All-Cause and Cause-Specific Mortality Among Men Released From State Prison, 1980–2005

| David L. Rosen, PhD, Victor J. Schoenbach, PhD, and David A. Wohl, MD

The United States has the highest incarceration rate in the world,[1] but 95% of prisoners are eventually released,[2] with most reentering society after less than 2 years of imprisonment.[3] The result is a large and ever-increasing population of former inmates.[4]

This growing population shoulders a heavy burden of disease, particularly infectious diseases such as hepatitis C virus, HIV, and other sexually transmitted infections.[5] This burden is a reflection of high disease rates in the impoverished communities from which prisoners come and prisoners' engagement in behaviors that are both illegal and harmful to health.[6] Mental health conditions, including substance use disorders, are also common among prisoners.[7,8] These conditions are not only directly harmful, they also may exacerbate other comorbidities (e.g., cardiovascular disease and diabetes)[9,10] and are associated with diminished access to routine medical care.[11,12]

The transition from prison back into the community is typically difficult. Ex-prisoners often need to seek out housing and employment, reestablish personal relationships, navigate access to supportive services, and abide by the restrictions of parole and other legal sanctions.[13] These needs frequently supersede routine health care.[14]

For some, the transition is also dangerous. For ex-prisoners, risk of death in the first year—and especially in the first few weeks—after release is high compared with the risk of death among the general population.[15–18] The vast majority of these deaths are the result of nonnatural causes, particularly homicide, suicide, and drug overdose.[15–18] In one of the few US studies of its kind, risk of death among former Washington state prisoners during the first 2 weeks after release was 12.7 times the risk of death among other state residents, and risk of death from drug overdose during the first 2 weeks after release was 129 times that of other state residents.[18]

Even less well-studied in the United States are the long-term health outcomes of former prisoners. A large retrospective study

conducted in Australia reported that mortality among prisoners exceeded that of the general population across all major causes of death.[19] The public health implication of these findings for the United States is troubling given the large size of the US ex-prisoner population, the heavy burden of disease among prisoners, and the legal sanctions and social stigma that diminish access to resources after release from prison.

The purpose of our study was to examine the mortality of prisoners after their release. Specifically, we used age-standardized mortality ratios stratified by race to examine overall and cause-specific mortality among male former inmates. In addition, we examined the relative risk of mortality among former prisoners after we controlled for a measure of socioeconomic status (SES) and assessed time between prison release and death from injuries common to former prisoners. Enumeration of mortality disparities among former inmates could help detect lapses in the continuity between correctional and community health care resources.

Objectives. We compared mortality of ex-prisoners and other state residents to identify unmet health care needs among former prisoners.

Methods. We linked North Carolina prison records with state death records for 1980 to 2005 to estimate the number of overall and cause-specific deaths among male ex-prisoners aged 20 to 69 years and used standardized mortality ratios (SMRs) to compare these observed deaths with the number of expected deaths had they experienced the same age-, race-, and cause-specific death rates as other state residents.

Results. All-cause mortality among White (SMR=2.08; 95% confidence interval [CI]=2.04, 2.13) and Black (SMR=1.03; 95% CI=1.01, 1.05) ex-prisoners was greater than for other male NC residents. Ex-prisoners' deaths from homicide, accidents, substance use, HIV, liver disease, and liver cancer were greater than the expected number of deaths estimated using death rates among other NC residents. Deaths from cardiovascular disease, lung cancer, respiratory diseases, and diabetes were at least 30% greater than expected for White ex-prisoners, but less than expected for Black ex-prisoners.

Conclusions. Ex-prisoners experienced more deaths than would have been expected among other NC residents. Excess deaths from injuries and medical conditions common to prison populations highlight ex-prisoners' medical vulnerability and the need to improve correctional and community preventive health services. (*Am J Public Health.* 2008;98:2278–2284. doi:10.2105/AJPH.2007. 121855)

METHODS

Data Sources and Linking

We obtained electronic state death records from the North Carolina Center for Health Statistics for the years 1980 to 2005 and electronic imprisonment records from the North Carolina Department of Correction for the years 1980 to 2004; the additional year of mortality data allows prisoners released at the end of 2004 to potentially contribute at least 1 year of person-time at risk.

We excluded women, who compose only 12% of the former prison population, because of concerns that alternate use of maiden and married names would limit the ability to link imprisonment and death records. Because 93% of all prisoners were coded as either Black or White, we further limited our study population to these 2 race categories. For the population of Black and White men aged 20 to 69 years, there were 169 795 imprisonment records and 376 029 death records.

