Effects of First-Time Imprisonment on Postprison Mortality: A 25-Year Follow-Up Study with a Matched Control Group

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Abstract

Objectives: To examine the effects of first-time imprisonment on postprison
mortality. *Method*: Data are used from a longitudinal study examining
criminal behavior and mortality over a 25-year period in a representative
group of 2,297 Dutch offenders who had their criminal case adjudicated
in 1977. Of these offenders, 597 were imprisoned for the first-time in their
lives in 1977. The remaining 1,700 offenders got a noncustodial sentence.
Ex-prisoners' mortality rates and causes of death are compared with those
in the general population and those in a matched control group of
non-imprisoned offenders. Propensity score matching is used to minimize
selection bias. Odds ratios with 95% confidence intervals are used to

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examine whether mortality among the ex-prisoners differ significantly from the general population or from the non-imprisoned controls. *Results*: About 18 percent of the imprisoned offenders died over the 25-year follow-up period. Compared with the general population (age and gender adjusted), ex-prisoners are three times as likely to die during the 25-year follow-up (odds ratio [OR] = 3.21). Compared with a more appropriate control group of non-imprisoned offenders (matched on age, gender, and propensity score), ex-prisoners are no longer significantly more likely to die (OR = 1.40). *Conclusions*: The results of the present study emphasize the importance of constructing appropriate comparison groups when examining the effects of imprisonment on postprison mortality.

Introduction

During the past decades, prison populations have been growing in many parts of the world (Blumstein and Beck 1999; Tonry and Bijleveld 2007). As an illustration, the number of incarcerated persons in America has increased almost eightfold since 1960, and currently more than one in every 30 American men and 1 in every 9 American black men between the ages of 20 and 34 are incarcerated (The Pew Charitable Trusts 2008). Although a leader in the world, these massive numbers of incarcerated persons are not unique to the United States. In England and Wales, almost 30,000 persons were incarcerated in 1960, whereas this figure was more than 80,000 persons in 2007 (Newburn 2007). Presently, almost ten million people are being held in penal institutions worldwide (Walmsley 2007). Therefore, imprisonment affects a considerable number of people worldwide, which warrants reliable knowledge on the consequences of imprisonment.

The large numbers of incarcerated persons and the severity of prison sentences have inspired important research lines on the potential positive and negative consequences of imprisonment. Several studies have investigated the effects of incarceration on, for instance, prisoners' employment prospects, their educational trajectories, their marriage and divorce chances, and their physical and mental health. This research consistently showed that former inmates experience long-term problems regarding employment, loss of income, and disruption of marital stability (Apel et al. 2009; Davis and Tanner 2003; Hagan and Dinovitzer 1999; Lopoo and Western 2005; Pager 2003; Sampson and Laub 1995; Western 2002; Western and Pettit 2005).

Moreover, the literature suggests that former inmates are relatively more vulnerable for mental disorders (e.g., depression and suicide) and chronic and infectious diseases such as HIV, tuberculosis, and hepatitis (Butler et al. 2004; Bollini and Gunchenko 2001; David and Tang 2003; Kruttschnitt and Gartner 2005; Liebling 1999; Liebling and Maruna 2005; Massoglia 2008; Petersilia 2003).

Currently, empirical studies on the ultimate collateral health outcome of incarceration, that is, premature death, are rare. Although several studies have examined mortality within prisons (e.g., Blaauw, Kerkhof, and Vermunt 1997; Liebling 1992), empirical research on mortality patterns after release from prison is less common, and we remain relatively uninformed about the causal effects of incarceration on premature death after release from prison. The limited knowledge on the effects of incarceration on premature death is, to a large extent, due to limitations in the research design of the existing studies. Determining an effect of incarceration on mortality is difficult because a selective group of offenders will enter prison. A review of the literature (see below for more information) shows that to date only 24 studies worldwide have compared postprison mortality rates of ex-prisoners with the mortality rates of some kind of comparison group. In most of these studies (i.e., 22 of the 24 studies), the mortality rates of former prisoners were compared with rates in the general population (age and gender adjusted). This is problematic, however, because there are well-known preexisting differences between prisoners and the general population (e.g., in criminal history, educational level, ethnicity, social class, mental health, etc.). Therefore, such studies may be seriously biased in their estimates of the effects of incarceration on mortality (i.e., probably overestimating prison effects). Subsequently, such studies are problematic in drawing causal conclusions regarding the effects of imprisonment on postprison mortality.

