with more than two categories were imputed by multinomial regression.

Predictors of fixed covariables were all covariables listed above plus gender, occupational grade, personal housing, having children, type of court, type of facility, prison size, prison density, stage of incarceration, an incarceration censoring variable, length of follow-up and the suicide variable (Moons et al., 2006). For criminal category with missing data for the entire incarceration, the value of the first period, which is the value of the follow-up start date, was imputed from the same variables.

The number of iterations required was determined by a graphical method (van Buuren & Groothuis-Oudshoorn, 2011) and corresponds to the minimum number of iterations at which the mean and variance of the imputed values for each characteristic 1) converged between the different imputed data sets; 2) remained stably within the same range of values. Four iterations were considered sufficient. The number of imputation needed was estimated according to the procedure proposed by von Hippel (Errickson, n.d.; von Hippel, 2020). The desired coefficient of variation was set at 5%. For each parameter, we used as the fraction of missing information the average, over 10 pilot analyses, of the upper limit of the 95% confidence interval of the fraction of missing information calculated over 50 imputations. The highest fraction of missing information led to the retention of 40 imputations.

Survival analyses were performed on each of the 40 imputations. Wald tests and hazard ratio confidence intervals were pooled using the formulas given by Rubin (Rubin, 1987). Likelihood ratio tests and proportional hazards tests were pooled by the D2 method (Eekhout et al., 2017).

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Table A. Length of follow-up and length of incarceration, in months

	n	median	(Q1-Q3)	mean	(min-max)
Length of individual follow-up	358 522	4.8	(2.0 - 10.8)	8.7	(<0.1 - 48.0)
Length of prison stays	290 401 ^a	5.1	(2.3 - 11.5)	10.5	(<0.1 - 465.6)

^a *The calculation of the lengths of prison stays excludes right-censored prison stays*

Table B. Observed lengths of DSC and NDSC, in days

	n	median	(Q1-Q3)	mean	(min-max)
Length of DSC ^a	98 894	6	(4 - 11)	8.6	(0 - 794)
Length of NDSC ^b	11 852	34	(10-89)	76.2	(0 – 1 428)

^a *Disciplinary solitary confinement in the disciplinary block;* ^b *Non-disciplinary solitary confinement*
Note: the expression "observed lengths" refers to the fact that, among DSC and NDSC which were ongoing on December 31, 2020, only the observed portion up to December 31, 2020 was taken into account in the calculation of durations. This phenomenon does not alter the representativeness of the DSC durations and very slightly underestimates the actual NDSC durations.

Table C. Bivariate survival analysis (n = 358 522)

	HR ^a	IC _{95%} ^b	p
Acute exposure			
< 2 weeks after a conviction	1.5	[0.9 - 2.3]	0.107
First day of DSC ^c	63.9	[42.8 - 95.3]	<0.001
Before decree ^d	39.3	[20.1 - 76.7]	<0.001
After decree ^d	95.6	[57.8 - 158.1]	<0.001
< 2 weeks after entry in NDSC ^e	12.1	[6.3 - 23.5]	<0.001
< 2 weeks after transfer	3.6	[2.4 - 5.4]	<0.001
Periods in confinement areas			
DSC ^c	13.5	[10.0 - 18.2]	<0.001
NDSC ^e	3.8	[2.3 - 6.3]	<0.001
History of an event ^f			
History of DSC ^c	0.9	[0.6 - 1.2]	0.444
History of NDSC ^e	1.3	[0.5 - 3.1]	0.570
History of transfer	1.1	[0.8 - 1.4]	0.729