To determine the mortality status of former prisoners, we attempted to link state imprisonment records with state death records. If certain personal identifiers in an imprisonment record matched those in a death record, the records were linked and the former prisoner was coded as deceased; if an imprisonment record failed to match any death record, the former prisoner was coded as living.

Both databases contained 4 identifiers: last name, first name, date of birth, and last 4 digits of the prisoner's social security number, hereafter 4-digit social security number. For the 6% of former prisoners with more than 1 social security number recorded over the course of multiple imprisonments, we attempted to match by each 4-digit social security number.

Initially we linked imprisonment and death records that matched by first and last names and date of birth. This resulted in the linkage of 15 172 imprisonment records to a corresponding death record. Of those imprisonment records that failed to link to a death record by names and date of birth, 2254 records matched death records on 3 of the 4 previously mentioned identifiers. We linked 416 records that matched on 3 identifiers and were judged to have phonetically similar last names despite different spellings. Similarly, we linked 16 records matched on all identifiers except first name, in which 1 of the first names was a common derivative or nickname of the other. For records that failed to match by date of birth, we parsed date of birth into 3 variables (day, month, year), and linked records matched on 2 of 3 date-of-birth variables and on all other identifiers (n=1384), for a total of 1816 records linked by 3 of 4 identifiers. Imprisonment records linked to multiple death records were excluded (n=10). Linked records were also excluded if imprisonment data indicated that death occurred during an incarceration (n=1221), if the date of death documented in the death record preceded the release date in the imprisonment record (n=16), or if race did not match across imprisonment and death records (n=72). After these exclusions, there remained 15 673 imprisonment records linked to a corresponding death record, 152 328 unlinked imprisonment records, and 359 041 unlinked death records (figure available as a supplement to the online version of this article at http://www.ajph.org).

Disease Classification

In the death records, underlying cause of death was coded using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*),[20] for years 1987 to 1998 and the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*),[21] for years 1999 to 2005. The *ICD* codes were grouped into causes according to the National Center for Health Statistics (NCHS) List of Selected Causes of Death.[22] Because the NCHS list does not include a mental health category, we constructed this category based on coding for the mental health chapters in the *ICD-9-CM* and *ICD-10*. Results are presented by 11 discrete categories, 14 constituent causes, and a category for alcohol- and drug-induced deaths, which was drawn from several categories. (A table that is available as a supplement to the online version of this article at http://www.ajph.org presents the relationship between our causes of death and the NCHS list; for mental health conditions and substance use, *ICD-9-CM* and *ICD-10* codes are presented.) Similar to Binswager et al., we refer to the NCHS category accidental poisonings and exposure to noxious substances as drug overdose.[18]

Census Data

We obtained annual North Carolina population data for the years 1980 to 2005, restricted to males and jointly stratified by age and race by querying Centers for Disease Control and Prevention's Wide-Ranging OnLine Data for Epidemiological Research Web site (http://wonder.cdc.gov/Census.html), which provides decennial census counts and intercensal estimates.[23,24]

Covariates

We calculated age at midyear for each year between the date of most recent prison release and the date of death, or in the absence of death, between prison release and midyear 2005. We grouped ages into 10-year categories (from 20–29 years to 60–69 years). As described previously, we limited our analysis to Blacks and Whites. Educational attainment is a common indicator for SES[25] and was available in imprisonment records, death records, and 2000 Census data.[26] We created a dichotomous variable for educational attainment based on high school graduation.

Analyses

We aggregated individual death records into groups jointly stratified by cause, incarceration history (ever imprisoned in the NC prison system vs never), age category, and race, and summed the number of deaths within each group. For the year 2000, we also jointly stratified groups by educational attainment.

We estimated age-, race-, and cause-specific death rates among the never-imprisoned male population for the study period. Because census data ostensibly include former prisoners, we constructed denominators for death rates by subtracting the count of former prisoners in each stratum from that of each corresponding census stratum. Numerators were the stratum-specific numbers of deaths from those mortality records not linked to a prison record.

We calculated the expected mortality of formerly imprisoned male residents, had they experienced the same age-, race-, and cause-specific death rates as other male residents (i.e., residents never imprisoned in North Carolina) by multiplying the stratum-specific person-years of released prisoners by the corresponding stratum-specific death rates of those never imprisoned. We quantified comparisons between actual and expected mortality among male former prisoners by using standardized mortality ratios (SMRs) and 95% confidence intervals (CIs). Exact CIs were calculated when the observed number of deaths was less than 100[27]; for greater numbers of observed deaths, approximate CIs were calculated.[28]

We stratified analyses by race. We calculated all-cause age-standardized death rates by using weights from the 2000 US standard population.[29] All-cause SMRs were calculated for each age group, and age-standardized SMRs were calculated across all causes of death and for individual causes.