Even the two studies (Fleming, McDonald, and Biles 1992; Sattar 2001, 2003) using more appropriate control groups (i.e., offenders receiving noncustodial sentences instead of the general population) did not take selection effects adequately into account. Obviously, the assignment of offenders to custodial or noncustodial sentences is not random. Judges will be more likely to imprison offenders who have committed serious crimes, who have more prior convictions, and who have a high risk of recidivism (Vigorita 2003). The idea that more serious and frequent offenders encounter more difficulties in their lives, including health and mortality problems, is well established (see also Gottfredson and Hirschi 1990; Robins 1978). The existing research shows that, among offenders, the more frequent and serious criminal offenders are relatively more likely to die at a young age

and are especially more likely to die from unnatural causes, such as suicide, motor vehicle accidents, drugs use, and violent encounters (Laub and Vaillant 2000; Nieuwbeerta and Piquero 2008; Piquero et al. 2007). Therefore, empirical studies should take these selection effects into account.

The aim of the current study is to examine the degree to which former prisoners have a relatively increased risk of premature death. The present study will address the above-mentioned shortcomings of previous studies that examined the effects of incarceration on mortality by (a) using a longitudinal research design, (b) investigating mortality over a long time period, (c) using a design in which mortality rates of ex-prisoners are compared both to the general population and to a group of offenders sentenced to noncustodial sentences, and (d) using advanced analysis techniques to further minimize possible selection bias.

Data are used from a Dutch longitudinal study, which traces the life course and criminal career of over 5,000 persons convicted in 1977 up until 2003. The analyses are conducted in three steps. First, following the tradition of previous studies, the mortality rates and causes of death of offenders convicted to imprisonment for the first time in 1977 are compared with the general population of similar age and gender. Second, mortality rates and causes of death of ex-prisoners are compared with age- and gender-adjusted persons who were convicted to a noncustodial sentence in 1977 (e.g., a fine, community service). Third, since non-imprisoned offenders are likely to differ on many characteristics from imprisoned offenders, the mortality rates of former prisoners are compared with a matched control group of offenders sentenced to noncustodial sentences. We use a propensity score matching method to minimize selection bias and to control for a variety of observed differences (i.e., demographic characteristics, criminal-related, and health-related variables). This method has frequently been applied in studies on the effects of criminal justice interventions (Nagin, Cullen, and Jonson 2009) but has not yet been used in research on the effects of imprisonment on postprison mortality. Using this strategy, the present study can draw stronger conclusions about the effects of imprisonment on postprison mortality and will provide new empirical and theoretical knowledge to extend the results of earlier research.

Possible Links between Imprisonment and Mortality

Although some criminological theories have suggested that offenders are more likely than non-offenders to suffer early morbidity and mortality (Gottfredson and Hirschi 1990; Robins 1978), knowledge on the exact

nature of the relationship between incarceration and mortality remains scarce. A number of criminological and health theories were reviewed to learn more about the possible effects of imprisonment on mortality. The present literature review shows that, based on different theories, at least four conflicting hypotheses can be formulated about the expected effects of imprisonment on mortality.

First, it is possible that *imprisonment has no effect on mortality* at all. In that case, differences in mortality rates between ex-prisoners and others result from the fact that other common factors influence both imprisonment and mortality.

For instance, individual factors such as low intelligence and high impulsivity can cause criminal behavior, as well as poor health and mortality. In their general theory of crime, Gottfredson and Hirschi (1990) emphasize the importance of the causal agent of low self-control in explaining crime. Compared with their high self-control counterparts, individuals with low self-control are more likely to engage in all sorts of criminal, reckless, and risk-taking behavior throughout their life course. Empirical studies have provided evidence for this theory and showed that personality factors such as high impulsivity, low self-control, and a high need for sensation seeking were related to criminal behavior, as well as to an irregular and unhealthy lifestyle with excessive drinking, drug use, risky sexual behavior, and risk-taking in traffic (Eysenck 1977; Gottfredson and Hirschi 1990; Junger and Dekovic 2003; Zuckerman 1979).

