Trajectories of psychological distress after prison release: implications for mental health service need in ex-prisoners

**SUPPLEMENTARY MATERIAL**

Emma G Thomas\*, Matthew J Spittal, Edward B Heffernan, Faye S Taxman, Rosa Alati, Stuart A Kinner

\*Corresponding author. Postal address: Harvard T.H. Chan School of Public Health, Department of Biostatistics, 655 Huntington Avenue, Building 2, 4th Floor, Boston, MA, USA 02115

Email: emmathomas@g.harvard.edu

Telephone: +1 617 432 1056

**Table S1:** K10 scores at each interview in the community and in prison

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Psychological**  **distress level (K10)** | **Baseline (%)** | **1 month follow-up (%)** | | **3 month follow-up (%)** | | | **6 month follow-up (%)** | | |
| **Prison**  **(n=1247)** | **Community**  **(n=806)** | **Prison**  **(n=41)** | | **Community**  **(n=749)** | **Prison**  **(n=100)** | | **Community**  **(n=648)** | **Prison**  **(n=199)** |
| Low | 49.7 | 56.2 | 46.3 | | 60.2 | 51.0 | | 63.2 | 53.8 |
| Moderate | 24.3 | 20.6 | 24.4 | | 18.6 | 18.0 | | 15.8 | 24.1 |
| High | 16.6 | 13.8 | 19.5 | | 13.0 | 19.0 | | 12.6 | 13.1 |
| Very high | 9.4 | 9.4 | 9.8 | | 8.3 | 12.0 | | 8.5 | 8.5 |
| Mean K10 score | 17.9 | 17.1 | 18.4 | | 16.4 | 18.2 | | 16.5 | 17.2 |

**Caption:** The table shows the percentage of participants within each K10 distress category and the mean K10 score at baseline interview and at each of the follow-up interviews. For the follow-up interviews, results are shown separately for those who were in the community and those who were back in prison.

**Table S2:** Goodness-of-fit statistics for trajectory models with different numbers of groups (N=1254)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Statistic** | **Number of groups** | | | | | |
| **2** | **3** | **4** | **5** | **6** | **7** |
| BIC | -1476.03 | -11409.87 | -11406.88 | -11382.16 | -11383.46 | -11391.22 |
| Mean posterior probability |  |  |  |  |  |  |
| Group 1 | 0.94 | 0.88 | 0.84 | 0.82 | 0.84 | 0.66 |
| Group 2 | 0.89 | 0.78 | 0.71 | 0.70 | 0.69 | 0.71 |
| Group 3 | - | 0.84 | 0.76 | 0.73 | 0.66 | 0.59 |
| Group 4 | - | - | 0.85 | 0.74 | 0.71 | 0.58 |
| Group 5 | - | - | - | 0.84 | 0.70 | 0.71 |
| Group 6 | - | - | - | - | 0.81 | 0.64 |
| Group 7 | - | - | - | - | - | 0.85 |

**Caption:** The table shows the Bayesian Information Criterion (BIC = , where is the log likelihood evaluated at the maximum likelihood parameter estimates, is the number of model parameters and is the sample size) and mean posterior probability of membership within each group for models with different numbers of trajectory groups. For each model, the highest order polynomial coefficient for the estimated trajectory of each group was dropped if it was not significant at the p<0.05 level, and this was repeated until all of the highest order terms were significant.

**Table S3:** Estimated polynomial coefficients from final trajectory modelwith five groups (N=1216)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Polynomial term** | ***Trajectory group*** | | | | | | | | | |
| ***Low*** | | ***Moderate*** | | ***High increasing*** | | ***High declining*** | | ***Very high*** | |
| **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** |
| **Intercept ()** | 12.15 (0.27) | <0.0001 | 17.93 (0.50) | <0.0001 | 25.83 (0.53) | <0.0001 | 26.69 (1.04) | <0.0001 | 36.69 (0.87) | <0.0001 |
| **Linear ()** | -0.69 (0.12) | <0.0001 | 0 | - | 0.62 (0.12) | <0.0001 | -4.81 (0.54) | <0.0001 | 0 | - |
| **Quadratic ()** | 0.06 (0.02) | 0.0001 | 0 | - | 0 | - | 0.44 (0.07) | <0.0001 | 0 | - |