We estimated the effect of imprisonment history on all-cause mortality and controlled for age, race, and educational attainment. Unfortunately, educational attainment data were only available with the decennial census.[26] We limited this analysis to the most recent year with data (2000). We derived estimates by using a multivariate linear model with Poisson error distribution.

To assess temporal patterns of injury-related mortalities among former prisoners, we examined the crude death rates for homicide,

suicide, drug overdose, and motor vehicle accidents for the first 5 years after prison release. All analyses were conducted with SAS version 9.2 (SAS Institute Inc, Cary, NC).

RESULTS

The study cohort, which was limited to Black and White men aged 20 to 69 years, consisted of 168 001 male former prisoners released from the North Carolina Department of Correction Division of Prisons between the years 1980 and 2004, yielding a total of 1 822 869 person-years at risk. Upon admission to prison, 45% of the cohort of former prisoners had graduated high school. The cohort was 55% Black, and at release, the median time ever imprisoned was 10.2 months (interquartile range [IQR]=3.9–29.6 months) and the median age was 32 years (IQR=25–40 years). Median follow-up time, beginning at most recent release, was 10.3 years (IQR=4.7–16.0 years).

Between 1980 and 2005, 9.3% (15 673 of 168 001) of former prisoners died. Compared with other residents, a greater proportion of deaths among former prisoners occurred from injuries such as homicide, suicide, drug use, and motor vehicle accident, and from several disease processes, including HIV infection, viral hepatitis, and both liver cirrhosis or disease and liver cancer (Table 1).

All-Cause Mortality

Overall, there was an excess of deaths among former prisoners compared with the expected number based on population death rates of other NC residents (Table 2). Standardized mortality ratios for White and Black former prisoners were, respectively, 2.08 (95% CI= 2.04, 2.13) and 1.03 (95% CI=1.01, 1.05). The relative excess of all-cause mortality among former prisoners declined with increasing age for Whites and Blacks. All-cause SMRs among Whites consistently exceeded those of Blacks. White former prisoners experienced more deaths than was expected across all age groups; Blacks experienced more deaths for ages younger than 40 years, but fewer deaths than expected for ages 50 to 69 years (Table 2). The age-standardized all-cause mortality rate among White former prisoners was nearly twice that of other White NC residents (1094.8 vs 596.1 per 100 000). Among Black former prisoners, the

TABLE 1—Distribution of Deaths Among Male Former State Prisoners and Other Male State Residents: North Carolina, 1980–2005

	Former Prisoners (n = 15 673), %	Other Residents (N = 359 041), %
Cardiovascular disease		
Total	20.6	35.5
Cerebrovascular disease	2.9	4.1
Ischemic heart disease	11.8	23.4
Cancer		
Total	14.7	26.3
Liver cancer	0.8	0.5
Lung or bronchial cancer	6.5	10.4
Liver disease and cirrhosis		
Total	4.3	2.4
Alcoholic liver disease	3.0	1.5
Causes other than alcohol	1.3	0.9
Diabetes	1.7	2.3
Infection		
Total	10.3	4.7
HIV	6.8	1.8
Viral hepatitis	0.8	0.2
Tuberculosis	0.1	0.1
Respiratory disease		
Total	2.9	4.3
Chronic lower respiratory disease	1.9	3.2
Mental and behavioral		
Total	4.2	1.6
Alcohol	3.5	1.2
Drugs	0.4	0.1
Accident		
Total	19.0	9.5
Motor vehicle accident	8.5	5.2
Drug overdose	4.7	1.1
Homicide	10.9	2.5
Suicide	4.8	3.7
Other	6.5	7.1
Alcohol or drugs[a]	11.5	3.8

Note. With the exclusion of "Alcohol or drugs," percentages from total causes sum to 100%.
[a]Includes deaths induced by alcohol or drugs within the following categories: mental and behavioral disorders, suicides, overdoses, and alcoholic liver disease.

age-standardized all-cause mortality rate was less than that for other NC Black residents (1004.6 vs 1111.2 per 100 000); this reversal from the SMR occurs because the age distribution of former Black prisoners is younger than that of the US standard population.

