Demographic and Criminal Determinants of Mortality in Prison: The Odds Of Surviving Confinement

Adansi A. Amankwaa, Albany State University
Charles Ochie, Sr., Albany State University

Abstract

Several studies have demonstrated the importance of sociodemographic factors on prison mortality. This study advances our understanding of mortality by expanding demographic models to include habitual offenders, primary offenses and sentence length. Using data from the Florida Department of Corrections, this article explores the relationship between demographic and criminal characteristics of inmates and the odds of surviving confinement. Results indicate that criminal characteristics of inmates and medical status more strongly affect the probability of surviving confinement than race and sex. Finally, there was no indication of confounding and interaction effects with the exceptions of a two-way interaction of good health and race, good health and prison offense, and prison offense and sentence length.

Introduction

The population and deaths in United States prisons have become notably more striking over the past two decades. Official statistics show that the actual number of deaths increased considerably over the years (Maguire and Pastore, 1997; Beck, 2000). Rising population combined with changes in the sentencing laws and the high risk of HIV/AIDS has resulted in an increase in mortality. Florida prisons' mortality increase has been rather striking. In Florida for example, actual observed deaths increased from 60 in 1984 to 174 in 1993. The proportion of deaths grew by about 190% for the 9-year period. Crude death rates increased from 2.2 per 1,000 in 1984 to 3.3 per 1,000 in 1993 (Florida Department of Corrections Annual Reports, 1984 to 1999). Other studies show that not only is mortality on the increase in U.S. prisons but also most of the deaths are AIDS-related (Hammett, Harmon, Maruschak, 1999; Amankwaa, 1995; Harlow, 1993). Yet, little is known about the precise nature of the determinants of mortality in prison. Studies of the determinants of mortality in the general population often seek to measure the impact of socioeconomic and demographic factors on mortality. Substantial insights can be gained if, in addition to the socioeconomic and demographic factors, offense type of inmates are examined.

This article explores a neglected topic in criminal justice and demographic literature: the link between mortality and inmate characteristics. Specifically, we examine the odds of an inmate dying in prison given demographic, criminal characteristics and medical status of inmates at the time of incarceration. The question is do offense type influences inmates mortality risks in prison? To answer this question, we evaluate the probability of surviving confinement using bivariate and multivariate analyses. The data for the study are drawn from detailed records of inmates in the Florida Department of Corrections, and include all releases in 1997-98 fiscal year.

Given the unavailability of medical variables, such as diagnosis and cause of death in the data set, which are very important in analyzing determinants of mortality, this article does not address causes of death. Whether or not an inmate died from AIDS, cancer or cardiovascular disease is beyond the scope of this article and thus will not be examined.

Conceptual Framework: Factors linking offense type and mortality

Based on previous findings, we expect that crime record is associated with mortality risks. In this section we outline some of the mechanisms that might produce this relationship.

Criminologist have investigated the relationship between offense type and sentencing policies (Cullen, Bynum, Garrett and Greene, 1985; McGarreell and Flanagan, 1987), including the effects of three strikes and you're out laws on the age structure of the prison population (Schmertmann, Amankwaa and Long, 1998). Much research suggests that the prison populations constitute different types of felony offenses which include, but are not limited to, murder, forcible rape, burglary, larceny, theft and arson. Moreover, and perhaps very important for health reasons, inmates are particularly prone to different health risks because of overcrowding (Koehler, 1994; Woods, Harris and Solomon, 1997). For example, inmates who sever longer in prison are more likely to have higher mortality associated with degenerative diseases. However, those who are incarcerated for shorter durations are also at risk of communicable and other infectious diseases such as HIV/AIDS and Tuberculosis (TB) (Koehler, 1994; Woods, Harris and Solomon, 1997).

Furthermore, given the prevalence of HIV/AIDS and other infectious and degenerative diseases in the U.S. prison system (Amankwaa, 1995; Hammett, Harmon and Maruschak, 1999), inmates tend to be more at risk than the general population because of institutionalization. Fortunately, our data allows control not only of time served but also primary and habitual offenses. Consequently, we can estimate the impact of time served on mortality. Thus, there are multiple reasons to expect offense type to be associated with higher mortality.

Medical status and mortality

Previous studies have suggested that the risk of surviving confinement varies by medical status. It has been argued that the structure of mortality in a population is determined not by the differences in fatality rates but by the incidence and prevalence of various diseases (United Nations, 1982). In fact, the association between medical status and mortality may be influenced by the environment in which the population lives. Nevertheless, medical status may be related to several factors, which we cannot measure, that may work to increase the risk of mortality. Some of these include how disease is perceived within the prison system. Within the prison setting, diseases that are regarded as a gradual deterioration in health status or are infectious in nature (HIV/AIDS and TB), which must be prevented, is given immediate attention (Hammett, Harmon and Maruschak, 1999). Furthermore, inmates whose diseases are perceived to be less threatening often face health hassles that have the potential to result in the loss of health benefits due to lack of or improper medical attention (Engle, 1999). Other factors involve problems of discouraging high risk sexual activity in prisons (Amankwaa, Amankwaa and Ochie, 1999).

Socidemographic factors and mortality

People who commit crimes may differ demographically from the general population. Much research suggests that people who commit crimes, on average, are young, black or Hispanic persons, not white (Hussey and Elo, 1997; Rogers, 1995; Kallan, 1997). Much research suggests that age, ethnicity, and sex are associated with mortality. Because these demographic characteristics are also related to the risks of mortality we controlled for them in our models.