Another factor that may influence both criminal behavior (including imprisonment) and mortality is socioeconomic status. It is well established that individuals of low socioeconomic status are overrepresented in prison populations. Throughout history, socioeconomic status (even without delinquency) has been related to health, with persons higher in the social hierarchy having a better health that those lower in the hierarchy (Adler et al. 2002). Additionally, research consistently demonstrated a relationship between low socioeconomic status and mortality risk from all causes, as well as specific causes of death (Anderson et al. 1997; Lynch and Kaplan 1994; Marmot et al. 1991).

Second, it can be hypothesized that *imprisonment has a direct positive effect on health and consequently decreases the risk of premature mortality*. It is, for instance, possible that imprisonment decreases mortality risk by improving prisoners' health. In the Netherlands, life in prison has some healthy elements. For instance, prisoners receive three meals a day, have a right to exercise, have free access to medical and mental health care that must meet the same quality requirements as health care outside prison, and have fewer possibilities to use drug and alcohol while imprisoned. Such health-improving elements of imprisonment may be particularly beneficial

for individuals who were already living in problematic circumstances before imprisonment, including, for example, poverty, addictions, and homelessness.

Imprisonment can also be hypothesized to change prisoners' skills, knowledge, and values (Fagan and Freeman 1999; Raphael 2007; Western and Pettit 2005). Some theories such as learning theories, and economic and social control theories, argue that investment in human capital (i.e., an individual's skill level, knowledge, and experiences) will increase a person's (market) value, will increasingly embed a person into conventional society, and will increase the costs associated with further criminal behavior (Becker 1968). This idea is consistent with the rehabilitation goal of imprisonment (de Keijser 2000). By offering training (such as education, job training, and social skill training), prisoners are expected to acquire new skills that may increase the possibilities of a conventional life and decrease the chance of future criminal behavior. Thus, when the rehabilitation of prisoners is successful, former prisoners are equipped with more constructive skills that may enhance a healthier lifestyle with a decreased risk of mortality.

Third, it is possible that *imprisonment has a direct negative effect on health and consequently increases mortality risk*. A prison experience can be seen as a major stressful event in prisoners' lives, which may negatively affect their mental and physical health, and thereby increase their risk of mortality. Stress theories argue that major life events and exposure to prolonged stress require major behavioral adaptation (Lazarus and Folkman 1984; Thoits 1995). Exposure to (chronic) stress will result in an increased awareness of the body and a burdening of certain physiological and bodily systems (e.g., cardiovascular, immune, and hormone systems). On the long term, if an individual is unable to successfully adapt to stress, this can predispose an individual to disease (Lazarus and Folkman 1984; McEwen and Stellar 1993; Pearlin 1989). Major life events have been related to a number of negative health outcomes, such as psychiatric problems, morbidity, and mortality (Kessler, Price, and Wortman 1985; McEwen and Stellar 1993).

Moreover, in some countries, the conditions of confinement are harsh, including a lack of food and medical services, poor quality of care, limited possibilities for self-care, aggressive incidents, and overcrowding. Such conditions can negatively affect prisoners' health on the long term and may increase the risk of premature death after release from prison. Furthermore, relatively high rates of chronic and infectious diseases are observed within prison facilities (Bollini and Gunchenko 2001; Butler et al. 2004; David and Tang 2003; Petersilia 2003). Therefore, prisoners may be disproportionately exposed to such diseases that can negatively affect their further health and

increase their risk of premature death. Finally, it has been argued that prisons can be "schools of crimes" and breeding grounds for further crime (Lilly, Cullen, and Ball 1995). In line with this belief, a prison experience will increase the chances of future criminal and risky behavior and associated risks of experiencing violent encounters in life (e.g., homicide).

Fourth, *imprisonment may have an indirect negative effect on health and therefore increase the risk of premature death*. Research has shown that imprisonment can be a turning point, changing the lives of those involved in a negative way. Imprisonment can, for instance, result in long-lasting problems on the labor market, in a loss of income, and homelessness (Apel and Sweeten 2007; Western 2002). Additionally, incarceration removes the prisoners from their spouses, families, friends, and neighbors. As a consequence, former prisoners can experience difficulties in family formation and dissolution and a decrease in social networks and social capital (Apel et al. 2009; Hagan and Dinovitzer 1999; Lopoo and Western 2004; Rose and Clear 2002; Wakefield and Uggen 2010). Former prisoners often have to deal with stigmatizing reactions that may also negatively affect the degree of social support. All these factors, that is, a low socioeconomic status, unmarried civil state, and decreased social support, are associated with increased mortality risks in themselves (Johnson et al. 2000; Mackenbach 1992; Pennix et al. 1997; Uchino, Cacioppo, and Kiecott-Glaser 1996).