Cause-Specific Mortality Among Whites

Across all causes of mortality, the observed number of deaths among White former prisoners was greater than expected (Table 3). Of

all the specific causes studied, the greatest relative excess of nonaccidental death (i.e., SMR) was from drug use, but the absolute number of deaths was small. Deaths from injury including homicide, suicide, and accidents were between 2 and 7 times the expected number, and deaths from drug overdoses were 9 times the expected number. The numbers of observed deaths from liver cirrhosis or disease and cancer of the liver were each approximately 3.5 times the expected, and the number of deaths from HIV

TABLE 2—Age-Specific and Age-Standardized Mortality Rates and Standardized Mortality Ratios (SMRs) Among Male Former State Prisoners: North Carolina, 1980–2005

	Mortality Rate[a]			Former Prisoner Deaths		
	Former Prisoners	Other Residents	Former Prisoner Person-Years	Observed, No.	Expected, No.	SMR (95% CI)
White						
Age, y						
20–29	483.6	134.7	143 920	696	193.9	3.59 (3.33, 3.87)
30–39	521.5	167.0	306 973	1601	512.6	3.12 (2.97, 3.28)
40–49	838.2	349.5	258 304	2165	902.7	2.40 (2.30, 2.50)
50–59	1703.6	920.4	117 810	2007	1084.4	1.85 (1.77, 1.93)
60–69	2996.3	2341.6	46 057	1381	1078.5	1.28 (1.21, 1.35)
Age-standardized	1094.8[b]	596.1[b]	. . .	7850	3772.0	2.08 (2.04, 2.13)
Black						
Age, y						
20–29	598.6	224.6	156 201	935	350.8	2.67 (2.50, 2.84)
30–39	585.8	404.1	329 465	1931	1331.4	1.45 (1.39, 1.52)
40–49	831.7	820.1	286 881	2387	2352.6	1.01 (0.97, 1.06)
50–59	1443.3	1844.4	119 864	1731	2210.8	0.78 (0.75, 0.82)
60–69	2299.9	3667.7	36 654	843	1344.4	0.63 (0.59, 0.67)
Age-standardized	1004.6[b]	1111.2[b]	. . .	7827	7589.9	1.03 (1.01, 1.05)

Note. CI = confidence interval.
[a] Per 100 000.
[b] Adjusted to the 2000 US standard population.[29]

infection was 69% greater than expected. For chronic conditions such as cardiovascular disease, respiratory disease, and diabetes, the numbers of deaths among former prisoners were at least 30% greater than expected.

Cause-Specific Mortality Among Blacks

Among Black former prisoners, the numbers of deaths from homicide, suicide, and accidents were between 1.2 and 2.7 times the expected number, and deaths from drug overdose were greater than twice the expected number (Table 3). The number of deaths from infection was also greater than expected, with the number of deaths from HIV infection exceeding twice the expected number. There were fewer than expected deaths from cardiovascular disease, diabetes, chronic lower respiratory diseases, "other" conditions, and all cancers, although there was an excess of deaths from liver cancer. Standardized mortality ratio CIs for tuberculosis included the null.

Effect of Imprisonment and Socioeconomic Status on Mortality

Socioeconomic status, as measured by high school graduation, was an effect modifier of the imprisonment–mortality relationship. Among those who never graduated, the relative risk (RR) of mortality was 19% lower among former prisoners compared with other NC residents (RR=0.81; 95% CI=0.73, 0.90). By contrast, among graduates, the risk of mortality was 36% greater among former prisoners than among other NC residents (RR=1.36; 95% CI=1.22, 1.53).

Injury-Related Deaths After Prison Release

Among inmates released from prison between 1990 and 1999, the rate of injury-related deaths during the first year after release was highest for homicide, followed by motor vehicle accidents, suicide, and drug overdose. During the next 4 years, mortality rates for homicide and motor vehicle accidents had larger absolute and relative declines than did rates for either suicide or drug overdose (Figure 1).

DISCUSSION

Our study is one of the first to examine mortality among released US prisoners and has a substantially larger study population and longer follow-up period than do past studies,[15–19] enhancing our ability to examine mortality from both injuries and chronic diseases. Overall, we found an excess number of deaths among the population of former prisoners compared with what would be expected if former prisoners had experienced the same age- and race-specific death rates as other residents.

Our finding that there was an excess number of injury deaths among former prisoners is consistent with several smaller studies that have shown that former prisoners are at increased risk of mortality from homicide, suicide, drug use, and other accidents.[15–18]

Few studies have examined the relationship between imprisonment and mortality from causes other than injury. One Australian study found that, after 8 years of mean follow-up, the number of observed deaths among former prisoners was greater than expected for all causes of death, including chronic medical conditions.[19] The only US study to examine causes of death other than injury showed that former prisoners were at increased risk of mortality from cardiovascular disease, liver disease, and cancer, although with an average population age of 32 years at release and a mean follow-up of less than 2 years, the study was not well suited to examine chronic disease deaths, which typically occur later in life.