Another important factor associated with mortality is socioeconomic status. For example, inmates who are more educated may be more likely to engage in healthy behaviors and have lower mortality rates. Thus, an observed association between an inmates healthier life styles and mortality may, in fact be due to socioeconomic characteristics. Indeed, our data set allows control for the education of inmates. As a result we can directly assess the impact of education on mortality.

Previous research findings

Socioeconomic and demographic variables are unquestionably important in predicting mortality. It is well documented that socioeconomic status is an important predictor of a person's health and mortality (Kallan, 1997; Feinstein, 1993; Preston and Taubman, 1994; Williams and Collins, 1995; Hummer, Rogers and Eberstein 1998; Rogers, 1995). Previous studies suggest that individuals with high income and education enjoy the benefits of longer and healthier life (Feinstein, 1993; Preston and Taubman, 1994; Williams and Collins, 1995; Hummer, Rogers and Eberstein 1998). The healthier an individual, the lower their mortality risk. Furthermore, some research indicates that race, age, and marital status influence a person's risk of dying (Hussey and Elo, 1997; Rogers, 1995; Kallan, 1997).

A number of variables have been identified in the research literature as important correlates of mortality. For example, income and education have been found to have a remarkable moderating effect on the risk of dying (Smith, Shipley and Rose, 1990; Potter, 1991; McCord and Freeman, 1990; Elo and Preston, 1996, 1997; Hummer, Rogers and Eberstein, 1998; Johnson et al, 1999) with various explanations for the differences. Furthermore, Johnson and colleagues (1999), using U.S. longitudinal data of persons aged 25-64, concluded that mortality differences exist for selected specific occupations beyond those explained by social status, income and education. Overall Doornbus and Kromhout (1991) found that there is a more persistent pattern of mortality differentials by education.

A larger literature investigates the effects of educational inequalities, sex, and race on adult mortality (Christenson and Johnson, 1995). Using Michigan's 1989-1991 death certificates, in conjunction with the 1990 Census data, Christenson and Johnson demonstrated that variations in education status differ by sex and race across the adult life cycle. In addition, the research shows that the relative differences in mortality rates between educational levels decline with age across sex and race categories.

Age has been one of the long-standing variables of interest in analyzing adult mortality. Following the initial work by Gompertz, Olshanskey and Carnes (1997), mathematical models show that the very young and the old have the highest death rates. Although these mathematical models are interesting, they do not adequately capture the actual variability in the human experience with death. Recently, researchers have developed genetic models of human frailty that attempt to combine demographic analysis with quantitative genetics and epidemiology (Weiss, 1990; Yashin and Iachine, 1997).

Other studies, however, have focused on the general linkage between marriage and the risk of mortality. One very important finding in demography is that married individuals' mortality rates are lower than those who are unmarried. In both developed and developing countries there is evidence to indicate the beneficial effects of marriage on mortality (Hu and Goldman, 1990; Rahman, 1993).

Most of the past work has focused on gaining an understanding of the determinants of mortality in the general population. Thus (understandably) there is little or no literature on the association between criminal characteristics and mortality. Although offense type may be relevant in understanding criminal behavior, it is possible that offense types vary significantly within the prison population. In the context of mortality research, inmates incarcerated with violent offences are more likely to serve longer sentences. Intraprison disparities of offense types therefore might lead to differences in mortality risks between violent and nonviolent offenses unless the length of sentence is held constant.

Hammett, Harmon and Maruschak (1999) use data on prisoners from the Centers for Disease Control and Prevention, National Prisoner Statistics and Bureau of Justice Statistics to examine AIDS- related mortality. Hammett, Harmon and Maruschak (1999) find AIDS a significant cause of death in prison. Their analysis, however, gives no attention to the determinants of mortality in prison. Amankwaa (1995) used data from the Florida Department of Corrections to examine causes of death. His research shows that AIDS is the major cause of death in the Florida prison system. Similar results were found among male prisoners in Maryland (Salive, Smith and Brewer, 1990). None of these studies sought to examine the effect of offense type on mortality. In short how the combined effect of demographic, offense type and medical status of inmates affect the chances (log odds) of surviving incarceration remains an issue to be explored.

Data and Measures

The data for the analysis came from the Florida Department of Corrections. In our analysis we used the data set containing all releases for the fiscal year 1997-98. Using the release data file for this analysis is deemed appropriate since death, a demographic outcome, is considered an exit from prison. For this very reason any inmate who died in prison is regarded as unable to survive confinement, while any offender who served his or her time successfully survives confinement. The present analysis is based on a total population of 24,490 inmates released, of which there were 225 deaths excluding all executions.

Information on the exact causes of death is not available on the inmate release data files. Consequently, this analysis uses information on the medical status[1] of the inmate as proxy for physical conditions. The measure of medical grade[1] is an indication of the severity or otherwise of the inmate's health conditions.

In this analysis we created a variable, survive confinement, from the release data set. The variable survive confinement is in a binary form categorized into whether the inmate died (i.e., unable to survive confinement) or survives confinement (i.e., inmate was released for other reasons). Such a measure is more feasible to interpret. For the logistic regression model, a dependent variable is expressed in a binary form. Once incarcerated one can only exit after completion of sentence (including control release) or death.