In sum, criminological and health theories do not provide clear and unequivocal answers but confront us with alternative hypotheses about the way imprisonment can result in either higher or lower risks of premature mortality.

Previous Empirical Studies

To identify studies on the effects of imprisonment on postprison mortality, we performed an extensive literature search. Different electronic databases (i.e., Criminal Justice Database, Medline, and PsychInfo) and the Internet were searched with relevant keywords, and reference lists were screened to find additional relevant studies. Based on this search, we identified 24 studies that examined mortality rates among former prisoners, relative to a comparison group (see Table 1).[1] Below we present the main characteristics of these 24 empirical studies.

The studies investigated mortality rates among former inmates in different parts of the world, such as the United States, the United Kingdom, Australia, and Europe. There was a substantial difference in the length of the postprison follow-up periods. Most of the studies have a relatively short

Table 1. Existing Research Comparing Mortality among Former Prisoners with Mortality in a Comparison Group

Author	Country	Population	Postprison Follow-Up	Control Group	Outcome	SMR/RR
Binswanger et al. (2007)	USA	30,237 prisoners released between 1999 and 2003	Mean of 1.9 year	General population (age, sex, race adjusted)	Mortality former prisoners > general population	All: 3.5 M: 3.3 F: 5.5
Bird and Hutchinson (2003)	Scotland	19,486 male prisoners released between 1996 and 1999	12 weeks	General population (age, sex adjusted) First 2 weeks postprison versus subsequent 10 weeks	Mortality former prisoners > general population Drug-related mortality in first 2 weeks > subsequent 10 weeks	Week 1-2: 12.7 Nondrugs: 4.9 Drugs week 1-2: 7.4 Nondrugs week 1-2: 0.8
Christensen et al. (2006)	Denmark	8,658 imprisoned drug users released between 1996 and 2001	1996-2001	General population (age, sex adjusted)	Mortality former prisoners > general population Mortality in first 2 weeks > subsequent 10 weeks	n.a. Week 1-2: 4.4
Coffey et al. (2003) Coffey et al. (2004)	Australia	2,849 adolescents with first custodial sentence between 1988 and 1999	1. Median 3.3 (males); 1.4 (females) 2. Median: 6.3 (males); 4.6 years (females)	General population (age, sex adjusted)	Mortality rates former prisoners > general population	M: 9.4 F: 41.3
Farrell and Marsden (2005, 2007)	England and Wales	48,771 prisoners released between 1998 and 2000	Deaths up to 2003	General population (age, sex adjusted)	Mortality rates former prisoners > general population, particularly in first 2 weeks	M: 7.5 F: 12.1 M week 1-2: 29.4 F week 1-2: 68.9

(continued)

Table 1 (continued)

Author	Country	Population	Postprison Follow-Up	Control Group	Outcome	SMR/RR
Fleming et al. (1992)	Australia and New Zealand	394 offenders who died while serving non-custodial correctional orders between 1987 and 1988 (of which 106 were on parole, i.e. ex-prisoner)	1987-1988	Offenders serving other community correction orders (probation, community service orders)	Mortality rates persons on parole (former prisoners) > offenders with community service orders	All: 6.9
Graham (2003)	Australia	25,469 prisoners released between 1990 and 1999	6 months-10.5 years	General population (age, sex adjusted)	Mortality rates for unnatural deaths former prisoners > general population.	All: 10.4 M: 6.6 F: 27.5
Harding-Pink(1990) Harding-Pink and Fryc (1988)	Switzerland	102 sudden unexplained deaths of persons who had been imprisoned between 1982 – 1986.	1-17 years.	General population (age, sex adjusted).	Mortality rates former prisoners > general population High mortality in first year postprison	First year: 4.8
Hobbs et al. (2006)	Australia	13,667 prisoners released between 1995 and 2001	2–8 years Mean 4.6 years	General population (age, sex, race adjusted)	Mortality rates former prisoners > general population	M indig: 1.8 M non-indig: 4.0 F indigo: 3.1 F non-indig: 14.0
Johanson (1981)	Sweden	128 male adolescents released from youth prison in 1951	24 years	General population, matched on sex, age, and place of residence	Mortality rates former prisoners > controls	n.a.
Joukamaa (1998)	Finland	870 male prisoners imprisoned in 1985	7 years	General male population (age adjusted)	Mortality rates former prisoners > general population	All: 3.9
Kariminia et al. (2007)	Australia	85,203 prisoners imprisoned between 1988 and 2002	15 years (mean 7.7 years)	General population (age, sex adjusted)	Mortality rates former prisoners > general population	M: 3.7 F: 7.8
Lewis et al. (1991)	USA	21 girls incarcerated in juvenile correction facility in the 1970s	7-12 years	General female population (age adjusted)	Mortality rates former prisoners > general population	All: 180