In our study population, there was an excess of deaths from chronic disorders among White former prisoners. Over a median follow-up period of greater than 10 years, we found that White former prisoners experienced about 30% more deaths than expected from cardiovascular disease and from cancer, 50% more deaths than expected from diabetes, and 117% more deaths than expected from respiratory diseases. Among both White and Black former prisoners, there were excess deaths from viral hepatitis, liver disease, and HIV infection—all conditions known to be of greater prevalence among prison populations compared with the general population.

However, among Black former prisoners, the numbers of deaths from most chronic disorders were actually lower than expected and fewer Black former prisoners in the oldest 2 age groups died than expected. In fact, all-cause mortality rates among Black former prisoners in the oldest age groups were lower than those

TABLE 3—All-Cause and Cause-Specific Observed Deaths and Standardized Mortality Ratios (SMRs) Among Male Former State Prisoners: North Carolina, 1980–2005

	Whites		Blacks	
	Deaths, No.	SMR (95% CI)	Deaths, No.	SMR (95% CI)
All-cause	7849	2.08 (2.04, 2.13)	7824	1.03 (1.01, 1.05)
Cardiovascular disease				
Total	1630	1.30 (1.24, 1.37)	1598	0.67 (0.64, 0.70)
Cerebrovascular disease	175	1.51 (1.29, 1.75)	277	0.64 (0.56, 0.72)
Ischemic heart disease	1105	1.24 (1.17, 1.32)	749	0.65 (0.61, 0.70)
Cancer				
Total	1193	1.27 (1.20, 1.34)	1112	0.74 (0.70, 0.78)
Liver cancer	62	3.30 (2.53, 4.23)	61	1.71 (1.31, 2.19)
Lung or bronchial cancer	592	1.65 (1.52, 1.79)	431	0.84 (0.76, 0.92)
Liver disease and cirrhosis				
Total	415	3.79 (3.43, 4.17)	262	1.18 (1.04, 1.33)
Alcoholic liver disease	280	4.12 (3.65, 4.63)	196	1.25 (1.08, 1.44)
Other causes	135	3.25 (2.72, 3.84)	66	1.02 (0.79, 1.30)
Diabetes	115	1.49 (1.23, 1.79)	149	0.70 (0.59, 0.82)
Infection				
Total	373	2.29 (2.06, 2.53)	1248	1.67 (1.58, 1.76)
HIV	110	1.69 (1.39, 2.03)	953	2.17 (2.03, 2.31)
Viral hepatitis	74	6.09 (4.78, 7.64)	45	2.55 (1.86, 3.41)
Tuberculosis	3	2.08 (0.43, 6.08)	10	0.61 (0.29, 1.12)
Respiratory disease				
Total	298	2.17 (1.93, 2.44)	158	0.84 (0.72, 0.98)
Chronic lower respiratory disease	219	2.14 (1.86, 2.44)	79	0.70 (0.55, 0.87)
Mental and behavioral				
Total	372	6.60 (5.95, 7.31)	287	1.20 (1.06, 1.35)
Alcohol	325	7.54 (6.74, 8.40)	218	1.16 (1.01, 1.32)
Drugs	23	12.59 (7.98, 18.89)	40	3.28 (2.34, 4.47)
Accident				
Total	1821	3.86 (3.68, 4.04)	1164	1.39 (1.31, 1.47)
Motor vehicle accident	772	3.01 (2.80, 3.23)	556	1.28 (1.18, 1.40)
Drug overdose	536	8.70 (7.98, 9.47)	208	2.06 (1.79, 2.36)
Homicide	555	6.67 (6.13, 7.25)	1159	2.70 (2.55, 2.86)
Suicide	594	2.59 (2.39, 2.81)	152	1.16 (0.98, 1.36)
Other	483	1.90 (1.74, 2.08)	535	0.77 (0.71, 0.84)
Alcohol or drugs[a]	1177	6.54 (6.18, 6.93)	632	1.51 (1.39, 1.63)

Note. CI = confidence interval.
[a]Includes deaths induced by alcohol or drugs within the following categories: mental and behavioral disorders, suicides, overdoses, and alcoholic liver disease.

June 14, 2007). At this time, there is little evidence to explain either finding. It may be that prison affords older Black men health care not otherwise accessed in the community and the benefits of this care persist after their release. Another possibility is that, upon release, Black men, for whom imprisonment has become increasingly common,[4] face less stigma and fewer barriers than do Whites in reestablishing social supports protective of health and access to health care.

After cardiovascular disease, cancer, and accidents, homicides were the leading cause of death among former prisoners. Risk of death from homicide declined during the first 5 years after release. We speculate that greater community involvement may be protective. A substantial proportion of deaths among former prisoners was attributable to alcohol and drug use. Also, the death rate from drug overdose was several times that of the general population and remained steady during the first 5 years after release. With 53% of prisoners reporting symptoms consistent with a *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*,[30] diagnosis of substance abuse or dependence,[7] more information is needed about the health care and substance use treatment experiences of prisoners after their release.