The independent variables used in our model, as shown in Table 1, are sex, race, educational level tested[2], age at release, sentence length, primary offense[3], habitual offenders and medical status. Race/ethnicity have been hypothesized to be an important predictor of mortality (Elo & Preston,1996). Race is treated as categorical variable with blacks, Hispanics, and other, coded as 0 and white coded as 1. Sex in this analysis is a dichotomous dummy variable: coded 0 equals female and 1 equals male. Our demographic controls are age and years of education. The average age of an inmate at the time of release is 33 years with a standard deviation of 9.53 indicating some dispersion. Education is measured in single years with the average years of education 7.16.

Our criminal measures include habitual offenders, primary offense[3] (categorized into violent and nonviolent offenders) and sentence length. Inmates who commit violent crimes, in general, are given longer sentences. The average time served is 452 months with a standard deviation of 67.64 indicating that there is a greater variability in the time served. These criminal characteristics of inmates may affect their likelihood of dying in prison. For example, the policy of mandatory sentences may affect survival chances directly, simply by preventing the offender from getting out earlier.

The data also include detailed information about the medical status of inmates. We classified medical status of the inmate in four ways: 1) no organic diseases, 2) minimum organic diseases, 3) moderate organic diseases and 4) severe organic diseases may affect whether or not an inmate will die in prison. Consequently, this analysis uses information on the medical status of the inmate as a proxy for physical conditions at time of release. The measure of medical grade is an indication of the severity or otherwise of the inmate's health conditions.

Table 1. Definitions and Mean Distributions of Variables Released, Florida Prisons: 1997-98

Variable	Definition	Mean	Standard Deviation
Dependent			
S	Inmate Survived Confinement 1 = Survived 0 = Died		
Independent			
Female	Sex of inmate 0 = female 1 = male		
White	Race of inmate 0 = Other 1 = Black 2 = White		
Education	Average Grade Tested (measured in years)	7.16	3.59
Age	Age Released (Months)	32.85	9.53
Primary Offense	Offense type[6] 0 = nonviolent 1 = violent		
Habitual Offender	Habitual offenders 0 = No 1 = Yes		
Sentence length	Sentence length in Months 0 = > 60 months 1 = < 59 months	451.99	67.64
NPS†	Medical status at admission 1 = Unrestricted (healthy) 2 = Minimum Organic Diseases 3 = Moderate Organic Diseases 0 = Severe Organic Diseases		

† NPS implies Normal Physical Stamina

Table 2. Composition and Distribution of Inmates Releases in 1997-98 and Bivariate Analyses of Surviving Confinement in Florida Prison system

Variable	Number Survive Confinement	Number Dead	Odds Ratio
Race:			
White	10,555	103	0.896
Black, Hispanic and other	13,935	122	
Sex:			
Male	22,516	212	0.699
Female	1,974	13	
Education Tested:			1.150***
No Education/Primary	8,722	101	
Middle/High	11,474	65	
College	2,792	13	
Age Released:			0.909***
Under 29	9,943	29	
30-39	9,062	56	
40-49	4,196	60	
50-59	993	40	
60-69	229	25	
70+	65	15	
Offense Type:			
Violent	12,432	129	0.766**
Nonviolent	12,056	96	
Habitual Offense:			
No	22,130	191	
Yes	2,358	34	1.679***
Length of sentence (months):			0.201
Less than 48	13,435	38	
49-360	10,588	120	
361-601	179	15	
Medical status:			
Unrestricted	13,745	15	514.183***
Minimum Organic Diseases	8,481	28	169.774***
Moderate Organic Diseases	1,729	32	29.818***
Severe Organic Diseases	414	149	

*** $p < 0.001$; ** $p < 0.05$

In Table 2, we show the number of inmates surviving confinement and the number that died. The results indicate that more Blacks, Hispanics and other racial groups died than Whites. In the 1997-98 fiscal year, the number of inmates who died in prison is higher among violent offenders than nonviolent offenders. Inmates with a severe medical status are more likely to die in prison than those with less severe health conditions. Table 2 also shows that inmates with longer sentences are more likely to die in prison. Further, as age increases, the disparity becomes even more pronounced.

ANALYTICAL APPROACH

In this study, mortality is treated as a binary outcome variable, which is associated with explanatory variables. Let S be survival through confinement of the i^{th} released inmate, which takes the value of 1 if the inmate survives confinement and 0 if the inmate dies in confinement. Logistic regression models are employed in this analysis since the dependent variable is dichotomous (Hanushek and Jackson 1977). From the general model presented below the odds of an inmate surviving confinement (with $x = 1$) is defined as $p(1)/[1 - p(1)]$. Similarly, the odds of dying (with $x = 0$) is defined as $p(0)/[1 - p(0)]$. However, the logit difference as denoted by z, which is defined as the log of the odds ratio (or log-odds), is algebraically represented as

$$z = \ln \frac{p(1)/[1 - p(1)]}{\{ p(0)/[1 - p(0)]\}} \qquad (1)$$

or

$$\ln(z) = \ln(e^{\beta 1}) = \beta_1 \qquad (2)$$

Data analysis focuses primarily on the question: Do socio-demographic and criminal characteristics of inmates affect their likelihood of surviving confinement? Data analysis addressing the question is carried out in two major stages. First, we estimate the bivariate relationship among the key variables. Second, we estimate a multivariate logistic model of surviving confinement. Four equations were estimated in this analysis. We first estimate three equations that describe the likelihood of inmates surviving confinement, controlling for age, education, sentence length and primary offense. Then we add a variety of control variables (medical status, sentence length, habitual offense and primary offense) that might account for observed variation. The following equation illustrates the approach employed:

$$S_i = \beta_0 + \beta_1 x_1 + \dots \sum_{u=1}^{k-1} \beta_{ru} D_{ru} + \beta_p x_p \qquad (3)$$

In summary, the findings from using the logistic model as shown in equation 1 will be used to draw some practical inferences from the estimated coefficients. The estimated parameter (β) will be interpreted as the effect of each predictor on the logged odds of an inmate surviving (released) confinement.

