The Dose–Response of Time Served in Prison on Mortality: New York State, 1989–2003

| Evelyn J. Patterson, PhD

Although several studies have documented the findings and detailed the analyses by cause of death[1,2] of postprison mortality, limited scholarship has investigated the prison environment's contribution. Several studies have shown that former prisoners are at considerable risk for drug overdose,[3–7] contributing to high mortality immediately after prison. Compared with their nonprisoner counterparts, those who have served time in prison have elevated levels of unnatural deaths. One study of persons released from prisons in Victoria, Australia, in the 1990s revealed that mortality levels owing to unnatural causes for former prisoners was twice that of prisoners and 10 times that of nonprisoners.[8] Scholarship has also found that persons who interacted with the criminal justice system were more likely to die from unnatural causes than were those who had no interaction with the criminal justice system.[9]

However, the postprison mortality literature suggests that prisoners possess characteristics coming to prison that set them apart from the rest of the population.[8–12] The selectivity of the population is an important issue but is not resolved by comparing the prison population to that of the general population or the mortality of past prisoners to people who have not been incarcerated. It is imperative to take into account that prisoners represent a small portion of those who commit delinquent acts. Prisoners are the people who were caught, indicted, and punished via incarceration. The judicial system does not capture all who commit crimes, nor are the sentencing patterns invariant across age, race, gender, and socioeconomic status.[13–18]

Some scholars have argued that the experience of incarceration can alter health trajectories because it is an axis of stratification relevant to mortality that has strong associations, as do other covariates of mortality such as race, gender, and socioeconomic status. One study showed that the experience of being

Objectives. I investigated the differential impact of the dose–response of length of stay on postprison mortality among parolees.

Methods. Using 1989–2003 New York State parole administrative data from the Bureau of Justice Statistics on state correctional facilities, I employed multinomial logistic regression analyses and formal demographic techniques that used the life table of the populations to deduce changes in life expectancy.

Results. Each additional year in prison produced a 15.6% increase in the odds of death for parolees, which translated to a 2-year decline in life expectancy for each year served in prison. The risk was highest upon release from prison and declined over time. The time to recovery, or the lowest risk level, was approximately two thirds of the time served in prison.

Conclusions. Incarceration reduces life span. Future research should investigate the pathways to this higher mortality and the possibilities of recovery. (*Am J Public Health.* 2013;103:523–528. doi:10.2105/AJPH.2012.301148)

incarcerated has a negative impact on life chances regardless of prior incarceration history.[19] Other work suggests a relationship between mortality and the length of time served in prison: some findings show longer stays are protective and others show the opposite.[20,21] Such studies have contributed to our understanding of the link between the criminal justice system and mortality immediately following release, focusing on mortality owing to overdose and suicide. I sought to extend this research by studying the mortality of New York State parolees over a 10-year period. By combining formal demography and survival analysis, I investigated the dose–response of time served in prison to changes in life expectancy.

METHODS

Examining the dose–response of prison requires a population that survived prison and is still under study, such as the recently paroled population. Each parolee has spent some length of time in prison and remains under the supervision of the correctional system. I used National Corrections Reporting Program administrative data, which provide comprehensive individual-level information from the state correctional facilities on persons released from

parole in states that choose to submit the information. Each record includes demographic variables, variables pertaining to the offenses for which the individual was charged, variables pertaining to length of stay in prison and on parole, and type of exit from parole (e.g., revocation of parole, unconditional release, and death—the outcome of interest in this study).

I used the files pertaining to the release from parole between 1989 and 2003 for the state of New York, following the cohort of persons released from prison to parole from 1989 to 1993. This cohort of parolees was followed through 2003. Unlike the yearly data of other states for this period, New York's parole data had a low percentage of missing records and overall consistency starting in 1989.[22] New York also continued to use some type of parole, whether mandatory or discretionary, between the years 1989 and 1993. By examining the parole population, I avoided one of the main criticisms of prior studies that compared prisoners and nonprisoners: selectivity. Comparing nonprisoners to prisoners introduces issues of selectivity because persons incarcerated might be inherently different from the nonincarcerated, thereby introducing unobserved heterogeneity. However, each person who is a part of the parole population has served time in prison.