Disentangling the relationship among imprisonment, SES, and mortality is difficult. Low SES increases risk for imprisonment[31] and mortality,[32] and imprisonment further perpetuates low SES.[33] We examined the imprisonment–mortality–SES relationship by using a crude indicator of SES—high school graduation. We found that after we controlled for age and race, a history of imprisonment was associated with reduced mortality among nongraduates, but with increased mortality among graduates. It is plausible that imprisonment improved access to health care resources for the poorest former prisoners but diminished access among other former prisoners.

Limitations

This study had a few limitations. First, records were linked on the basis of stringent criteria, and aliases were unavailable to us. As a result, some deceased former prisoners were likely misclassified as living, which would underestimate SMRs. Second, with death record data limited to North Carolina residents, former

of White former prisoners. This was an unexpected finding given that, within the 2 oldest age groups of those without a history of imprisonment, mortality rates among Blacks were more than 50% greater than those of Whites.

Although unexpected, this finding is consistent with subsequent findings from an unpublished US Bureau of Justice Statistics analysis of mortality during imprisonment, which found that death rates among older Black prisoners were less than those for older Black residents, and less than those for older White prisoners, for whom mortality was 20% greater than among their community counterparts (C. J. Mumola, Bureau of Justice Statistics, US Department of Justice, written communication,
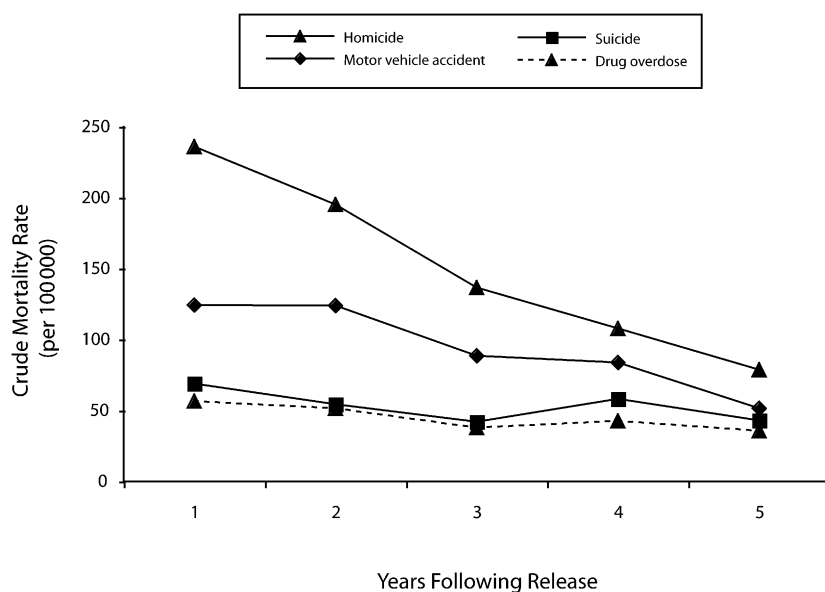
FIGURE 1—Average annual injury mortality rates of male former prisoners released from North Carolina state prison between January 1, 1990, and December 31, 1999.

prisoners residing outside the state at the time of death were misclassified as living, further attenuating SMRs. Therefore, we caution that the protective effects of imprisonment on mortality for older Blacks may be attributable in part to misclassification.

We used the NCHS cause-of-death categories to accommodate use of both *ICD-9-CM* and *ICD-10* codes. A benefit of this categorization system is that assessments have been published describing the comparability of categorization across *ICD-9-CM* and *ICD-10*. For most causes of death in this study, the published percentage change across *ICD* revisions was less than 5%.[34,35] We have no reason to believe that *ICD* codes were applied differentially on the basis of imprisonment history.

We do caution that our analysis of SES on the imprisonment–mortality relationship was exploratory in nature because high school graduation was measured differently for prisoners, living residents, and decedents, and because other important covariates such as income were unavailable for inclusion in the analysis. Finally, dates of imprisonment were only available for prisoners' most recent incarceration. Therefore, former prisoners' person-time was calculated from their most recent release, overestimating risk among

prisoners with multiple incarcerations. Overestimation may have been slightly more common among Blacks, who, according to national data, are about 4% more likely than are Whites to return to prison within 3 years after release (54.2% vs 49.9%).[36]

Conclusions

We found that an excess number of deaths occurred among former prisoners across a wide range of causes and that this population was particularly vulnerable to death by accident, homicide, drug use, and medical conditions common to prisoners. However, for 1 group—older Black men—prison may have had a protective effect.