FINDINGS

BIVARIATE ANALYSIS

The analysis begins with a discussion of the bivariate relationships shown in Table 3. The results show a remarkable number of significant relationships that seem to indicate the importance of demographic and criminal characteristics on the inmate's ability to survive confinement. Looking at Table 3 we see that inmates with no education are more likely to die in confinement than those with some education. Since we used the entire population in this analysis as a measure of the degree of statistical association between education and surviving confinement, we calculated the difference between the proportions. The difference in proportions in our case is 0.007. Although the proportion is small, it shows that the probability of dying in prison is different depending on whether the inmate has no education or some education.

Table 3. Bivariate Distribution: Survival and Educational Level.

Survival Status	Educational Level (Score)				
	No Education	Middle/High School/some College	No Education	Middle/High School/Some College	Differences
	Frequency	Frequency	Proportion	Proportion	Proportion
Dead	101	78	0.012	0.005	0.007
Survive Confinement	8621	14188	0.988	0.995	-0.007
Total	8722	14266	1.00	1.00	0.00

X^2=26.470; df (2) 2-sided p=.000

Table 4 also indicates that inmates who are classified as normal and physically capable for work (i.e., unrestricted medically) are less likely to die in prison compared to those with moderate or severe organic diseases. For example, inmates with moderate or severe organic diseases are about 7 times more likely to die in confinement than those with minimum organic diseases. The difference in proportion is 0.072. There is a strong association between health status and surviving confinement as indicated by the chi-square and p-values (chi-square = 5738.960; p=.000).

We were also interested in determining whether an inmate's criminal status (primary offense) makes any difference in the chances of surviving confinement. In Table 5 we cross-tabulated offense type by survival status. For example, the probability is higher among those who committed violent offenses, such as murder or manslaughter, than nonviolent offenders, 0.01 and 0.008 respectively. Overall, the differences in proportion show that a higher proportion of inmates who commit violent crimes die during the period of incarceration compared to those who committed less violent crimes. There is clearly a statistically significant relationship between primary offense and death, since z^2 = 3.917 at a = .048.

Table 4. Bivariate Distribution: Survival and Medical Status at Release.

Survival Status	Medical Status at Release				
	Minimum/ unrestricted	Moderate/ severe	Minimum/ unrestricted	Moderate/ severe	Differences
	Frequency	Frequency	Proportion	Proportion	Proportion
Dead	43	181	0.012	0.084	-0.072
Survive Confinement	22183	1962	0.988	0.915	0.083
Total	22226	2143	1.00	1.00	0.00

X^2=5738.960; df (3); 2-sided p=.000

Table 5. Bivariate Distribution: Survival and Criminal Status (Primary Offense)

Survival Status	Primary Offense				
	Violent	Nonviolent	Violent	Nonviolent	Differences
	Frequency	Frequency	Proportion	Proportion	Proportion
Dead	129	96	0.01	0.008	0.002
Survive Confinement	12303	11960	0.99	0.992	0.002
Total	12432	12056	1.00	1.00	0.00

X^2=3.917; df (1); 2-sided p=.048

Further, Table 6 demonstrates the probability of surviving confinement when criminal status is held constant. Among inmates who have minimal organic diseases, those with violent behaviors are twice as likely to die in prison (0.002 and 0.001). Similarly, among inmates with moderate or severe health conditions, those who are nonviolent are more likely to survive confinement (0.07 to 0.10). However, an inmate's primary offense type does not eliminate all the differences in surviving confinement between those with minimum health conditions and those with severe health problems. In fact, inmates with minimum health conditions are still more likely to survive confinement compared to violent and nonviolent offenders, but the differences have been diminished somewhat from that found in Table 3, where primary offense was not held constant. The significance of the relationship (z^2 = 3292.101 at a = .000) leads to the conclusion that there is a nonzero co-variation.

Table 4. Bivariate Distribution: Survival and Medical Status at Release.

Survival Status	Primary Offense					
	Violent			Nonviolent		
	Medical Status at Release			Medical Status at Release		
	Minimum/ unrestricted	Moderate severe	Total	Minimum/ unrestricted	Moderate/ severe	Total
	Proportion (f)	Proportion (f)	Proportion (f)	Proportion(f)	Proportion (f)	Proportion (f)
Died in Confinement	0.002 (26)	0.10 (102)	0.01 (128)	0.001 (17)	0.07 (79)	0.008 (96)
Survive Confinement	0.998 (11341)	0.90 (913)	0.99 (12254)	0.88 (10841)	0.93 (1049)	0.99 (11890)
Total	0.92 (11367)	0.08 (1015)	1.00 (12382)	0.91 (10858)	0.094 (1128)	1.00 (11986)

X^2=3292.101, df (3) 2-tail p=.000

Bivariate analysis of the log odds of surviving confinement are presented in Table 2. There was a strong positive association between education, medical status, and habitual offender, all of which are statistically significant. There appears to be little or no impact of race, and sex on the odds of surviving confinement. For example, whites are .896 times less likely to survive confinement relative to other racial groups. However, the odds of surviving confinement among the racial groups are not statistically significant.

