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## Original Contribution

# Prisoner Survival Inside and Outside of the Institution: Implications for Health-Care Planning

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The life expectancy of persons cycling through the prison system is unknown. The authors sought to determine the 15.5-year survival of 23,510 persons imprisoned in the state of Georgia on June 30, 1991. After linking prison and mortality records, they calculated standardized mortality ratios (SMRs). The cohort experienced 2,650 deaths during follow-up, which were 799 more than expected (SMR = 1.43, 95% confidence interval (CI): 1.38, 1.49). Mortality during incarceration was low (SMR = 0.85, 95% CI: 0.77, 0.94), while postrelease mortality was high (SMR = 1.54, 95% CI: 1.48, 1.61). SMRs varied by race, with black men exhibiting lower relative mortality than white men. Black men were the only demographic subgroup to experience significantly lower mortality while incarcerated (SMR = 0.66, 95% CI: 0.58, 0.76), while white men experienced elevated mortality while incarcerated (SMR = 1.28, 95% CI: 1.10, 1.48). Four causes of death (homicide, transportation, accidental poisoning, and suicide) accounted for 74% of the decreased mortality during incarceration, while 6 causes (human immunodeficiency virus infection, cancer, cirrhosis, homicide, transportation, and accidental poisoning) accounted for 62% of the excess mortality following release. Adjustment for compassionate releases eliminated the protective effect of incarceration on mortality. These results suggest that the low mortality inside prisons can be explained by the rarity of deaths unlikely to occur in the context of incarceration and compassionate releases of moribund patients.

cause of death; health status disparities; hepatitis C; mortality; prisons; prisoners; survival analysis

Abbreviations: CI, confidence interval; GDC, Georgia Department of Corrections; HIV, human immunodeficiency virus; SMR, standardized mortality ratio.

***Editor's note**: An invited commentary on this article appears on page 488.*

As a consequence of political pressure to increase punishment for crime, the United States leads the world in rates of incarceration (1). The length of time that a particular prisoner serves behind bars may depend on both structural factors (the laws of the state, the conduct of the jury and judge, underlying racism, etc.) and individual factors (the particular crime committed; educational level, which in turn affects the ability to afford skilled legal counsel) (2). A multitude of causes, including high rates of substance abuse, engagement in risky sexual behaviors, intermittent homelessness, and poor access to mental health care, can explain why the 10.7 million persons who spent at least a portion of the year 2006 in a US prison or jail (3) are believed to have poorer health on average than the general population (4, 5). For example, the prevalence of human immunodeficiency virus (HIV) infection among US prisoners is 3.8 times that for US adults as a whole (6, 7). Many predictors of criminal activity are also predictors of poor health outcomes. Numerous studies have demonstrated that the period immediately following release, especially the first month, is associated with high mortality (8–20). Causes of deaths occurring more frequently than expected among releasees include 6 conditions of particular interest in correctional populations: HIV infection, homicide, transportation injuries, accidental

poisoning (including drug overdose), suicide, and liver disease (8, 21). The long-term health outcomes of persons cycling into and out of prisons are generally unknown; current beliefs are inferred from cross-sectional studies carried out in current prisoners and short-term follow-up studies of releasee cohorts.

Sex and race are important predictors of mortality in releasees. For example, in Washington State, women exhibited significantly higher adjusted relative rates of death than men after release from prison (8). The adjusted relative rate also varied by race, with blacks having the lowest adjusted relative rate (8), perhaps due to white prisoners' having a greater disparity in underlying health compared with their nonincarcerated racial counterparts (22). In a North Carolina study of male releasees, white ex-prisoners were shown to have twice the mortality of other white men, while black ex-prisoners were shown to have the same mortality as other black residents (21).