(continued)

Table 1 (continued)

Author	Country	Population	Postprison Follow-Up	Control Group	Outcome	SMR/RR
Paanila, Hakola, and Tiihonen (1999)	Finland	102 male habitually violent offenders imprisoned between 1971 and 1995	3.5 months-24.5 years	General male population (age adjusted)	Mortality rates former prisoners > general population	All: 4.9
Pratt et al. (2006)	England and Wales	244,988 prisoners released between 1999 and 2002	1 year	General population (age, sex adjusted)	Suicide rates former prisoners > general population	M: 8.3 F: 35.8
Putkonen et al. (2001)	Finland	132 female homicidal offenders apprehended between 1982 and 1992	1-17 years	General female population (age adjusted)	Mortality rates former prisoners > general population	Natural: 6.7 Unnatural: 225.7
Rosen, Schoenbach, and Wohl (2008)	USA	168,001 male former prisoners released between 1980 and 2004	Median 10.3 years. Deaths between 1980 and 2005	General male population (age, sex, race adjusted)	Mortality rates former prisoners > general population	White: 2.08 Black: 1.03
Sattar (2001, 2003)	England and Wales	Offenders serving custodial ($n = 236$) and noncustodial sentences ($n = 1,267$; including 249 ex-prisoners under supervision of Probation Service) in 1996-1997	1996-1997	Offenders serving community sentences, former prisoners being supervised in community, and general population (age, sex adjusted)	Mortality rates community offenders and former prisoners > general population Prisoners were only slightly more likely to die than general population	1996 ex-prisoners: 2.76 1997 ex-prisoners: 3.58 1996 community offenders: 3.58 1997 community offenders: 3.78 1996 prisoners: 1.50 1997 prisoners: 1.33
Seaman et al. (1998)	Scotland	316 male drug users with HIV who had been imprisoned between 1983 and 1994	12 weeks	Mortality caused by overdose in first 2 weeks versus next 10 weeks	Death from overdose in first 2 weeks > subsequent 10 weeks	All: 5.9
Singleton et al. (2003)	England and Wales	12,438 prisoners released in 1999	Up to January 2001	General population (age, sex adjusted)	Mortality rates former prisoners > general population, particularly in first 2 weeks	Drug week 1: 12.5 Nondrug week 1: 1.1

(continued)

Table 1 (continued)

Author	Country	Population	Postprison Follow-Up	Control Group	Outcome	SMR/RR
Spaulding et al. (2007)	USA	273 male prisoners imprisoned in 1992	6.5 years	General male population (age adjusted)	Mortality rates former prisoners > general population	All: 4.5
Stewart et al. (2004)	Australia	9,381 prisoners released between 1994 and 1999	0-2160 days (median 1223 days)	General population (age, sex, race adjusted)	Mortality rates former prisoners > general population	F abor: 3.4 F non-abor: 17.8 M abor: 2.9 M non-abor: 6.3
Verger et al. (2003)	France	1,127 male prisoners released in 1997	1 year	General male population (age adjusted)	Mortality rates former prisoners > general population	Natural 15-34: 8.7 Natural 35-54: 1.7 Unnatural 15-34 yrs: 3.5 Unnatural : 35-54 yrs: 10.6
Yeager and Lewis (1990)	USA	118 adolescents imprisoned in juvenile correctional facility in the 1970s	7 years	General population (age, sex, race adjusted)	Mortality rates former prisoners > general population	All: 58 M White: 38 M non-White: 37

Note: SMR= standardized mortality rate. M = males; F = females. Indig = indigenous, non-indig = non-indigenous. Abor = aboriginal, non-abor = non-aboriginal. n.a. = not available.

follow-up period. For instance, the studies of Bird and Hutchinson (2003) and Seaman, Brettle, and Gore (1998) investigated the first 12 weeks after release from prison. A few studies, however, investigated mortality up to 25 years after release from prison (Johanson 1981; Paanila, Hakola, and Tiikonen 1999; Rosen, Schoenbach, and Wohl 2008).