It may seem inevitable that mortality among former prisoners would be greatest from conditions common to prison populations. Nevertheless, prisons provide an important point of intervention: prisons can be used as a venue to screen for disease; provide medical, mental health, and substance use treatment; and, upon prisoners' release, facilitate the continuity of care from the correctional to the community setting. Although prison systems vary in their efforts to provide disease screening and treatment, the quality of these services has not been systematically evaluated, and programs that provide for continuity of care are rare.[5]

Criminal conviction and imprisonment have many consequences, several of them unintentional. More effort is needed to delineate the direct and collateral consequences of imprisonment, including the short- and long-term effects of imprisonment on health. Future studies, including in-depth qualitative investigations, are needed to examine health and health care experiences before, during, and after imprisonment to more clearly understand the personal, institutional, and societal barriers to health and health care among this vulnerable population. ■

About the Authors

At the time of this study, David L. Rosen was an MD/PhD student at the University of North Carolina Schools of Medicine and Public Health, Chapel Hill. David A. Wohl is with the University of North Carolina Schools of Medicine and Public Health, Chapel Hill. Victor J. Schoenbach is with the University of North Carolina School of Public Health, Chapel Hill.

Requests for reprints should be sent to Victor J. Schoenbach, PhD, Department of Epidemiology, CB#7436, UNC School of Public Health, Chapel Hill, NC 27599-7436 (e-mail: vjs@unc.edu).

This article was accepted March 12, 2008.

References

1. Walmsley R. *World Prison Population List, Seventh Edition*. King's College London, International Centre for Prison Studies; 2007. Available at: http://www.kcl.ac.uk/depsta/law/research/icps/downloads/world-prison-pop-seventh.pdf. Accessed September 1, 2008.

2. Beck AJ, Mumola CJ. *Prisoners in 1998*. Washington, DC: Bureau of Justice Statistics, US Dept of Justice; 1999. Publication NCJ 175687.

3. Hughes T. *National Corrections Reporting Program*. Washington, DC: Bureau of Justice Statistics; 2005.

Available at: http://www.ojp.usdoj.gov/bjs/dtdata. htm#ncrp. Accessed January 7, 2007.

4. Bonczar TP. *Prevalence of Imprisonment in the U.S. Population, 1974–2001*. Washington, DC: Bureau of Justice Statistics, US Dept of Justice; 2003. Publication NCJ 197976.

5. *The Status of Soon-to-be-Released Inmates, A Report to Congress, Volume 1*. Chicago, IL: National Commission on Correctional Health Care; 2002.

6. Braithwaite RL, Arriola KR. Male prisoners and HIV prevention: a call for action ignored. *Am J Public Health*. 2003;93:759–763.

7. Mumola CJ, Karberg JC. *Drug Use and Dependence, State and Federal Prisoners, 2004*. Washington, DC: Bureau of Justice Statistics, US Dept of Justice; October 2006. Publication NCJ 213530.

8. James DJ, Glaze LE. *Mental Health Problems of Prison and Jail Inmates*. Washington, DC: Bureau of Justice Statistics, US Dept of Justice; 2006. Publication NCJ 213600.

9. Miller BJ, Paschall CB Svendsen DP III. Mortality and medical comorbidity among patients with serious mental illness. *Psychiatr Serv*. 2006;57:1482–1487.

10. Cornish JW, O'Brien CP. Crack cocaine abuse: an epidemic with many public health consequences. *Annu Rev Public Health*. 1996;17:259–273.

11. Sterk CE, Theall KP, Elifson KW. Health care utilization among drug-using and non-drug-using women. *J Urban Health*. 2002;79:586–599.

12. Chitwood DD, McBride DC, Metsch LR, Comerford M, McCoy CB. A comparison of the need for health care and use of health care by injection-drug users, other chronic drug users, and nondrug users. *Am Behav Scientist*. 1998;41:1107–1122.

13. Travis J. *But They All Come Back: Facing the Challenges of Prisoner Reentry*. Washington, DC: Urban Institute Press; 2005.

14. Mallik-Kane K. *Returning Home Illinois Policy Brief: Health and Prisoner Reentry*. Washington, DC: Urban Institute; 2005.

15. Bird SM, Hutchinson SJ. Male drugs-related deaths in the fortnight after release from prison: Scotland, 1996–99. *Addiction*. 2003;98:185–190.

16. Pratt D, Piper M, Appleby L, Webb R, Shaw J. Suicide in recently released prisoners: a population-based cohort study. *Lancet*. 2006;368:119–123.