Eighty-four percent (111 509) of people released from prison in New York between 1989 and 1993 were released to parole. Table 1 displays characteristics of those who experienced an event (some type of exit from parole) during the study period. Of those experiencing an event, 2015 experienced the event of death. Although this is a retrospective study of the 1989–1993 prison release cohort that entered parole, I included 98% of the initial sample, censoring only 2%; that is, 2% of the persons in the 1989–1993 parole cohort did not experience an event by the end of 2003. The results of a sensitivity analysis investigating potential biases because of the censoring confirmed that the censoring did not influence my findings. Thus, the table of persons includes virtually the entire 1989–1993 parole cohort, and those who were censored did not affect the findings.

The sample was mostly men and mostly younger than 35.0 years. The average age at parole entrance was 30.9 years for this population. The majority of the parolees were non-Hispanic Black, followed by non-Hispanic White, and then Hispanic. These 3 groups made up 99.6% of the population experiencing an event (death, return to prison, release from parole, and all other modes). Seventy-nine percent of the sample did not complete high school. Most of the parolees were originally sentenced for drug offense, followed by violent offense, and then property offense. Almost 70.0% of the persons served 2 years or less in prison. Eight percent served 4 or more years in prison. Within 3 years of stay on parole, more than three quarters of the sample had experienced an event. I restricted my analysis to those who served 10 years or less in prison. Analyses restricting the sample to those serving 6 years or less produced similar results.

Survival Analysis

I used survival analysis to study mortality via a discrete time analysis that used maximum likelihood estimation. I broke each individual's parole history into monthly units; for each month served on parole, individuals contributed a new case. For example, an individual who served 6 months on parole contributed 6 cases. One of the strengths of hazard models is that they take into account the nonindependence of repeated observations among

individuals, thereby providing unbiased estimates. Most of the variables I used—gender, race, level of education, type of crime committed, and length of stay in prison—did not vary with time and were the same for each person-month contributed to the model. Age and duration on parole, however, did vary from person-month to person-month. Most of the demographic characteristics I included controlled for base-level mortality. The type of crime committed (i.e., the most serious offense an individual was successfully charged with) operationalized risk behaviors of the individual, and the duration spent in prison accounted for the dose–response of prison.

After assembling the data into person-month units, I employed a multinomial logit model to estimate the set of simultaneous binary logits of the different modes of parole exit: death, returning to prison, release from parole, and all other modes. Thus, for each type of exit, the model produced logit coefficients that corresponded to comparing the event to the nonoccurrence of the event.

Estimating the Change in Life Expectancy

The multinomial provides the odds of the event occurring, but it is advantageous to summarize the findings in a more tangible form as well. Formal demographic methods allow estimation of the change in life expectancy because of an increase or decrease in the likelihood of death. The mean age upon entry to parole was approximately 30 years. Using the 1989–1991 US life table allows the estimation of the decrease in life expectancy at age 30 years (i.e., the number of additional or fewer years a person aged 30 years can expect to live) for each additional year lived in prison for the 1989–1993 parole cohort. A slight alteration in the Keyfitz equation[23] allows an estimation of the change in life expectancy at aged 30 years as

$$(1) \quad \Delta e(30) = -ke(30)H,$$

where H (entropy) can be calculated as

$$(2) \quad H = \frac{\int_{30}^{\infty} l(x) \ln \frac{l(x)}{l(30)} dx}{T(30)},$$

and the constant k is the change in overall mortality, which is obtained from the multinomial

TABLE 1—Composition of Persons Released From Parole: New York State, 1989–2003

Covariate	Composition (Proportion)
Gender	
Men	0.926
Women	0.074
Missing	0.001
Age, y	
≤ 24	0.258
25–29	0.275
30–34	0.218
35–44	0.193
45–64	0.054
≥ 65	0.002
Missing	0.002
Race/ethnicity	
Hispanic	0.305
Non-Hispanic White	0.168
Non-Hispanic Black	0.523
Other	0.004
Missing	0.007
Education	
< high school	0.790
≥ high school	0.210
Missing	0.025
Type of crime	
Violent	0.304
Property	0.224
Drug	0.393
Missing	0.000
Duration in prison, y	
< 1	0.385
1.00–1.99	0.319
2.00–2.99	0.151
3.00–3.99	0.062
≥ 4	0.083
Missing	0.000
Duration on parole, y	
< 1	0.220
1.00–1.99	0.343
2.00–2.99	0.219
3.00–3.99	0.133
≥ 4	0.085
Missing	0.000

Note. The sample size was n = 111 509.
Source. Bureau of Justice Statistics, National Corrections Reporting Program.

model. For more description of the demographic notation used in the equations, refer to a basic demographic methods text such as *Demography: Measuring and Modeling Population Processes*.[24]

RESULTS

Figure 1 shows the estimates of the hazard function of the key duration relationship, duration in prison and mortality, restricting the length of study to those who experienced an event within 10 years. The figure exhibits a relatively curvilinear relationship and increases as time served in prison increases. That is, prison had a negative dose–response on the life span.