Multivariate Results

Before interpreting the results, it is important to mention that the logistic regression was estimated using maximum likelihood. We introduced variables from demographic, primary offense, habitual offense, and medical status sequentially to observe changes in individual coefficients, their standard errors and in the overall fit ("-2 log-likelihood ratio"). For each independent variable the estimated coefficient is presented with the standard error of the estimates in parenthesis and the expected (ß) given just below. In addition to the estimated coefficients, the estimated log likelihood and chi-square are listed for every model. The outcome variable is coded 1 for inmates who survive confinement and 0 for those who died prior to being released. Thus, a positive coefficient implies an increased probability of surviving confinement. The multivariate effects of the covariates on the conditional probabilities of surviving confinement are reported in Table 7.

Table 7 presents the estimated odds ratios and standard errors for logistic regressions in which the dependent variable is a dichotomous indicator of whetherinmates survived confinement at the time they were released in the 1997-98 fiscal year. To understand more fully the effects of criminal and demographic characteristics on surviving confinement, we regressed demographic and criminal predictors: sex, ethnic/race, educational level, age of inmate, medical status, prison offence, habitual offense, and sentence length on surviving confinement. Four separate models are estimated with varying sample sizes.

The results in Table 7 indicate that the log odds of surviving confinement vary by sex, even after holding education, race/ethnicity, and medical status constant. There is a statistically significant lower probability of males surviving confinement compared to females. In model 1 the probability of surviving confinement is lower for males. For instance, the log odds 0.578 attached to the variable "male" means, holding age, education, race and medical status constant, the probability of surviving confinement is smaller by 58% for males compared to females. In other words, males are more at risk of dying during the period of incarceration than females.

The odds ratio of the race variable indicates that Whites are less likely to survive confinement than Blacks, Hispanics and other minority groups. For example if primary and habitual offense are controlled, the odds of Whites surviving confinement is 0.62 times less than Blacks, Hispanics and other racial groups. The odds are barely significant at the 0.10 level. However, there is no evidence in Model 1 to suggest that racial differences influence the probability of surviving confinement. Even though the estimated coefficient for Whites compared to Blacks and other racial groups(the reference category) is statistically not significant, the adjusted odds ratio is $z = e^{-.027} = .974$ suggesting that the log-odds (expected ß = .974) of Whites surviving confinement is lower than any other racial category. The results indicate that there is no significant racial difference on the odds of surviving confinement when the remaining independent variables are held constant. The insignificant effect of race may be due to the absence of preferential treatment among prison inmates.

Under the assumption that the logit is linear in the covariate "age at release", the estimated odds ratio for an increase in 10 years in age at release is $z(10) = \exp(10 \times -0.210) = .122$. This indicates that for every increase of 10 years in age at release, the risk of surviving confinement decreases by 0.122 times controlling for education, age, race, sex, medical status, habitual offense, sentence length and interaction terms.

The results presented in Table 7 (i.e., models 1 and 2) suggest that the average grade tested of inmates influences the odds of surviving confinement. Specifically, we hypothesize that individual inmates may increase their survival chances if their average grade tested is higher. As an illustration, the estimated odds ratio for an increase of 10 years in the average

Table 7. Logistic Regression Results for Analysis of Demographic, Sentence Length and Offense Type

Independent Variables	Model 1	Model 2	Model 3	Model 4
	Odds Ratio (SE)	Odds Ratio (SE)	Odds Ratio (SE)	Odds Ratio (SE)
Sex				
Female	1.000	......	1.000	1.000
Male	0.578 (0.330)		2.686 (0.340)***	2.628 (0.342)***
Race				
Black	1.000	......	1.000	1.000
other (ref)				
White	0.974 (0.185)		0.716 (0.292)	0.665 (0.293)
Education	1.030 (0.024)	......	1.071 (0.27)***	1.073 (0.027) ***
Age at release	0.975 (0.007) ***	......	0.982 (0.008)***	0.983 (0.008)**
Medical Status				
Severe Organic Diseases (ref)	1.000		1.000	1.000
Unrestricted	364.009 (0.313)***	......	81.778 (0.924)	87.196 (0.925)***
Minimum Organic Diseases	157.440 (0.253)***	......	30.958 (0.896)***	33.653(0.899)***
Moderate Organic Diseases	27.874 (0.226)***	......	6.926 (0.896)***	7.397(0.899)**
Primary Offense				
Non-violent (ref)		1.000	1.000	1.000
Violent		1.117 (0.155)	0.519 (0.296)***	0.738 (0.355)
Habitual Offender				
Yes (ref)		1.000	......	1.000
No		1.496 (0.199) **		1.619 (0.258)*
Sentence Length(months)		0.205 (0.163)***	......	0.996 (0.002)*
Interactions Race * Medical status			0.453 (0.390) ***	0.454 (0.391)**
Prison Offense *Medical status			0.879(0.387)	0.929 (0.388)
Prison Offense *sentence length			0.995 (0.001)***	0.998 (0.002)
-2 Log-Likelihood	1199.259	1937.734	989.643	983.615
Number of Cases	22,966	24,200	22,786	22,786
df	7	3	11	13

*** < 0.001; ** p £ 0.05; p £ .10

grade tested is z(10) = exp(10 * .106) = 2.89. This indicates that for every 10 years increase in the average grade tested, the probability of surviving confinement increases 2.89 times. Thus, we find evidence for the average grade tested and the likelihood of surviving confinement net of the effects of the remaining independent variables.