Of the 24 studies, 22 compared mortality rates of former prisoners with rates in the general population, adjusted for age and gender (sometimes also adjusted for race). The results consistently show that compared with gender- and age-adjusted persons from the general population, former inmates were more likely to die from both natural and unnatural causes of death. Former inmates appear particularly at risk of dying during the first few weeks after release from prison (Bird and Hutchinson 2003; Christensen et al. 2006; Farrell and Marsden 2007; Seaman et al. 1998; Singleton, Meltzer, and Gatward 2003). Mortality during the first weeks following release of prison was particularly associated with death by drug overdose. This suggests that, soon after their release, addicted prisoners used drugs again and died due to overdose (perhaps by accident, having not used drugs during imprisonment). Other prevalent causes of unnatural deaths among former prisoners were accidents, suicide, and homicide. Leading causes of natural deaths among former prisoners were cardiovascular diseases, cancer, liver diseases, and infections (Binswanger et al. 2007; Kariminia et al. 2007; Rosen et al. 2008).

Comparing mortality rates of former prisoners with gender- and age-adjusted persons from the general population can be informative. However, this method can provide only limited information regarding the relationship between imprisonment and the increased risk of premature death. The group of former prisoners and the general population differ on more characteristics than age and gender alone. Prison populations are, for instance, overrepresented by ethnic minorities, people from lower social classes, and people with poor mental and physical health (Sattar 2001); such preexisting differences can also cause differences in mortality rates.

A more adequate approach is to compare former prisoners with a more similar control group, such as offenders who were sentenced to a noncustodial sentence. Only two studies have investigated mortality rates among former prisoners and offenders receiving noncustodial sentences (Table 1). In England and Wales, Sattar (2001, 2003) compared the nature and risk of death of prisoners, with offenders serving community sentences, former prisoners being supervised in the community, and the general population. Standardized mortality rates showed that, compared with the general population, community offenders and former prisoners were both more

likely to die. Mortality rates of former prisoners were either somewhat lower (in 1996) or similar (in 1997) to mortality rates of offenders serving community sentences (Sattar 2003). Although these overall mortality rates may seem similar, the study also showed that ex-prisoners were more likely to die within the first weeks after release from prison. These results suggest that the phase immediately after release is particularly risky for ex-prisoners in terms of accidents or incidents with drugs, alcohol, or suicide (Sattar 2003).

In Australia, Fleming and colleagues (1992) investigated people who died while they were serving a noncustodial correction order during the years 1987 and 1988. The sample consisted of offenders on parole (i.e., ex-prisoners) and offenders serving other community correction orders, such as probation and community service orders. The mortality rate of ex-prisoners was 15.1 per 1,000 orders compared with 10 per 1,000 orders for offenders on probation and 2.2 per 1,000 orders for offenders serving community service orders. The results of their study suggest that former prisoners serving parole orders are at increased risk of premature death compared with people serving other forms of noncustodial sentences. It should be noted, however, that the group of parolees in their study was older than those serving other types of custodial orders, and age is also associated with mortality risks.

However, even in the two studies mentioned above, the judge's decision to assign offenders to custodial or noncustodial sentences is not random and will be influenced by the offender's criminal history, the type of offense, and the risk of recidivism. This increases the chance of preexisting differences between prisoners and other offender groups and subsequently decreases the possibility to determine whether imprisonment causes an increased risk of mortality. Ideally, a randomized experimental approach should be used to determine whether imprisonment is causing poor health, including premature death. However, an experiment in which offenders are randomly sentenced to a custodial or noncustodial sanction is very difficult to achieve within the criminal justice system due to resistance among judges, practical difficulties, and ethical issues—especially with longer prison sentences. Fortunately, statistical techniques have been developed, which help to take selection effects into account when examining the effects of incarceration on mortality.