Based on the relatively poor health of incarcerated populations and the high mortality rates seen after release, one might predict that inmates would also suffer from high mortality while incarcerated. A recent Bureau of Justice Statistics report, however, showed that while incarcerated, inmates aged 15–64 years experience 19% lower mortality than comparably aged controls in the general population; among blacks, mortality for prisoners is 43% lower than age-adjusted mortality for the general black population (23). A mortality study of French prisoners (1977–1983) similarly found lower mortality among prisoners while incarcerated, with a standardized mortality ratio (SMR) of 0.92 after adjustment for age and sex (24). A 20-year mortality study among persons under age 60 years in English and Welsh prisons demonstrated an SMR of 0.70 (25). Several factors could explain the lower prison mortality relative to the general population: access to health care that many persons lack on the outside; a controlled environment, with fewer hazards and a more regular sleep schedule and diet; compassionate release of moribund inmates just prior to death; and selection of already-healthy persons based on their ability to commit crime.

The last of these hypotheses, that persons who are incarcerated enter prison healthier than the general population, has been proposed previously (25). It is analogous to a concept encountered in the field of occupational health, the ''healthy worker effect.'' This term reflects the fact that a person must be relatively healthy for employment in the workforce and must remain healthy to remain employed (26). Consequently, both morbidity and mortality rates within the workforce trail those in the general population (27). A similar phenomenon—a person must be healthy in order to commit certain crimes—may operate in inmate cohorts. This suggests the possibility of a ''healthy prisoner effect.''

While prior research has observed lower mortality while inmates are inside prison and higher mortality immediately following release, research into the relative strength of the two effects is lacking. Prompt treatment of urgent health needs in prisons is both a moral and a legal imperative (28, 29), but some diseases, such as hepatitis C, can take over 30 years to fully manifest into life-threatening conditions (30). If life expectancy is long, prison health-care providers should be more aggressive in addressing slow-moving health threats; the long-term health needs of prisoners may be equally as important as short-term risk reduction.

Much of the existing literature has focused on mortality either in releasee cohorts or in continually imprisoned cohorts. Except for 2 long-term follow up studies of juvenile delinquents (31, 32) and a small ($n = 4{,}615$) study in the Netherlands (the Criminal Careers and Life Course Study) (33), we are unaware of any long-term longitudinal studies, even though the life experience of the majority of offenders involves cycling into and out of institutions. Here we present results of a study designed to explore whether the potentially protective effects of incarceration persist over time and whether the low mortality inside of prison offsets the higher risk of mortality after release. Figure 1 displays some possible incarceration histories of subjects.

## MATERIALS AND METHODS

### Georgia prison cohort

The study cohort consisted of all persons incarcerated in a Georgia state prison on June 30, 1991. Retrospective follow-up of the cohort for mortality was performed through December 31, 2006. Data on this cohort, including lifetime incarceration history, came from the Planning and Strategic Management Section of the Georgia Department of Corrections (GDC).

All cohort members whose mortality status was unknown as of December 31, 2006, according to GDC records were matched with death information from the Georgia Death Registry, which maintains death certificates for deceased persons in Georgia. Next, names of persons not matched to the Georgia Death Registry were submitted to the National Death Index to obtain mortality records for persons who died outside of Georgia. In both stages, inmates were matched on the basis of name, Social Security number, age, home address, and known aliases. For both the Georgia Death Registry and the National Death Index, we accepted as true matches those records which the registries classified as true.

Deaths were classified as occurring either inside or outside of prison on the basis of GDC records. We categorized prisoners by educational level (attainment of a high school diploma before or during the study period vs. no attainment) as a proxy for socioeconomic status. Total, nonincarcerated, and incarcerated person-time for each age, sex, race, and educational group in the inmate cohort were calculated for each year of the study. Nonincarcerated person-time included all time (both between incarcerations and following the final incarceration) cohort members had spent outside of the Georgia prison system during the study period. Mean ages weighted by person-time during nonincarcerated and incarcerated periods were calculated. SMRs were calculated by comparison with the age-, sex-, race-, and calendar-year-adjusted Georgia population rates. SMRs were also calculated by educational level and for cross-tabulated subgroups. All SMRs were calculated using Life Table Analysis System software (LTAS.NET) from the National Institute for Occupational Safety and Health (8, 21).