Before estimating the multinomial logit models, I performed a Wald test to ensure the variables inserted in the models had some effect on the dependent variable. Each variable in the 3 models tested significant at the 5% level, and most tested significant at the 1% level. Table 2 displays the results of the multinomial logit for the event of death. The results for other modes of exit—returning to prison or jail, parole release, and other modes—are not shown in this table. Each model contributes to the demonstration of the relevance of time served in postprison mortality. The first model simply asserts the relationship with covariates relating to time served. The second model adds covariates to control for mechanisms known to influence mortality outcomes, and the third model considers selection issues.

Model 1 examines the baseline model for duration in prison. The odds ratio (OR) for months in prison was 1.017. That is, for each month served in prison, the odds of dying upon release increased 1.7%, or 20.4% per year. This OR may seem small. One could argue that the odds of dying merely increased on the basis of the assumption of curvilinearity; however, when the unit of analysis was a quarter of a year or half a year, the OR increased in the expected curvilinear fashion. For example, when assuming the curvilinear increase using the OR given for 1 month, the lower bound of the confidence interval is 1.066 and the upper bound is 1.138. When the analysis is run with the unit of analysis at a quarter year and converted to half a year, the lower bound is 1.094 and the upper bound is 1.194. Finally, when the unit of analysis is half a year, the lower bound is 1.083 and the upper bound 1.167. Each of these intervals shows overlap and that the OR was not merely a function of the assumption of curvilinearity. Because of the interval and detail of observation of the data provided for the phenomena under study, I used the month as the unit of analysis.

Model 2 included several additional covariates—age, race, gender, education, and type of crime committed by the parolee. The additional covariates displayed some surprising findings, particularly with regard to ethnicity. There were stark contrasts in the level of mortality for Hispanics compared with non-Hispanic Whites. Hispanics had an odds of death that was 70% higher than that for non-Hispanic Whites, and the odds of death for

non-Hispanic Blacks was 32% higher than that for non-Hispanic Whites. The gap in mortality between Hispanics and non-Hispanic Whites in the general population was not large.

After adjusting for the undercount of deaths, Smith and Bradshaw calculated the 1990 life expectancy of Hispanic women to be 79.4 compared with the 79.2 for non-Hispanic Whites, and the life expectancy of men to be 69.6 compared with non-Hispanic Whites' life expectancy of 72.8 in the general population.[25] This seems trivial compared with the 70% increased odds found in the parole population in this study. One piece of this large differential may be the housing conditions of New York's population, in which Hispanics are more likely than are Whites to rent and, when renting, more likely to live in badly maintained and overcrowded units.[26]

The findings regarding socioeconomic status went in the expected direction: those who were high school graduates had lower odds of death than did those with less than a high school education. The odds of death for women were 38% lower than were those of men. In 1990, men aged 30.00 years and living in New York could expect to live an additional 43.14 years, whereas women aged 30.00 years could expect to live an additional 49.76 years.[27] Drug offenders had lower odds of death than did those whose controlling offense was violent. This does not necessarily challenge the previous literature regarding the higher odds of death from drug overdose immediately following prison. However, it does hint at the existence of more complex interactions occurring and necessitates additional research in the area to shed light on the pathways.