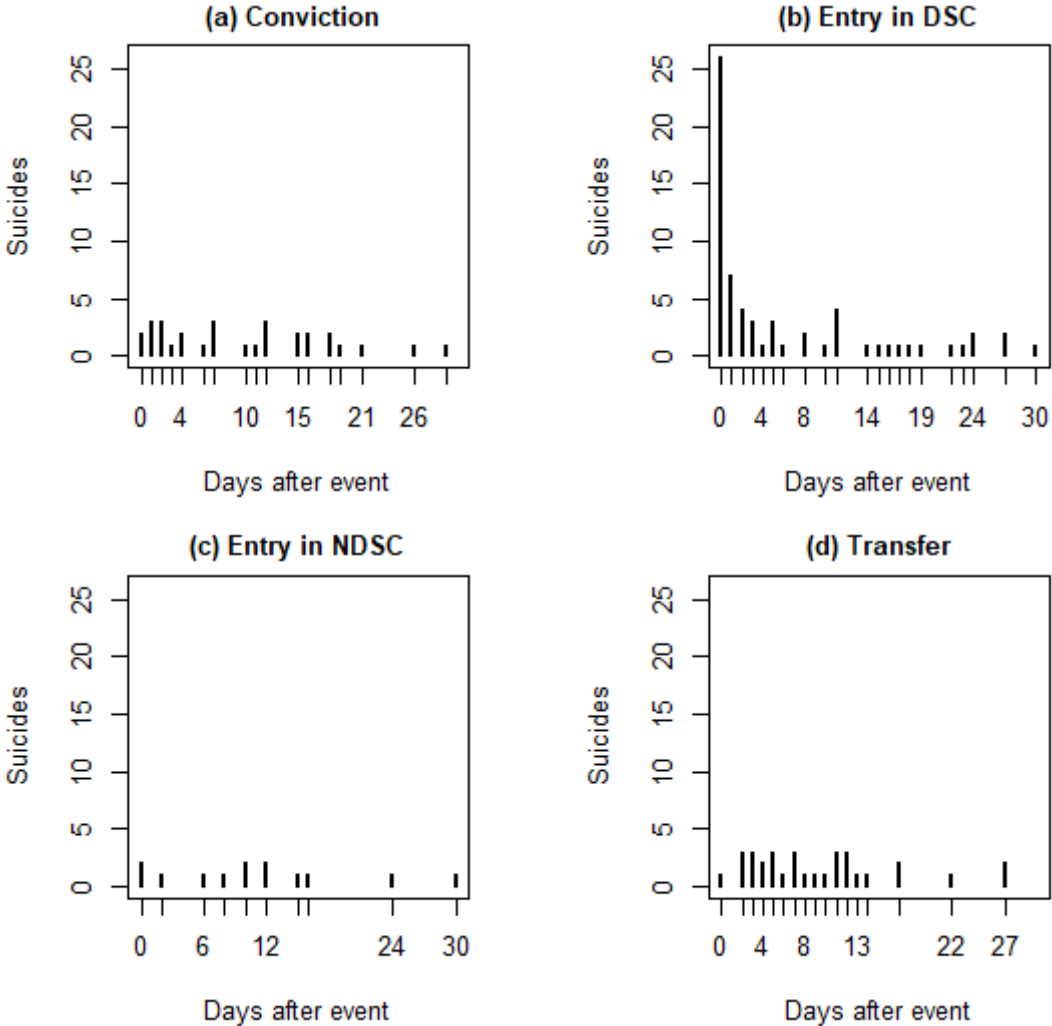
^a Person-years; ^b 95% confidence interval; ^c Disciplinary solitary confinement in the disciplinary block; ^d Governmental decree of February 13, 2019 on the disciplinary system in prison, implemented on March 15, 2019; ^e Non disciplinary solitary confinement; ^f Left censored prison stays (n = 66 055) were excluded for history variables

Table D. Studies on suicide during disciplinary solitary confinement in the disciplinary block in France

	Bourgoin, 1993	Hazard, 2008			Duthé, 2013	Vanhaesebrouck, 2022	Current study	
Study period	1982-1991	1998- 1999	2001- 2002	2006- 2007	2006- 2009 ^a	2017-2018	2017- 2018	2019- 2020
Source of data on DSC for suicides ^b	Inquiry ^c	Inquiry ^c			Routine ^d	Inquiry ^c	Routine ^d	
Proportion of suicide in DSC ^b	14%	17%	11%	16%	8%	14%	8%	13%
Suicide rate in DSC ^b per 10 000 PY ^e	194				180		222	
Adjusted hazard ratio of suicide risk in DSC ^b					15.7		19.9	