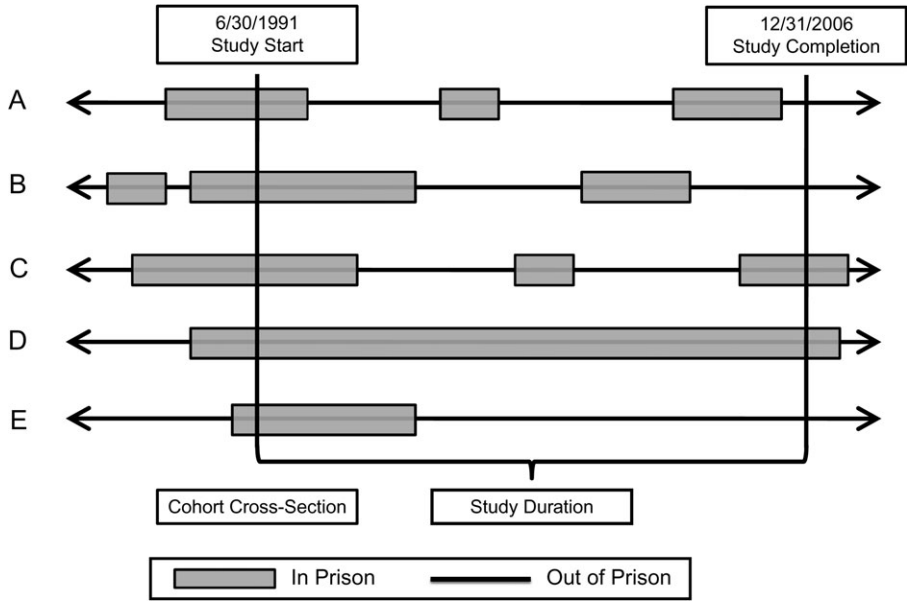


**Figure 1.** Several possible incarceration histories in a study of incarceration and health status, with the sole inclusion criterion being incarceration at the start of the study, Georgia, 1991–2006.

We derived SMRs as a function of time since release, in discrete time segments of 0–<1 month, 1–<6 months, and 6–12 months. The analysis of time since release included all releases (i.e., a person released thrice would contribute 3 months to the 0- to <1-month SMR, assuming survival after the third release).

We adjusted mortality rates to investigate the potential effect of a program of releasing moribund inmates just prior to death. A former Georgia prison medical director (Dr. J. Paris, DeKalb County (Georgia) Board of Health, personal communication, 2009) estimated the range of annual numbers of compassionate releases. We performed a sensitivity analysis of the effect of this program using the lower and upper bounds of the range of annual numbers of compassionate releases.

To assess the causes of lower-than-expected mortality during incarceration and excess mortality after release from prison, we calculated cause-specific SMRs for select causes of death that had significantly lower- or higher-than-expected frequencies among releasees in previous US studies. We then calculated the proportion of unexpected deaths due to these causes, defined as the sum of the excess deaths from each cause (observed minus expected) divided by the total number of excess deaths.

The Emory University Institutional Review Board approved this study. All data management and analysis was performed using the Statistical Analysis System, version 9.2 (SAS Institute Inc., Cary, North Carolina). Data were stripped of identifying information prior to analysis.

## RESULTS

In this cohort of 23,510 Georgia inmates incarcerated on June 30, 1991, 20,860 persons were alive and 2,650 were reported deceased as of December 31, 2006. Table 1 shows selected demographic characteristics. The cohort was 95% male and two-thirds black, a distribution consistent with current Georgia prison demographics. The 973 persons ever testing HIV-positive included 92 persons who seroconverted

**Table 1.** Selected Demographic Characteristics of a Prisoner Cohort, Georgia, 1991–2006

| Characteristic | No. | % |
|---|---|---|
| Sex-race group | | |
| Black men | 14,714 | 63 |
| Nonblack men | 7,494 | 32 |
| Black women | 829 | 4 |
| Nonblack women | 473 | 2 |
| No prior incarcerations at study start | 12,090 | 51 |
| HIV status during observation period | | |
| Ever HIV-positive | 973 | 4 |
| Always HIV-negative | 21,839 | 93 |
| Indeterminate result or missing data | 698 | 3 |
| HIV seroconversion during study period | 92 | |
| No. of releases during study period | | |
| 0 | 2,316 | 10 |
| 1 | 15,407 | 66 |
| 2 | 3,129 | 13 |
| 3 | 1,599 | 7 |
| ≥4 | 1,059 | 5 |
| Mean age (SD) on June 30, 1991, years | 24 (9) | |

Abbreviations: HIV, human immunodeficiency virus; SD, standard deviation.