There is evidence to suggest that, both substantively and methodologically, medical status influences the probability of surviving confinement. The medical status factors produced mixed evidence. In models 1 and 3 (Table 7), the dummy variable "unrestricted" (i.e., normal physical stamina) shows positive and statistically significant coefficients. The odds of surviving confinement for an inmate with an "unrestricted" initial medical diagnosis is 110.374 times compared to those diagnosed with severe organic diseases.

Furthermore, those diagnosed with moderate or minimum physical conditions are more likely to survive confinement compared to inmates with severe organic diseases (the base category). This finding is consistent with the argument that health status is a function of life expectancy (Weiss, 1990). Thus, on the basis of this analysis it would appear that an inmate's primary and habitual offense, age at release, sex, educational level tested, and medical status are the best predictors of surviving confinement rather than race and sex.

In contrast, striking differentials are evident with respect to the measures of an inmate's offense type. As in bivariate analysis in Table 2, inmates who are not habitual offenders are more likely to survive confinement than habitual offenders (omitted category). We also find significant the effects of habitual offenses on surviving confinement without controlling for sex, race, educational level, and medical status. Model 2 shows that the odds of surviving confinement for non-habitual offenders is 1.496 times greater than for habitual offenders, and the advantage is statistically significant at the 0.04 level.

Another difference in the results in Table 7 compared to Table 2 is that inmates with violent offenses have a higher risk of dying in confinement compared to those who committed nonviolent offenses. In general, the probability of surviving confinement for inmates who committed nonviolent crimes is higher as compared with the base category (inmates who committed violent offenses). Although the odds are significant at the bivariate level, it is statistically insignificant in model 2. Because the odds ratio is statistically not significant, we conclude that there is no significant difference in the probability of surviving confinement for violent and nonviolent offenders.

Interactions of Race with Medical Status

Now let us consider the two-way interaction terms involving race and medical grade, and primary offense and medical status (model 8). It is important to mention that the effects of any variable involved in interaction cannot be adequately interpreted without considering the other variables with which it interacts.

Examining the results in Table 7, we see that the estimated coefficient for the independent variable "unrestricted" changed from 364.009 in model 1 to 81.778 in model 3, when interaction terms were added to the model. The odds of surviving confinement are higher for inmates who were diagnosed with no organic diseases than if the inmates were diagnosed with severe organic systemic diseases. For example, the odds of surviving confinement are more than 364 times greater among those diagnosed as unrestricted (compared to those with severe organic systemic diseases) and smaller by about 81.778 times for Whites in relation to base category (i.e., Black, Hispanics and other racial groups). However, the effect of medical status on surviving confinement also depends on race. For example, white inmates with unrestricted conditions reduce their odds of surviving confinement by only .453 compared with the base category (model 3). The statistically significant coefficient of the interaction terms of race and medical status in both models 3 and 4 suggest that the odds of surviving confinement is lower among Whites than Blacks and other racial groups.

Interactions of Primary Offense with Medical Status and Sentence Length

Interactions of the primary offense, medical status, and length of sentence were not statistically significant; this finding suggests that nonviolent and violent criminal behavior affect the odds of surviving confinement in the same order of magnitude among inmates with restricted and severe organic diseases (model 4). For example, the result of the two-way interaction suggests that inmates who are violent and were diagnosed as moderate/severe are 0.879 times less likely to survive confinement as those with unrestricted/minimum health conditions.

However, the differences in surviving confinement by type of offense depends on the length of sentence. The odds of surviving confinement among violent offenders diminished by 0.5% (e^{-005} = 0.995; Model 4) for each month incarcerated. In other words, nonviolent offenders show survival advantages compared to violent inmates. On the other hand, the odds of the non-violent surviving confinement versus violent offenders diminished by 12.1% ($e^{-0.129}$ = 0.879) although it is statistically not significant. Furthermore, the multiplicative two-way interaction between White and moderate or severe organic diseases did produce statistically significant results.

Discussion

Our analysis draws attention to the importance of demographic characteristics, criminal characteristics and medical status. In fact the results of the analysis regarding the log-odds of surviving confinement are interesting in themselves, but they also clarify some important issues about criminal characteristics. These findings underscore the need to include offense type of inmates in our attempt to estimate the odds of surviving confinement. Our analysis demonstrates that measures of offense type are not only predictors of prison mortality, but they also vary across levels of medical status. Theoretically, this is consistent with the argument that the more severe the offense, the longer the time served, since the length of one's sentence enhances an individual's age and consequently increases the ability to resist degenerative disease and accidental deaths.

These findings pose questions about the applicability of theoretical and empirical findings in demography to subpopulations such as prison: (1) how relevant is offense type (criminal characteristics) on the probability of surviving confinement, and (2) what is the appropriate sentence length?