In model 2, the OR for duration in prison dropped to 1.01 but remained significant. This OR means that each year in prison increased the odds of death upon exit by 12.0%. Accordingly, those spending 5 years in prison could expect a 60.0% increase in their odds of death. Part of the response to prison could be attenuated by the fact that mortality decreases as people survive parole. Perhaps as an individual survives parole, the mortality hazard function approaches the mortality levels of the general population. I tested this hypothesis in model 3 by adding covariates relating to the time spent on parole. The model shows that for each month an individual survived parole, the
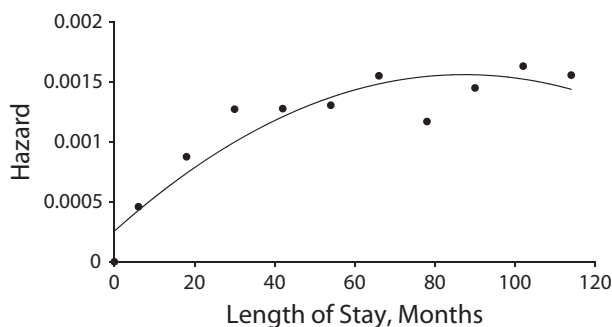
Source. Calculations are from Bureau of Justice Statistics data.

FIGURE 1—Unadjusted hazard function of length of stay in prison with fitted quadratic function: New York State, 1989–2003.

TABLE 2—Multinomial Logit of Exiting Parole–Death: New York State, 1989–2003

Covariates	Model 1, OR (95% CI)	Model 2, OR (95% CI)	Model 3, OR (95% CI)
Gender			
Men (Ref)		1.000	1.000
Women		0.623** (0.503, 0.771)	0.629** (0.508, 0.778)
Race/ethnicity			
Non-Hispanic White (Ref)		1.000	1.000
Hispanic		1.695** (1.458, 1.971)	1.743** (1.499, 2.027)
Non-Hispanic Black		1.323** (1.144, 1.530)	1.336** (1.155, 1.544)
Other		0.298 (0.074, 1.198)	0.320 (0.080, 1.011)
Aging, mo			
Age		1.005** (1.003, 1.007)	1.006** (1.005, 1.008)
Age^2 (Ref)		1.000** (1.000, 1.000)	1.000** (1.000, 1.000)
Education			
< high school (Ref)		1.000	1.000
≥ high school		0.846** (0.754, 0.949)	0.841** (0.749, 0.944)
Type of crime			
Violent (Ref)		1.000	1.000
Property		0.988 (0.865, 1.129)	0.932 (0.816, 1.066)
Drugs		0.773** (0.691, 0.865)	0.765** (0.683, 0.856)
Other		1.057 (0.882, 1.267)	1.032 (0.861, 1.237)
Duration variables, mo			
Duration in prison	1.017** (1.001, 1.023)	1.010** (1.004, 1.016)	1.013** (1.007, 1.019)
Duration in prison^2	1.000** (1.000, 1.000)	1.000** (1.000, 1.000)	1.000** (1.000, 1.000)
Duration on parole			0.981** (0.974, 0.987)
Duration on parole^2			1.000** (1.000, 1.000)

Note. CI = confidence interval; OR = odds ratio. Other modes of exit not shown. The sample size was n = 2 774 344. –2 log likelihood = 1 011 239.
Source. Bureau of Justice Statistics, National Corrections Reporting Program.
*P < .05; **P < .01.

odds of dying decreased by approximately 2.0%. Thus, for those who survived 1 year on parole, the odds of dying decreased by 24.0%. The OR for length of stay in prison increased to 1.013 in the fully specified model. This translates to a yearly increased likelihood of death of 15.6%.

Table 3 combines the selectivity effect of surviving parole with the dose–response of prison for various lengths of stay in prison. Length of stay in this table ranged from 0 to 60 months. As the table shows, for each year served in prison, a person could expect to lose approximately 2 years of life. Thus, a person who served the mean length of stay in prison of the 1989–1993 New York parole cohort (21.7 months) could expect to live approximately 3.6 years less than could a person who did not serve time in prison. The table also lists the time to recovery or the time it takes for the person to return to the original mortality curve. The time to recovery is essentially two thirds of the time served in prison. Accordingly, those serving 6 months in prison require 4 months until their mortality curve resembles that of the general population.

DISCUSSION

The event of death, like many other health outcomes, has been shown to vary along axes of stratification such as race, ethnicity, socio-economic status, and gender.[28–32] Much of the mortality literature consists of studies seeking to contribute to the reduction of health inequalities observed across social strata. Axes of stratification can arise because of historical or current structural inequality in the treatment of groups in addition to the behaviors and experiences of groups. A growing literature posits the experience of prison as another axis of stratification.[33–35] If incarceration is an axis of stratification, our knowledge of mortality is limited if our studies do not incorporate it when studying life outcomes. Thus, it is critical to assess the influence of incarceration on death rates, as so many other axes of stratification have proven influential in the prediction of mortality and encouraged research and actions that foster the elimination of disparities.