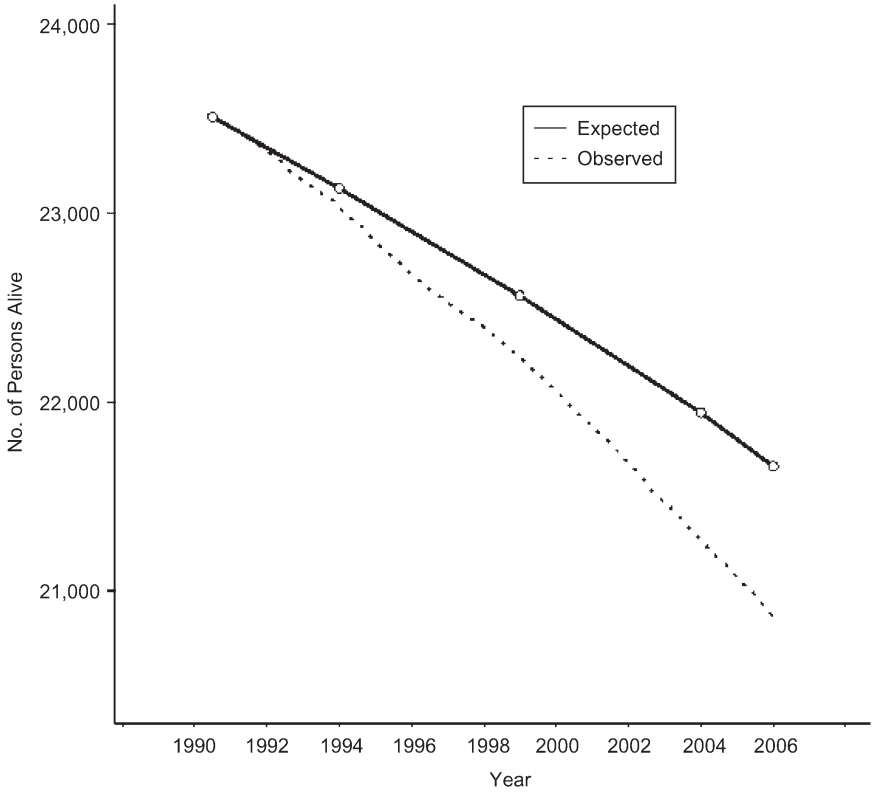


**Figure 2.** Observed and expected mortality in a prisoner cohort, Georgia, 1991–2006.

during the study period. The study had 362,369 person-years of observation. All National Death Index matches were accepted as true matches; we identified no false positives (i.e., a situation where we could demonstrate that a person with a National Death Index match was identified as still residing in prison past the putative date of death).

Over the study period, 20,788 (90%) of the 23,104 cohort members who did not die in prison were released at least once. Women spent a significantly lower amount of their total person-time in prison than men (16% and 24%, respectively; 2-tailed $t$ test: $P < 0.001$). There were no racial differences in the proportion of person-time spent incarcerated (data not shown). Weighted by person-time, the mean age during incarceration was 30 years, while during non-incarceration it was 35 years.

Figure 2 displays the observed and predicted numbers of persons alive in each year of follow-up. Observed mortality was consistently higher than expected, as illustrated by the continually diverging survival curves. We calculated accelerated mortality as the difference between a given date and the date on which the number of deaths predicted to have occurred did in fact occur, divided by the total follow-up time to that point—in other words, the percentage of time up to a given point by which the expected mortality was accelerated. In the years 1995, 2000, and 2005, observed deaths were accelerated by 19%, 27%, and 25%, respectively. The total mortality expected to occur over the 15.5 years of follow-up was reached in only 11.6 years. Overall, the 2,650 observed deaths represented a mortality rate 43% higher than expected (see Table 2 and Figure 2). Stratified by race and sex, black men in the cohort experienced the lowest mortality relative to their age-, race-, and sex-matched peers in the community (Table 3; SMR = 1.18, 95% confidence interval (CI): 1.12, 1.24). Because this group dominated the cohort, overall mortality was driven by their experience. Nonblack males had mortality nearly double that of their Georgia counterparts, while both black and nonblack females died at more than twice the expected rate (SMR = 2.13 and SMR = 2.92, respectively; see Table 3). SMRs did not vary by educational level, the proxy for socioeconomic status.