This Study

The aim of the present study is to examine mortality rates and causes of death among offenders who were imprisoned in 1977 and to compare these with gender- and age-adjusted persons from the general population, with age- and gender-adjusted controls who were sentenced to noncustodial

sentences in 1977, and with a matched control group of offenders sentenced to noncustodial sentences. This will be achieved by (a) using data from a unique longitudinal study examining criminal behavior and mortality over a 25-year period in a representative group of Dutch offenders (former prisoners as well as offenders sentenced to noncustodial sanctions) and (b) using propensity score matching to minimize selection bias. Propensity score methods are effective in estimating treatment effects in observational studies and focus on the comparability of the experimental and control group in terms of pre-intervention, observable variables (Haviland et al. 2008; Rosenbaum and Rubin 1983). In the present study, the experimental group (i.e., people sentenced to imprisonment in 1977) and the control group (i.e., people who were sentenced to noncustodial sentences in 1977) were not only matched on demographic variables but also on health-related characteristics (i.e., alcohol and drugs dependence), and a variety of criminal-related characteristics (e.g., type of offense, severity of offense, and criminal history).

Method

Data and Measures—Full Sample

The present study used data from the Criminal Career and Life-course Study (CCLS), a large-scale and longitudinal study conducted by the Netherlands Institute for the Study of Crime and Law Enforcement (NSCR). Within the CCLS, court information and life course data were collected for 4,615 Dutch offenders who had their criminal case adjudicated in 1977. The CCLS cohort is based on a 4 percent sample of criminal cases that were either ruled upon by a Dutch judge or decided upon by the public prosecutor. The sample was randomly selected from all cases registered at the Public Prosecutor's Office, which were irrevocably disposed of in 1977. Offenders were at least 12 years old, because this is the minimum age for criminal responsibility in the Netherlands. On average the offenders were 27 years old in 1977 and both men and women (11 percent) were included in the sample.

For the full CCLS sample, information on the criminal careers of the offenders was collected using the General Documentation Files (GDF) of the Criminal Record Office (''rap sheets''). The GDF contain information on every criminal case that was registered by the Public Prosecutor's Office. Data were available on all convictions preceding 1977—starting from age 12 years. Additionally, all the respondents' new convictions between 1977 and 2003 were registered.

In addition to information on demographics (i.e., gender, age, and ethnicity), the GDF contain information on a number of criminal justice response variables, such as the number of previous convictions, the type of criminal offence, the type of sentence (custodial, community service, treatment measures, and fines), and the length of the sentence. Therefore, detailed information was available on whether people were sentenced to imprisonment in 1977 as well as on their criminal career. Data on employment status[2] and alcohol and drug dependence were derived from the information records that the police fill out after arresting a suspect (for more information on the CCLS see: Blokland and Nieuwbeerta 2005; Blokland, Nagin, and Nieuwbeerta 2005; Nieuwbeerta and Piquero 2008).

Selected Sample

The full CCLS sample contains information on all offenses that led to any type of outcome (e.g., not guilty, guilty, prosecutorial decision to drop the case due to lack of evidence, prosecutorial decision to drop the case for policy reasons, and prosecutorial fines). For the present study, only persons who committed an offense in 1977 that resulted in (a) a guilty finding, (b) a prosecutorial waiver due to policy reasons, or (c) a fine were included, combining these three outcomes as convictions. In this way 1,798 cases, in which the person was clearly or possibly not guilty of the offense in 1977 were excluded.

Additionally, because we were interested in the causal effects of imprisonment on postprison mortality, we decided to focus on persons with a *first-time* imprisonment in 1977 to prevent interference from feedback effects. Feedback effects would imply a prior incarceration to affect the chances of subsequent convictions and imprisonment, as well as post-sanction health and mortality. In total, 758 persons had a history of imprisonment before 1977.

Eventually, this resulted in a sample of 2,297 male and female offenders. On average these offenders were 28 years old in 1977 ($SD = 11.0$), the majority (88 percent) were born in the Netherlands, and about half of the offenders were unmarried and had no children, almost 40 percent were unemployed. Police records showed that one-third of the sample had problems with alcohol and 2 percent of them were dependent on drugs.[3]

Of the offenders, 26 percent ($n = 597$) were incarcerated for the first time in their lives in 1977 (Table 2). For the remaining 1,700 convicted offenders, the judge reached a guilty verdict but instead of imprisonment imposed a noncustodial sentence.[4] These offenders serve as a control group in some of our analyses.