^a January 1, 2006 to July 31, 2009. Full calendar years in other studies; ^b Disciplinary solitary confinement in the disciplinary block; ^c Brief administrative investigation after each suicide; ^d Daily prison management data; ^e Person-years

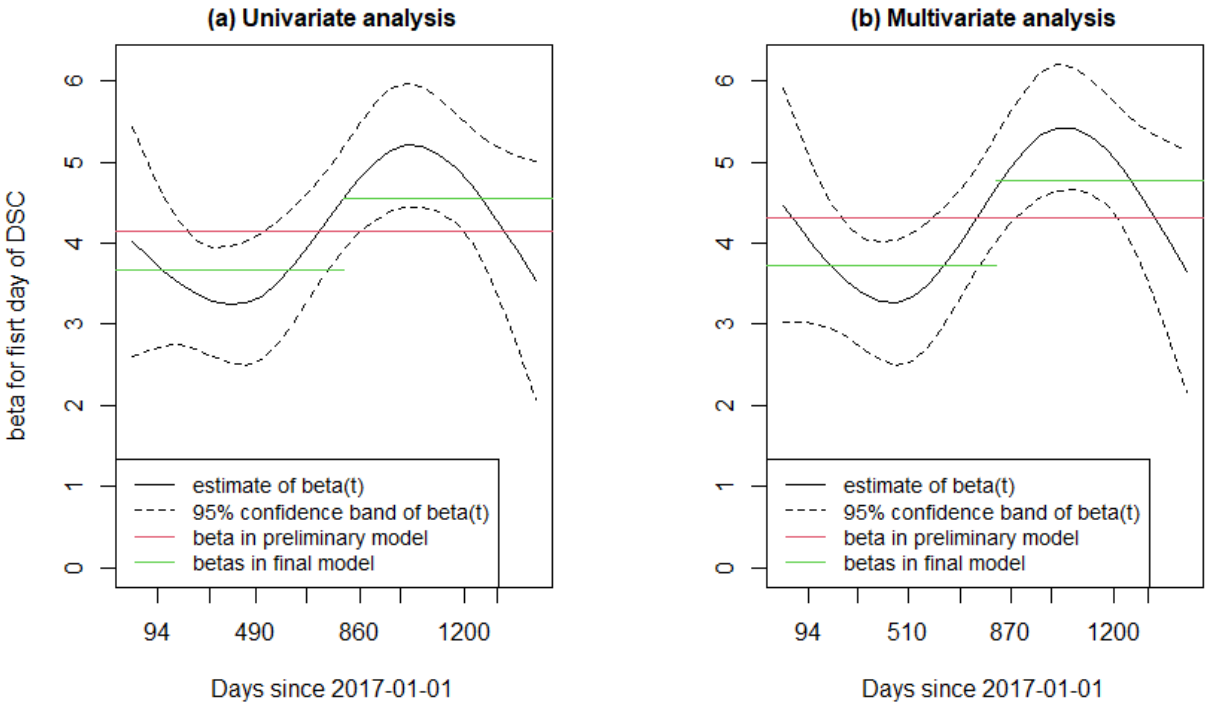
Figure A. Distribution of suicides in the month following each type of event



DSC: disciplinary solitary confinement in the disciplinary block; NDSC: non-disciplinary solitary confinement