### Mortality by incarceration status

There were 406 deaths that occurred while cohort members were incarcerated, yielding an in-prison SMR of 0.85 (95% CI: 0.77, 0.94). In prison, black men experienced the lowest relative mortality and were the only sex-race group with an SMR significantly less than 1 (SMR = 0.66, 95% CI: 0.58, 0.76; Table 3). Conversely, nonblack men had a 28% higher-than-expected risk of mortality while incarcerated, based on their referent Georgia population (SMR = 1.28, 95% CI: 1.10, 1.48). The small number of deaths occurring in prison among women in this cohort resulted in wide confidence intervals overlapping the null value.

**Table 2.** Numbers of Expected and Observed Deaths and Standardized Mortality Ratios in a Prisoner Cohort and Its Demographic Subgroups, Georgia, 1991–2006[a]

| | In Prison | | | | Out of Prison | | | | Overall | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Obs | Exp | SMR | 95% CI | Obs | Exp | SMR | 95% CI | Obs | Exp | SMR | 95% CI |
| Total | 406 | 475 | 0.85 | 0.77, 0.94 | 2,244 | 1,453 | 1.54 | 1.48, 1.61 | 2,650 | 1,851 | 1.43 | 1.38, 1.49 |
| Sex | | | | | | | | | | | | |
| Male | 397 | 466 | 0.85 | 0.77, 0.94 | 2,121 | 1,405 | 1.51 | 1.45, 1.58 | 1,795 | 2,518 | 1.40 | 1.35, 1.46 |
| Female | 9 | 9 | 1.03 | 0.47, 1.95 | 123 | 48 | 2.56 | 2.13, 3.06 | 132 | 56 | 2.36 | 1.97, 2.79 |
| Race | | | | | | | | | | | | |
| Black | 221 | 329 | 0.67 | 0.59, 0.77 | 1,388 | 1,049 | 1.32 | 1.25, 1.40 | 1,609 | 1,332 | 1.21 | 1.15, 1.27 |
| Nonblack | 185 | 146 | 1.27 | 1.09, 1.47 | 856 | 404 | 2.12 | 1.98, 2.26 | 1,041 | 519 | 2.01 | 1.89, 2.13 |
| Age group, years | | | | | | | | | | | | |
| <65 | 373 | 446 | 0.84 | 0.75, 0.93 | 2,183 | 1,357 | 1.61 | 1.54, 1.68 | 2,556 | 1,758 | 1.45 | 1.40, 1.51 |
| ≥65 | 33 | 29 | 1.13 | 0.78, 1.58 | 61 | 96 | 0.63 | 0.48, 0.81 | 94 | 93 | 1.01 | 0.82, 1.24 |
| Educational level | | | | | | | | | | | | |
| Less than high school diploma | 234 | 278 | 0.84 | 0.74, 0.96 | 1,310 | 878 | 1.49 | 1.41, 1.57 | 1,544 | 1,102 | 1.40 | 1.33, 1.47 |
| High school diploma or more | 149 | 178 | 0.84 | 0.71, 0.98 | 821 | 511 | 1.61 | 1.50, 1.72 | 970 | 668 | 1.45 | 1.36, 1.55 |

Abbreviations: CI, confidence interval; Exp, expected no. of deaths; Obs, observed no. of deaths; SMR, standardized mortality ratio.
[a] Because of rounding and missing values, numbers of expected deaths may not add up to totals.