**Caption:** The table shows the estimated polynomial coefficients and their standard errors (SEs) from our final trajectory model with five groups. These parameters were estimated jointly with those of the multinomial logistic regression model used to identify baseline predictors of trajectory group membership (Table S4). For each trajectory group, the parameters lead to a polynomial expression describing the mean of an *uncensored* normal distribution as a function of time since release: , where months since prison release. Parameter estimates are equal to zero for polynomial terms that were dropped from the model. The standard deviation of the uncensored normal distribution was estimated to be 5.84 (SE 0.09). The function must be transformed to obtain an estimate for the mean of the *censored* normal distribution used to model the K10 scores. The transformation is as follows:

,

where is the cumulative distribution function and is the density function of the standard normal distribution. The P-values shown are from tests of the null hypothesis that each coefficient is equal to zero.

**Table S4:** Results of multinomial logistic regression model(N=1216)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | ***Trajectory group*** | | | | | **p-value from Wald test** |
| ***Low*** | ***Moderate*** | ***High increasing*** | ***High declining*** | ***Very high*** |
| **RRR (95%CI)** | **RRR (95%CI)** | **RRR (95%CI)** | **RRR (95%CI)** | **RRR (95%CI)** |
| Constant | 1.00 (ref.) | 0.24 (0.14, 0.43) | 0.05 (0.03, 0.10) | 0.02 (0.01, 0.07) | 0.02 (0.01, 0.06) | - |
| Female | 1.00 (ref.) | 2.53 (1.42, 4.50) | 4.11 (2.27, 7.46) | 3.33 (1.38, 8.01) | 1.30 (0.31, 5.52) | <0.0001 |
| Age <25 years | 1.00 (ref.) | 0.43 (0.24, 0.76) | 0.57 (0.30, 1.05) | 0.74 (0.31, 1.79) | 0.00 | 0.0554 |
| Indigenous | 1.00 (ref.) | 0.57 (0.31, 1.04) | 0.99 (0.52, 1.86) | 1.19 (0.43, 3.32) | 1.02 (0.23, 4.47) | 0.3993 |
| Prior incarceration | 1.00 (ref.) | 1.41 (0.86, 2.29) | 1.26 (0.72, 2.21) | 0.44 (0.19, 1.02) | 0.70 (0.24, 1.99) | 0.0796 |
| Sentence >6 months | 1.00 (ref.) | 0.97 (0.61, 1.53) | 0.90 (0.52, 1.53) | 0.86 (0.37, 1.97) | 1.28 (0.45, 3.68) | 0.9716 |
| High risk drug usea | 1.00 (ref.) | 2.32 (1.38, 3.90) | 2.14 (1.19, 3.86) | 2.54 (1.05, 6.13) | 0.00 | 0.0098 |
| High risk drinkingb | 1.00 (ref.) | 1.80 (1.10, 2.94) | 1.28 (0.73, 2.25) | 2.26 (1.02, 5.02) | 1.66 (0.57, 4.85) | 0.0983 |
| Anxiety disorderc | 1.00 (ref.) | 3.13 (1.12, 8.73) | 3.72 (1.37, 10.10) | 5.67 (1.70, 18.91) | 12.05 (3.04, 47.79) | 0.0022 |
| Mood disorderc | 1.00 (ref.) | 1.40 (0.63, 3.12) | 3.94 (1.98, 7.82) | 5.39 (2.09, 13.94) | 2.66 (0.74, 9.58) | <0.0001 |
| Schizophreniac | 1.00 (ref.) | 0.96 (0.24, 3.85) | 1.21 (0.34, 4.35) | 2.85 (0.63, 12.92) | 1.54 (0.12, 20.52) | 0.6153 |
| History of self-harm | 1.00 (ref.) | 3.88 (2.24, 6.70) | 6.06 (3.40, 10.81) | 6.46 (2.80, 14.88) | 7.53 (2.42, 23.39) | <0.0001 |

aIn the 3 months prior to incarceration

bIn the year prior to incarceration

cSelf-reported current diagnosis at baseline interview

**Caption:** The table shows relative risk ratios (RRRs) for membership in each trajectory group according to baseline characteristics. The RRR is the ratio of the relative risk (for membership in each group compared to the *low* group) in those who are exposed to each baseline variable compared to those who are not. Confidence intervals (CIs) for the RRRs are omitted when the standard error was very large due to small numbers. The P-values are from Wald tests of the null hypothesis that each baseline characteristic has no effect on probability of trajectory group membership, after adjustment for all other listed characteristics.