Previous studies on mortality in prison are based on descriptive statistics. There is evidence to suggest that mortality is on the rise in prison. Data such as these does not allow policymakers to fully understand the effects of offense type, sentence length and health status on survival. In contrast, our analysis, focuses on the relevance of criminal characteristics on the probability of surviving confinement. We thus highlight the importance of criminal characteristics, which affect the odds of surviving confinement, a factor that has been underemphasized in earlier studies of prison mortality. There is considerable evidence, in demographic literature (Gompertz, Olshanskey and Cranes, 1997; Christenson and Johnson, 1995; Elo and Preston, 1997) that age tends to increase the risk of death. Because of the changes in sentencing laws in Florida and elsewhere, keeping criminals in the prison system longer rather increases this probability.

Another striking observation in this study is that education tends to influence inmates' chances of surviving confinement. Evidence from this study tends to support the argument that mortality differentials exist based on levels of education (Doornbus and Kromhout, 1991; Duleep, 1989). Educational advantages tend not to diminish even when one is incarcerated. Although incarceration tends to limit one's personal freedoms as it relates to medical care, education appears to improve the chances of an inmate surviving confinement, if primary offense is held constant.

Policy implications

These results have implications about how the likelihood of aging in prison and the corresponding frailty and complications associated with aging influence the risk of mortality. Increases in age may lead to increased frailty as a consequence of worsening of degenerative diseases that not only affect the cost of geriatric care but also increased mortality. Even though prison age structure may vary, there is evidence to suggest a strong relationship between aging, degenerative diseases and health care cost.

Reduction in the number of the aging prison population through controlled release programs, will help to reduce the hidden cost of health care for the chronically ill. Although it is possible that some older inmates are capable of committing various crimes when released (Schmertmann, Amankwaa & Long, 1998), it is also possible that keeping the aged incarcerated who pose no threat to society will add to the overall cost of prisons, specifically health care. It is difficult to predict *a priori* how the negative and positive influences will balance out and what their net effects will be. However, there is evidence to suggest that the odds of surviving confinement decrease with increasing age across levels of medical status.

Notes

1. The variable medical status is classified into five categories. These categories indicate that the inmate has (1) normal physical stamina, ie unrestricted, (2) minimum organic systemic diseases (3) moderate organic systemic diseases and thus requires reasonable available care, and (4) severe organic systemic diseases, requires continuous monitoring and (5) pregnant inmate. The term organic involves the following diseases: cardiovascular, respiratory, gastrointestinal, neurological, endocrine, metabolic, lack of nutrition, physique and age. For purposes of this research categories 1, 2, 3 were coded as 1 respectively with 4 as 0 while pregnant inmates were excluded.

2. The Florida Department of Corrections re-evaluates inmates by reclassifying them into grade levels. Several variables are employed in estimating the grade level of an inmate. First, the Bureau of Education in the Department of Corrections administers a preliminary examination to determine the type of examination to give each inmate. A second appropriate test is given in comprehension, mechanical and spelling, including vocation. Using a testing procedure developed by the department all convicted criminals are examined to assess their current educational level. An estimated mean of the tests indicate the functional grade level of the inmate. It is believed that the score obtained by each inmate truly reflects the individual inmate's educational level.

3. Type of offense (nonviolent and violent) is based on a broad classification of more than 50 primary offenses. These 50 offense groups were regrouped first into 29 and later 10 categories based on the new sentencing guidelines. The new structure arranges offenses by level of seriousness from least severe (Level 1) to most severe (Level 10). Within each category there are a variety of different types of offenses. In this analysis we re-categorized Levels 6 through 10 as violent (including murder, manslaughter etc) and Levels 1 through 6 as nonviolent.

References

Amankwaa, Adansi A. 1995. Causes of Death in Florida Prisons: The Dominance of AIDS. *American Journal of Public Health*, vol. 85 No 12 pp 1710-1711.

Amankwaa, Adansi, Amankwaa, Linda and Ochie, Charles. (1999). Revisiting the Debate of Voluntary Versus Mandatory HIV/AIDS Testing in US Prisons, *Journal of Health and Human Services Administration*, vol 22, no 2 pp220-236.

Beck, Allen J. 2000. "Prisoners in 1999," U.S. Department of Justice, Bureau of Justice Statistics Bulletin, Washington, DC GPO, August.

Christenson Bruce A. and Johnson, Nan E. 1995. Educational Inequality in Adult Mortality: An Assessment with Death Certificate Data from Michigan." *Demography*, Vol 32, no 2 May pp 215-229

Cullen, F. T., Bynum, T. S., Garrett, K. M. and Greene, J. R. (1985). Legislator Ideology and criminal justice policy: Implications from Illinois. In E. S. Fairchild and V. J. Webb (eds), *The politics of crime and criminal justice*, pp 57-76. Beverly Hills CA: Sage.

Doornbus, G. & Kromhout, D. (1991). Educational level and mortality in a 32-year follow-up study of 18-year-old men in the Netherlands. *International Journal of Epidemiology* 19:374-9.

Duleep, H. (1989). Measuring socioeconomic mortality differentials over time. *Demography* 26:345-51.

Elo, Irma T. & Preston, Samuel H.. 1996. "Educational Differentials in Mortality: United States 1979-1985." *Social Science and Medicine* 42(1):47-57.

_____ 1997. "Racial and Ethnic Differences in Mortality at Older ages." Pp. 10-42 in L. G. Martin & B. J. Soldo, eds. Racial and Ethnic Differences in the Health of Older Americans. National Academy Press. Washington, D.C.