After release, mortality in all groups was significantly elevated relative to Georgia counterparts (SMR = 1.54, 95% CI: 1.48, 1.61). Similar to results during incarceration, black men had the lowest relative mortality (SMR = 1.29, 95% CI: 1.22, 1.36) and nonblack women had the highest relative mortality (SMR = 3.56, 95% CI: 2.59, 4.78; Table 3). This pattern is consistent with the differential incarceration rates between these populations in general society, with black males being incarcerated at significantly higher rates than other demographic subgroups.

We calculated SMRs for the 0–<1 month, 1–<6 month, and 6–12 month periods following release, with all releases considered. We observed a heightened SMR during the month following release ($n$ = 19 deaths; SMR = 1.90, 95% CI: 1.18, 2.91), but the wide confidence intervals overlapped the overall postrelease SMR of 1.54, making comparisons difficult. We did not observe the extremely high mortality immediately postrelease reported in previous studies (8, 11). SMRs during the periods 1–<6 months after release and 6–12 months after release were 1.67 (95% CI: 1.36, 2.03) and 1.64 (95% CI: 1.33, 1.99), respectively; these SMRs were not significantly different from the overall postrelease SMR of 1.54, showing that the early spike in postrelease mortality in this cohort steadily regressed towards the level of the overall, still-heightened postrelease mortality.

### Stratification by age

Mortality patterns differed by age, with former prisoners aged 65 years or more exhibiting a lower-than-expected

**Table 3.** Numbers of Expected and Observed Deaths and Standardized Mortality Ratios in a Prisoner Cohort, by Sex-Race Group, Georgia, 1991–2006[a]

| Sex-Race Group | In Prison | | | | Out of Prison | | | | Overall | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Obs | Exp | SMR | 95% CI | Obs | Exp | SMR | 95% CI | Obs | Exp | SMR | 95% CI |
| Men | | | | | | | | | | | | |
| Black | 215 | 324 | 0.66 | 0.58, 0.76 | 1,309 | 1,013 | 1.29 | 1.22, 1.36 | 1,524 | 1,292 | 1.18 | 1.12, 1.24 |
| Nonblack | 182 | 142 | 1.28 | 1.10, 1.48 | 812 | 392 | 2.07 | 1.93, 2.22 | 994 | 503 | 1.98 | 1.86, 2.10 |
| Women | | | | | | | | | | | | |
| Black | 6 | 5 | 1.21 | 0.44, 2.63 | 79 | 36 | 2.22 | 1.76, 2.76 | 85 | 40 | 2.13 | 1.70, 2.63 |
| Nonblack | 3 | 4 | 0.79 | 0.16, 2.31 | 44 | 12 | 3.56 | 2.59, 4.78 | 47 | 16 | 2.92 | 2.14, 3.88 |

Abbreviations: CI, confidence interval; Exp, expected no. of deaths; Obs, observed no. of deaths; SMR, standardized mortality ratio.
[a] Numbers of expected deaths may not add up to total numbers because of rounding.

**Table 4.** Standardized Mortality Ratios for Leading Causes of Low Mortality During Incarceration, Georgia, 1991–2006

| Cause of Death | No. of Deaths | | Standardized Mortality Ratio | 95% Confidence Interval | % Unexpected Mortality[a] |
|---|---|---|---|---|---|
| | Observed | Expected | | | |
| Accidental poisoning | 1 | 6 | 0.16 | 0.00, 0.89 | –7 |
| Homicide | 20 | 31 | 0.65 | 0.40, 1.00 | –16 |
| Suicide | 11 | 17 | 0.65 | 0.33, 1.17 | –9 |
| Transportation injuries | 0 | 29 | N/A | N/A | –42 |
| Total | 32 | 83 | 0.39 | 0.27, 0.54 | –74 |

Abbreviation: N/A, not applicable.

[a] There were 69 fewer deaths than expected. The percentage of unexpected mortality was calculated as ([observed − expected]/69) × 100.

overall risk of death during study follow-up (SMR = 0.63, 95% CI: 0.48, 0.81). Similarly to aggregate results, incarcerated inmates under age 65 years were slightly protected against mortality (SMR = 0.84, 95% CI: 0.75, 0.93), while small numbers precluded conclusions about incarcerated inmates aged 65 years or more.