**Table S5:** Estimated polynomial coefficients from sensitivity analyses (N=893)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Polynomial term** | ***Trajectory group*** | | | | | | | | | |
| ***Low*** | | ***Moderate*** | | ***High increasing*** | | ***High declining*** | | ***Very high*** | |
| **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** | **Coefficient (SE)** | **P-value** |
| **Intercept ()** | 12.48 (0.26) | <0.0001 | 18.27 (0.51) | <0.0001 | 25.19 (0.57) | <0.0001 | 26.64 (1.04) | <0.0001 | 37.06 (0.94) | <0.0001 |
| **Linear ()** | -0.81 (0.13) | <0.0001 | 0 | - | 0.80 (0.13) | <0.0001 | -5.11 (0.54) | <0.0001 | 0 | - |
| **Quadratic ()** | 0.06 (0.02) | 0.0006 | 0 | - | 0 | - | 0.47 (0.08) | <0.0001 | 0 | - |

**Caption:** The table shows the estimated polynomial coefficients and their standard errors (SEs) from our final trajectory model with five groups, estimated in the restricted sample of N=893 participants constructed for sensitivity analyses. The standard deviation for this model was estimated to be = 5.69 (SE 0.10). These parameters were estimated jointly with those of the multinomial logistic regression model used to identify baseline predictors of trajectory group membership (Table S6).

**Table S6:** Results of multinomial logistic regression model from sensitivity analyses(N=893)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | ***Trajectory group*** | | | | | **P-value from Wald test** |
| ***Low*** | ***Moderate*** | ***High increasing*** | ***High declining*** | ***Very high*** |
| **RRR (95%CI)** | **RRR (95%CI)** | **RRR (95%CI)** | **RRR (95%CI)** | **RRR (95%CI)** |
| Constant | 1.00 (ref.) | 0.23 (0.13, 0.42) | 0.06 (0.03, 0.13) | 0.02 (0.01, 0.07) | 0.01 (0.00, 0.05) | - |
| Female | 1.00 (ref.) | 2.73 (1.45, 5.13) | 3.55 (1.84, 6.86) | 3.41 (1.21, 9.62) | 2.33 (0.53, 10.28) | 0.0009 |
| Age <25 years | 1.00 (ref.) | 0.31 (0.15, 0.63) | 0.53 (0.26, 1.08) | 0.36 (0.11, 1.22) | 0.20 (0.02, 1.96) | 0.0091 |
| Indigenous | 1.00 (ref.) | 0.54 (0.26, 1.09) | 1.00 (0.50, 1.99) | 0.65 (0.13, 3.20) | 0.69 (0.13, 3.54) | 0.5004 |
| Prior incarceration | 1.00 (ref.) | 1.14 (0.67, 1.96) | 1.16 (0.64, 2.10) | 0.43 (0.16, 1.13) | 0.69 (0.22, 2.13) | 0.3384 |
| Sentence >6 months | 1.00 (ref.) | 0.95 (0.57, 1.58) | 0.94 (0.52, 1.69) | 0.93 (0.35, 2.48) | 1.70 (0.53, 5.47) | 0.9702 |
| High risk drug usea | 1.00 (ref.) | 2.94 (1.62, 5.34) | 2.47 (1.27, 4.81) | 2.20 (0.75, 6.45) | 0.42 (0.04, 4.01) | 0.0018 |
| High risk drinkingb | 1.00 (ref.) | 2.04 (1.17, 3.55) | 1.15 (0.61, 2.17) | 1.76 (0.63, 4.91) | 1.87 (0.60, 5.83) | 0.1365 |
| Anxiety disorderc | 1.00 (ref.) | 2.84 (0.99, 8.13) | 3.75 (1.40, 10.04) | 3.37 (0.91, 12.42) | 6.79 (1.58, 29.12) | 0.0321 |
| Mood disorderc | 1.00 (ref.) | 0.99 (0.41, 2.37) | 3.27 (1.60, 6.67) | 6.97 (2.43, 19.99) | 4.04 (1.10, 14.83) | <0.0001 |
| Schizophreniac | 1.00 (ref.) | 0.94 (0.21, 4.30) | 1.12 (0.27, 4.70) | 1.30 (0.14, 12.38) | 1.64 (0.13, 20.75) | 0.9894 |
| History of self-harm | 1.00 (ref.) | 4.07 (2.22, 7.43) | 4.19 (2.21, 7.96) | 7.84 (2.86, 21.47) | 6.49 (1.99, 21.20) | <0.0001 |

aIn the 3 months prior to incarceration

bIn the year prior to incarceration

cSelf-reported current diagnosis at baseline interview

**Caption:** The table shows relative risk ratios (RRRs) for membership in each trajectory group according to baseline characteristics, estimated in the restricted sample of N=893 participants constructed for sensitivity analyses. The p-values are from Wald tests of the null hypothesis that each baseline characteristic has no effect on probability of trajectory group membership, after adjustment for all other listed characteristics.