17. Seaman SR, Brettle RP, Gore SM. Mortality from overdose among injecting drug users recently released from prison: database linkage study. *BMJ*. 1998;316:426–428.

18. Binswanger IA, Stern MF, Deyo RA, et al. Release from prison—a high risk of death for former inmates. *N Engl J Med*. 2007;356:157–165.

19. Kariminia A, Butler TG, Corben SP, et al. Extreme cause-specific mortality in a cohort of adult prisoners—1988 to 2002: a data-linkage study. *Int J Epidemiol*. 2007;36:310–316.

20. *The International Classification of Diseases, Ninth Revision, Clinical Modification*. Vol. 1 and 2. 3rd ed. Hyattsville, MD: Department of Health and Human Services; 1989. DHHS publication PHS 89-1260.

21. *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*. Geneva, Switzerland: World Health Organization; 2007. Available at:

http://www.who.int/classifications/apps/icd/icd10online. Accessed February 5, 2007.

22. Documentation for the public use multiple cause of death file on comparability between ICD-9 and ICD-10: a double-coded file based on the 1996 data year multiple cause of death file. Hyattsville, MD: National Center for Health Statistics; 2004. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/Comparability/icd9_icd10. Accessed October 10, 2006.

23. Centers for Disease Control and Prevention, National Center for Health Statistics. *US Department of Commerce, US Census Bureau Population Division, Census Population 1970–2000 for Public Health Research, Bridged-Race Population Estimates, United States, 1990–2003, July 1st Resident Population by State, County, Age, Sex, Race, and Hispanic Origin* [CDC WONDER online database]. Available at: http://wonder.cdc.gov/census.HTML. Accessed April 3, 2007.

24. Centers for Disease Control and Prevention, National Center for Health Statistics. *Bridged-Race Population Estimates, United States, July 1st Resident Population by State, County, Age, Sex, Race, and Hispanic Origin, Compiled From 2000–2005 (Vintage 2005) Bridged-Race Postcensal Population Estimates* [CDC WONDER online database]. Available at: http://wonder.cdc.gov/census.HTML. Accessed April 3, 2007.

25. Galobardes B, Shaw M, Lalow DA, Smith GD, Lynch J. Indicators of socioeconomic position. In: Kaufman JS, Oakes JM, eds. *Methods in Social Epidemiology*. San Francisco, CA: Jossey-Bass; 2006:47–85.

26. US Census Bureau. *PCT65. Sex by Age by Educational Attainment for the Population 18 Years and Over [83]–Universe: Population 18 Years and Over* [Data Set: Census 2000 Summary File 4–Sample Data]. Available at: http://factfinder.census.gov. Accessed February 21, 2007.

27. Goldblatt P. *Longitudinal Study, Mortality and Social Organisation*. London, England: Her Majesty's Stationery Office; 1990.

28. Rothman K, Boice J Jr. *Epidemiologic Analysis With a Programmable Calculator*. Washington, DC: Department of Health, Education, and Welfare, Public Health Service; 1979.

29. *Surveillance Epidemiology and End Results (SEER) Standard Populations—19 Age Groups: 2000 US Standard Population (Census P25-1130)*. Bethesda, MD: National Cancer Institute. Available at: http://seer.cancer.gov/stdpopulations/stdpop.19ages.html. Accessed February 8, 2007.

30. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*. Washington, DC: American Psychiatric Association; 1994.

31. Satterfield JH, Faller KJ, Crinella FM, Schell AM, Swanson JM, Homer LD. A 30-year prospective follow-up study of hyperactive boys with conduct problems: adult criminality. *J Am Acad Child Adolesc Psychiatry*. 2007;46:601–610.

32. Link BG, Phelan J. Social conditions as fundamental causes of disease. *J Health Soc Behav*. 1995;Spec No: 80–94.

33. Kerley KR, Benson ML, Lee MR, Cullen FT. Race, criminal justice contact, and adult position in the social stratification system. *Soc Problems*. 2004;51:549–568.

34. Anderson RN, Miniño AM, Hoyert DL, Rosenberg HM. *Comparability of Cause of Death Between ICD-9 and*

ICD-10: Preliminary Estimates. Hyattsville, MD: National Center for Health Statistics; 2001.

35. [Online file.] Hyattsville, MD: National Center for Health Statistics; 2004: Table 1. Final and preliminary comparability ratios for 113 selected causes of death. Available at: ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Datasets/Comparability/icd9_icd10/Comparability_Ratio_tables.xls. Accessed March 10, 2007.

36. Langan PA, Levin DJ. *Recidivism of Prisoners Released in 1994*. Washington, DC: Bureau of Justice Statistics, US Dept of Justice; June 2002. Publication NCJ 193427.