### Effects of compassionate release and unlikely causes of death on mortality during incarceration

To investigate the significantly depressed mortality levels observed during incarceration, a finding confirmed by prior studies, we adjusted in-prison mortality for the effect of the compassionate release program. A former GDC medical director estimated that 10–22 compassionate releases occurred annually in Georgia during our study period (Dr. J. Paris, DeKalb County (Georgia) Board of Health, personal communication, 2009). Consequently, we performed a sensitivity analysis to determine the effect of compassionate releases. We recalculated the in-prison SMR adding either 150 deaths or 330 deaths to the observed counts and obtained upper and lower estimates, each with 95% confidence intervals. Because there were only 69 fewer deaths than expected, compassionate releases can account for any depressed mortality during incarceration observed during our study period. Adjusted SMRs for in-prison mortality ranged from 1.17 (95% CI: 1.08, 1.27) to 1.55 (95% CI: 1.44, 1.66). However, even fewer than 150 compassionate releases could be attributed to the cohort if some of the releases during the observation period came from persons admitted to Georgia prisons after 1991. It is theoretically possible, though unlikely, that *all* compassionate releases during the study period could have been among persons admitted after the start of the observation period, in which case the compassionate release program would explain none of the depressed mortality.

As a potential secondary explanation for the depressed mortality during incarceration, we obtained cause-specific SMRs for select deaths that are unlikely to occur in prison (Table 4). As expected, no deaths from transportation injuries occurred during incarceration, and this alone accounted for 42% of the lower-than-expected mortality. Lower rates of homicide, accidental poisoning (drug overdose), and suicide accounted for 16%, 7%, and 9% of the lower-than-expected mortality, respectively. Had these 4 events occurred at rates predicted by the referent population, 74% of the depressed mortality would have been removed. Such an analysis does not remove the fact that mortality was significantly lower than expected during incarceration, but it suggests that simple factors related to immobilization and heightened surveillance in the prison environment may explain the apparent protective effect.

Mortality due to HIV infection and hepatitis was of a priori interest. Levels of both HIV infection and cirrhosis were elevated relative to the referent population. Over the entire study period, 387 persons died from HIV-related causes (SMR = 1.84, 95% CI: 1.66, 2.04) and 64 persons died from cirrhosis and other liver diseases (SMR = 1.87, 95% CI: 1.44, 2.39). HIV mortality varied over the course of the study period, with relative mortality peaking during the years 1995–1999 (SMR = 2.00, 95% CI: 1.71, 2.34). From 2000 to 2006, the SMR was 1.72 (95% CI: 1.42, 2.06), indicating a potential drop in HIV-related mortality relative to the general population, but HIV mortality was still significantly elevated, as expected.

### Excess mortality following release

Six causes of death accounted for 62% of the excess mortality in former prisoners, with HIV and homicide accounting for 20% and 18%, respectively (Table 5). Cancer and heart disease were the 2 leading causes of death, but cancer accounted for only 7% of the excess mortality, while heart disease did not occur significantly more than expected (data not shown). Transportation injuries, accidental poisonings, and cirrhosis of the liver accounted for 17% of the excess mortality.

## DISCUSSION

We observed overall heightened mortality in our cohort over 15 years of follow-up relative to the general Georgia population. This is not unexpected given that less than one-quarter of person-time was spent incarcerated, where any potentially protective effect may occur. We observed

**Table 5.** Standardized Mortality Ratios for Leading Causes of Excess Mortality Following Release From Prison, Georgia, 1991–2006

| Cause of Death | No. of Deaths | | Standardized Mortality Ratio | 95% Confidence Interval | % Excess Mortality[a] |
|---|---|---|---|---|---|
| | Observed | Expected | | | |
| Accidental poisoning | 80 | 23 | 3.48 | 2.76, 4.33 | 7 |
| Cancer | 326 | 268 | 1.22 | 1.09, 1.35 | 7 |
| Cirrhosis and other liver diseases | 52 | 26 | 1.99 | 1.48, 2.60 | 3 |
| Homicide | 215 | 76 | 2.84 | 2.47, 3.24 | 18 |
| Human immunodeficiency virus | 313 | 156 | 2.00 | 1.78, 2.23 | 20 |
| Transportation injuries | 140 | 86 | 1.63 | 1.37, 1.92 | 7 |
| Total | 1,126 | 635 | 1.77 | 1.67, 1.88 | 62 |

[a] There were 791 excess deaths following release. The percentage of excess mortality was calculated as ([observed − expected]/791) × 100.

a protective effect of incarceration, although it persisted only for black men after stratification by sex and race. The distribution of person-time was such that this protective effect was overwhelmed by the heightened mortality postrelease.