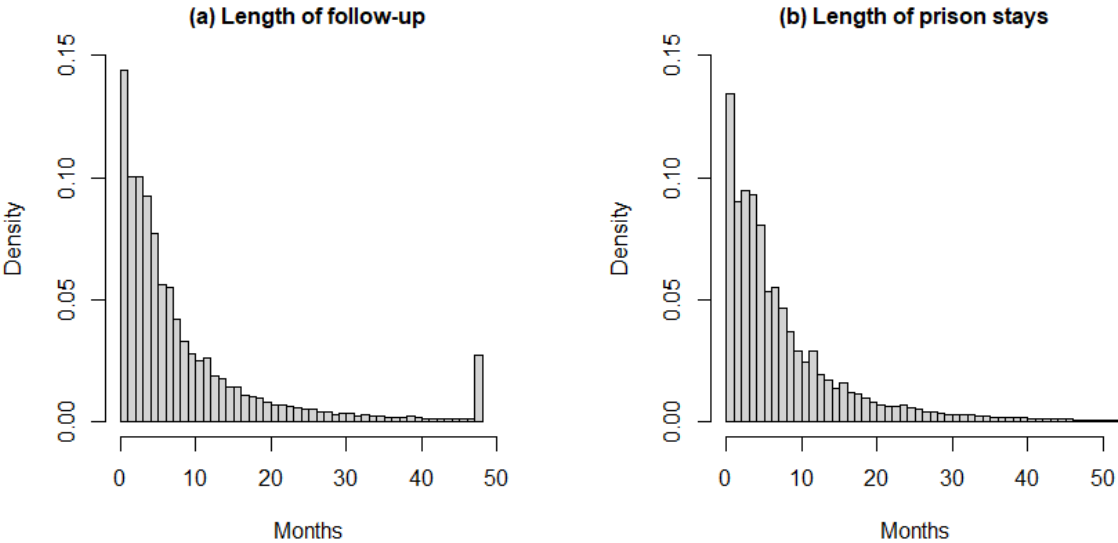
Figure B. Violation of the proportional hazards assumption for the first day of disciplinary solitary confinement: preliminary and final modelling

DSC: disciplinary solitary confinement in the disciplinary block



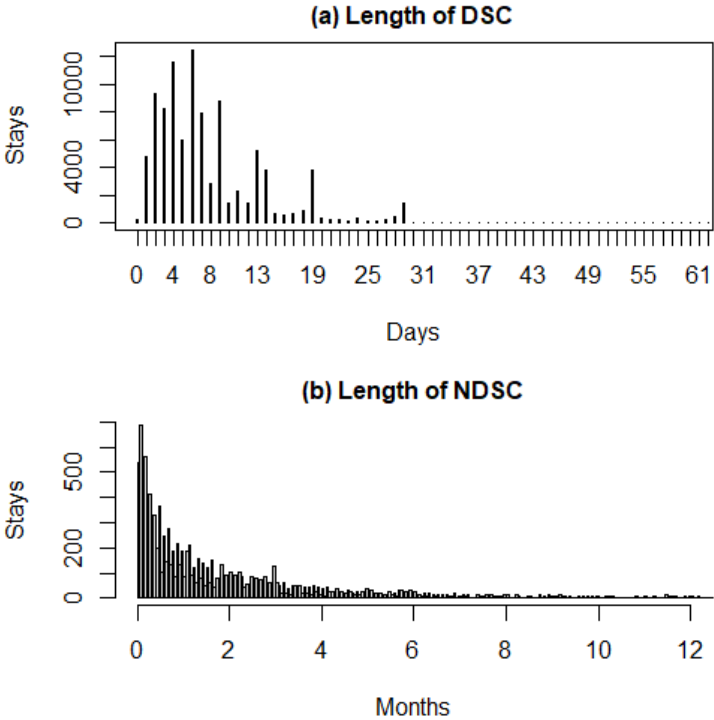
Note: the initial modelling, in red, violates the proportional hazards assumption (bivariate analysis: $p=0.029$; multivariate analysis: $p=0.008$). The proposed correction, in green, does not violate this assumption (bivariate analysis: $p=0.170$ and $p=0.820$; multivariate analysis: $p=0.176$ and $p=0.877$).

Figure C. Length of individual follow-up and length of detention



Note: The calculation of lengths of detention excludes right-censored prison stays. For individual follow-up times, the higher bar at 48 months corresponds to all left and right censored prison stays.

Figure D. Observed length of DSC and NDSC



DSC: disciplinary solitary confinement in the disciplinary block; NDSC: non-disciplinary solitary confinement

Note: the expression "observed lengths" refers to the fact that, among DSC and NDSC which were ongoing on December 31, 2020, only the observed portion up to December 31, 2020 was taken into account in the calculation of durations. This phenomenon does not alter the representativeness of the DSC durations and very slightly underestimates the actual NDSC durations.