Engle, Laura. 1999. It's a Crime! HIV Behind Bars. Body Positive, vol XII No1 http://www.thebody.com/bp/jan99/crime.html

Feinstein, Jonathan S. 1993. The relationship between socioeconomic status and health: A review of the literature, *Milbank Quarterly* 71 no 2:279-322.

Florida Department of Corrections. 1997-98 Annual Report The Guidebook to Corrections in Florida.

Harlow, C.W. (1993). "HIV in U.S. Prisons and Jails." Bureau of Justice Statistics, Special Report. U.S. Department of Justice.

Hammett, Theodore M. and Harmon Patricia. (1999). "Medical Treatment and a Continuum of Care," 1996-1997 UPDATE: HIV/AIDS, STDs, AND TB IN CORRECTIONAL FACILITIES by Hammett, T M, Harmon P., and Maruschak. US Department of Justice. Office of Justice Programs, *National Health,* pp. 69-84.

Hu, Y. & N. Goldman. (1990). Mortality differentials by marital status: an international comparison. *Demography*, 27:233-50.

Hummaer Robert A., Richard G. Rogers and Isaac W. Eberstein. 1998. Sociodemographic differentials in adult mortality: A review of analytic approaches. *Population and Development Review*, 24 no 3:553-578.

Hussey Jon M and Irma T. Elo. 1997. "Cause Specific Mortality among Older African Americans: Correlates and Consequences of Age Misreporting." *Social Biology* vol 44 no 3-4 Fall-Winter pp 227-246.

Johnson Norma J., Sorlie Paul D and Backlund Eric. 1999. The Impact of Specific Occupation on Mortality in the U. S. National Longitudinal Mortality Study." *Demography* vol 36 no 3 August 355-367

Kallan Jeffrey. 1997. Effects of Sociodemographic variables on Adult Mortality in the United States; Comparisons by sex, age and cause of death. *Social Biology* vol 44 no 1-2 Spring-summer pp 136-147.

Koehler, John (1994). HIV Infection, TB and the Health Crisis in Corrections. *Public Administration Review*, 54 (1): 31-35.

Maguire Kathleen and Pastore, Ann J. (eds.). 1997. *Sourcebook of Criminal Justice Statistics 1996*, U.S. Department of Justice, Bureau of Justice Statistics. Washington DC: GPO.

McCord, C., & H. Freeman. (1990). Excess mortality in Harlem. *New England Journal of Medicine*, 322: 173-77.

McGarrell, E. F., and Flanagan, T. J. (1987) Measuring and explaining legislator crime control ideology. *Journal of Research in Crime and Delinquency*, 24:102-118

Olshanskey, S. J. and Carnes B. A. 1997. "Ever Since Gompertz." *Demography* 34 (1):1-15.

Potter, L. (1991). Socioeconomic determinants of white and black males' life expectancy differentials, 1980. *Demography*, 28:303-21.

Preston, Samuel H. 1980. "Causes and consequences of mortality declines in less developed countries during the twentieth century", in *Population and Economic Change in Developing Countries*, ed Richard A. Easterlin. Chicago Press, pp. 289-341.

______ 1976. Mortality Patterns in National Populations: With Special Reference to Recorded Causes of Death. Academic Press Inc., New York

Preston Samuel H and Paul Taubman. 1994." Socioeconomic differences in adult mortality and health status," in Linda Martin and Samuel H. Preston (eds), *Demography of Aging*. Washington D.C. National Academy Press pp 279-318.

Rahman, O. 1993. "Excess Mortality for the Non-Married in Rural Bangladesh." *International Journal of Epidemiology* 22: 445-56.

Rogers Richard G., Hummer Robert A, Nam Charles B and Peter Kimberly. 1996. "Demographic, Socioeconomic and behavioral factors affecting ethnic mortality by cause." *Social Forces* 74 no 4:1419-1438

Rogers Richard 1995a. "Marriage, sex and mortality, *Journal of Marriage and the Family* 57 no 2:512-526.

Salive M E., Smith G S, and Brewer F T. 1990. Death in prison: changing mortality patterns among male prisoners in Maryland, 1979-87. *American Journal of Public Health*, 80: 1479-1480.

Schmertmann, Carl P, Amankwaa, A. Adansi & Long Robert. 1998. Three Strikes and Your're Out: Demographic Analysis of Mandatory Prison Sentencing. *Demography*, vol 35 no 4 445-463.

Smith, G., M. Shipley & G. Rose. (1990). Magnitude and causes of socioeconomic differentials inmortality: further evidence from the Whitehill Study. *British Medical Journal*, 301:429-32.

United Nations. (1982) Levels and Trends of Mortality since 1950: A joint study by theUnited nations and the World Health Organization, Department of International Economic and Social Affairs. New York.

Weiss K M 1990. "The Biodemography of Variations in Human Frailty." Demography 27 (2): 185-206.

Williams David and Chiquita Collins. 1995. "US socioeconomic and racial differences in health: Patterns and explanations," *Annual Review of Sociology* 21:349-386

Woods, Gail L., Harris, Steven L., and Solomon, David (1997). Tuberculosis Knowledge and Beliefs Among Prison Inmates and Lay Employees. *Journal of Correctional Health Care*.4(1) pp 61-71

Yashin, A. I. And I. A. Iachine. 1997. How Frailty Models Can Be Used For Evaluating Longevity Limits: Taking Advantage of an Interdisciplinary Approach." *Demography* 34 (1):31-48.