We do not believe a ''healthy prisoner effect'' exists. The decreased mortality during incarceration in our cohort can be explained by 2 factors: compassionate release and causes of death for which prisoners are not at risk while incarcerated. We calculate that compassionate release practices alone can account for the depressed mortality in prisons; the magnitude of the effect of the compassionate release program specifically on the Georgia cohort incarcerated in 1991 cannot be known with certainty, because we do not know what percentage of the entire prison population released under the program during the observation period came from the study cohort. In addition, because we had no individual data on compassionate releases taking place during the study period, we could not apportion the releases by age, sex, or race, precluding conclusions about the effect on specific demographic subgroups. In addition to compassionate releases, we found that much of the low mortality inside prisons can be accounted for by the nature of the prison environment. The lack of transportation injuries alone accounted for over 40% of the deviation from expected mortality. As such, the apparently low mortality may be an artifact of these institutional protections, rather than any ''healthy'' effect of incarceration.

The lowest adjusted mortality rate was observed in black men during incarceration, in accordance with recent studies carried out in both Washington State and North Carolina (8, 34). Contrasting 2 external comparisons, blacks versus whites, has limitations because referent populations differ. One possible explanation for the lower SMR observed in black men is the high prevalence of former incarceration in this group in society generally. A Bureau of Justice Statistics report estimated that, in 2001, 16.6% of black adult men had spent time in state or federal prison during their life, while only 2.6% of white adult men had ever been imprisoned (35). This effective misclassification of the reference group results in SMRs that are standardized to persons who have previously been incarcerated, diluting the effect of incarceration. Moreover, the large difference between black and white incarceration rates in the general population makes comparisons using SMRs problematic, because the misclassification occurs differentially. Another effect of the high incarceration rate among blacks in the general population is that blacks who are incarcerated will be a more representative sample of the general population than whites, who are incarcerated at a much lower rate, and can therefore represent a more extreme subsample of the reference population.

### Limitations

Our study cohort may no longer be representative of the Georgia prison population. Since 1991, when this cohort was defined, the number of prisoners in both Georgia and the United States as a whole has more than doubled, and between 1992 and 2006, HIV prevalence in state prisons fell from 2.7% to 1.8% (7, 36). Moreover, the Georgia prison population is not necessarily representative of the US population as a whole. Heroin injection has become rare in Georgia (37), which may explain why overdose death was less common than in the recent study of releasees in the state of Washington (8). Premature mortality is a crude proxy for health, and our study provides little information concerning the quality of life of former prisoners.

### Strengths

Our findings illustrate that the common assertion that inmates are ''10 or more years older'' in health terms than similarly aged free persons (38, 39) is an oversimplification of the health of prisoners. Rather, the ''shift'' in mortality or morbidity is dependent on the age of the prisoner and the amount of time considered for follow-up. If our results were extrapolated, our cohort would have to be followed for 40 years before a 10-year difference in total mortality was observed (25% accelerated mortality).

### Conclusions

While mortality is extremely high immediately after prison release for some discharge cohorts, our study population of persons discharged over a period of years persistently demonstrated moderately heightened mortality. Health-care planning for a population of prisoners should not ignore long-term health needs. Interventions such as treatment for hepatitis C could result in an appreciable number of years of life gained for persons who pass through a correctional institution (30). A national expert on the cost of correctional health care estimated that the United States currently spends $9.9 billion annually on medical services in prisons (Dr. J. Moore, independent nurse consultant, personal communication, 2010). State officials have a fiduciary duty to use evidence when planning how to spend prison health-care dollars, but data have often been insufficient. When planning for the health of prisoners, more emphasis should be placed on the individual life course in its entirety.

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