**Table S7:** Mental health service in the first year following release by K10 trajectory groups identified in sensitivity analyses (N=890)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Statistic** | ***Trajectory group*** | | | | | **Totala**  **(N=890)** |
| ***Low***  **(n=495)** | ***Moderate* (n=235)** | ***High increasing* (n=97)** | ***High declining* (n=43)** | ***Very high***  **(n=17)** |
| Percent (number) with any service contactb | 7.3 (7) | 14.0 (32) | 27.6 (26) | 22.1 (9.8) | 30.6 (5.1) | 12.4 (110) |
| Odds ratio (95%CI)b | 1.0 (ref.) | 2.1 (1.2, 3.5) | 4.8 (2.6, 8.8) | 3.6 (1.6, 8.3) | 5.6 (1.7, 17.8) | - |
| Median (IQR) number of days to first service contact for service users | 123 (7, 266) | 144 (48, 222) | 86 (29, 225) | 57 (21, 160) | 4 (0, 7) | 104 (11, 231) |
| Median (IQR) contact hours for service usersb | 2.5 (1.0, 3.8) | 1.5 (1.0, 4.1) | 3.6 (1.3, 9.5) | 3.0 (1.9, 3.5) | 5.9 (1.5, 11.3) | 2.6 (1.0, 5.0) |

aAmong participants included in K10 trajectory analyses

bWeighted by proportion of first year following release prior to first reincarceration (if any)

**Caption:** The table shows statistics on community mental health service contact in the first year following prison release in the restricted sample of N=890 participants constructed for sensitivity analyses and who had CIMHA and QCS data available.

**Table S8:** Associations between baseline variables and missing K10 scores at follow up

|  |  |
| --- | --- |
| **Baseline variable** | **Odds ratio (95%CI)** |
| Baseline K10 score |  |
| Low | 1.00 (ref) |
| Moderate | 0.80 (0.61, 1.04) |
| High | 0.83 (0.61, 1.13) |
| Very high | 0.85 (0.58, 1.25) |
| Female | 0.96 (0.74, 1.25) |
| Age <25 years | 1.37 (1.07, 1.75) |
| Indigenous | 2.52 (1.94, 3.27) |
| Prior incarceration | 2.43 (1.92, 3.08) |
| Sentence >6 months | 1.17 (0.95, 1.46) |
| High risk drug usea | 1.47 (1.16, 1.90) |
| High risk drinkingb | 1.58 (1.26, 1.98) |
| Anxiety disorderc | 1.13 (0.75, 1.69) |
| Mood disorderc | 0.93 (0.70, 1.24) |
| Schizophreniac | 1.34 (0.75, 2.41) |
| History of self-harm | 1.00 (0.78, 1.27) |

aIn the 3 months prior to incarceration

bIn the year prior to incarceration

cSelf-reported current diagnosis at baseline interview

**Caption:** The table shows results from univariate logistic regression analyses where the outcome variable was missing at least one of three K10 scores at post-release follow up.

**Figure S1:** Mean K10 trajectories estimated in sensitivity analyses (N=893)

**Caption:** The figure shows results from trajectory model analyses applied to the restricted sample of N=893 participants constructed for sensitivity analyses. The plotted curves show the estimated mean K10 score as a function of months since release, where negative months signify the pre-release period, for each psychological distress trajectory group. The plotted points show the mean K10 score and mean interview date weighted by the posterior probability of membership each trajectory group. The horizontal gridlines were chosen to reflect established categories of psychological distress (low, moderate, high and very high distress, in order of increasing K10 score) and the darker vertical gridline represents the time of release from custody. The estimated population percentages in each trajectory group were 53.6% (*low* group), 27.7% (*moderate*), 11.6% (*high increasing*), 5.0% (*high declining*) and 2.2% (*very high*).The mean posterior probabilities of membership within each group were 0.89, 0.77, 0.86, 0.80 and 0.95 respectively.