I examined the dose–response of prison on the mortality of parolees. Instead of focusing on differences between ex-prisoners and nonprisoners, I used the homogeneity of the parole population to ascertain information about an understudied event—the mortality of ex-prisoners as it relates to their length of stay in prison. After controlling for a variety of demographic and offense-related factors, I showed that each year in prison increased the odds of death by 15.6% in this 1989–1993 parole cohort. This translates to an increased odds of death of 78% for somebody who spent 5 years in prison and a loss of approximately 10 years in the expected life expectancy at age 30 years. The time to recovery, however, shed light on another process at work. Those who are able to survive parole without incident eventually return to the before-prison mortality curve. This finding is in line with previous research that reports an initial high risk of death at the population level that declines over time.[3,20]

Prison sentences are accompanied by a reduction in life expectancy and, thus, have a direct relationship with length of stay in prison. An increase in the odds of prison translates into real years of life lost. Although I was unable to ascertain the pathways through which this occurs, I controlled for a variety of factors that have proven important in past mortality studies. More importantly, I have made a strong case that loss of life is associated with time lived in state correctional facilities, and I have demonstrated the need for further research beyond administrative data that will permit the testing of the pathways to the higher mortality experienced and the possibility of recovery.

Limitations

My findings should be considered in the light of several limitations. First, this was an analysis of parole mortality in the state of New York.

TABLE 3—Change in Life Expectancy and Time to Recovery: New York State, 1989–2003

Length of Stay in Prison, Months	Change in Life Expectancy at Age 30 Years	Time to Recovery, Months
0	0.00	0
3	-0.50	2
6	-0.99	4
12	-1.99	8
18	-2.98	12
24	-3.97	16
36	-5.96	23
48	-7.94	31
60	-9.93	38

Source. Bureau of Justice Statistics, National Corrections Reporting Program Data.

Although New York has the largest state correctional population, other states should be studied as well as later cohorts to examine whether the health consequences of prison have changed over time. Second, the cause of death was unknown. The literature mentions the increase in particular types of mortality, and determining the differential responses of prison on natural and unnatural mortality is of interest. Third, I used the 1989–1993 parole cohort in my analyses. It is quite possible that just as mortality decreased in general, it may have also decreased for later cohorts of parolees. Fourth, I constructed event histories for persons on the basis of administrative data. Although this provides a starting place, additional variables are of interest, such as measures of social, health, and economic support of individuals on parole; better measures of risk behaviors before and after prison; and variables specific to the individual's prison experience.

This area of study demands an investigation of the variables that measure access to care. A person provided a 30-day supply of medication to manage an illness upon release from prison, for example, might not be able to connect to a new health care provider; furthermore, access to care and health benefits might prove challenging.[33,36,37]

Conclusions

Despite the study's limitations, I have indicated a new area deserving further study. Scientists have dedicated centuries of research to understanding the levels of mortality in human populations and how to lower them. I have demonstrated that one of the United States' core institutions does the opposite. This is particularly distressing considering that the United States supersedes every other nation in its propensity to incarcerate.[38]

Understanding the intended and unintended consequences of the prison experience on the lives of the incarcerated and those in their social network is a growing social issue. The lifetime likelihood of going to prison is 9.0% for men.[39] The lifetime likelihood of imprisonment in 1991 incarceration rates is 28.5% for Black men and 16.0% for Hispanic men. This translates to a prevalence rate of 12.0% for Black men and 4.9% for Hispanic men.[40] The prevalence of ever-incarcerated men grew from 3.4% in 1991 to 4.9% in 2001 (16.6% for Black men, 2.6% for White men, and 7.7% for Hispanic men).[40]

There is a growing need to understand the health consequences of incarceration because more people experience this event now than at any other moment in American history. Scholarship continues to demonstrate that punishments have a significant impact on an individual's life that continues after imprisonment.[41–45] Much work in this area of study concentrates on outcomes such as denial of citizenship rights, increased morbidity risks, and erosion of lifetime earnings and job opportunities.[44,46–50] Such collateral consequences of incarceration can be reversed. For example, advocacy groups have led many states to reinstitute the voting rights of ex-prisoners. Death, though, cannot be reversed. It is this lack of reversal that makes this area of study so consequential. ∎

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