Table 2. Characteristics of the Total Imprisoned Group and the Total Control Group

	Total Imprisoned N = 597		Total Controls N = 1,700	
	N	*%*	*N*	*%*
Gender***				
Male	578	96.8	1543	90.8
Female	19	3.2	157	9.2
Age***				
12-20 years	129	21.6	541	31.8
21-24 years	145	24.3	275	16.2
25-34 years	202	33.8	461	27.1
35-44 years	76	12.7	237	13.9
45+ years	45	7.5	186	10.9
Ethnicity***				
Dutch	495	82.9	1527	89.8
Non-Dutch	102	17.1	173	10.2
Marital status**				
Unmarried, no children	324	54.3	925	54.4
Unmarried, children	21	3.5	34	2.0
Married, no children	40	6.7	176	10.4
Married, children	144	24.1	435	25.6
Divorced, no children	14	2.3	38	2.2
Divorced, children	54	9.0	92	5.4
Employment**				
High-prestige occupation	171	28.6	491	28.9
Low-prestige occupation	235	39.4	542	31.9
Unemployed	191	32.0	667	39.2
Alcohol dependent***				
Yes	241	40.4	529	31.1
No	356	59.6	1171	68.9
Drug dependent*				
Yes	21	3.5	30	1.8
No	576	96.5	1670	98.2
Type of conviction***				
Crime of violence	293	49.1	404	23.8
Property offense	94	15.7	449	26.4
Traffic offense	86	14.4	419	24.6
Damage	23	3.9	210	12.4
Drug offense	51	8.5	61	3.6
Other offenses	50	8.4	157	9.3
Number of convictions***				
No prior conviction	189	31.7	865	50.9
1-10 prior convictions	379	63.5	804	47.3
More than 11 prior convictions	29	4.9	31	1.8

*Note: *p < .05; **p < .01; ***p < .001.*

Table 2 shows that the group of imprisoned offenders and the group of non-imprisoned offenders differ significantly with respect to all observed characteristics. Compared with the non-imprisoned "controls," the imprisoned group consisted of fewer women, more persons who were not born in the Netherlands, fewer adolescents, more divorced persons with children, and more addicted persons. The imprisoned offenders had more convictions preceding their conviction in 1977. They were also more often convicted for violence and drug offences and less often for property crimes, traffic offenses, and damage, relative to the controls.

Mortality and Causes of Death Measures

The Municipal Basic Administration of Personal Data was consulted to identify whether respondents had died during the 25-year follow-up period (1977-2003). Subsequently, data on the causes and dates of the respondents' death were obtained by linkage with the Netherlands National Death Index, a database containing information on all deaths in the Netherlands since 1901.[5] When a person in the Netherlands dies, the physician or coroner who declares the person dead fills out a certificate on the cause of death and sends this to the National Death Index. Physicians and coroners in the Netherlands have always classified causes of death according to the International Classification of Diseases (ICD). The ICD has been amended several times during the period covered by the present study (World Health Organization 2004). Fortunately, at the level of aggregation used in our study, the various primary causes of death as categorized in previous versions of the ICD could easily and consistently be recoded into the most recent version of the ICD, that is, the ICD-10.[6]

Data Analysis

General

Chi-square tests (for categorical variables) and *t* tests (for continuous variables) were used to compare former prisoners with the control group regarding their sociodemographics and health-related and criminal-related characteristics. Odds ratios (ORs) with 95 percent confidence intervals were used to examine whether mortality rates among the former prisoners differed significantly from the general population as well as from the non-imprisoned controls.

In comparing the mortality rates of the distinguished groups, a correction is made for age and sex distribution differences. To correct for age and sex

differences, use is made of the direct standardization technique. The age distribution of the imprisoned group is used as the standard population. This implies that the age and gender distributions in the other groups (general population and the non-imprisoned controls) are weighted such that these equal the age and gender distributions in the imprisoned group in 1977.

Propensity Score Matching

To examine the effects of imprisonment on mortality in an optimal way, propensity score matching is used as analytic strategy. This strategy is designed to balance pretreatment and observable covariates between experimental and control groups (Rosenbaum and Rubin 1983, 1984; Haviland, Nagin, and Rosenbaum 2007; Nieuwbeerta, Nagin, and Blokland 2009). One advantage of propensity score matching compared with models based on regression techniques is that this approach is more robust concerning model misspecification (Drake 1993). Another advantage over regression models is that it increases the internal validity of the inferences that can be drawn because with the matching approach the population to whom the analyses pertain is totally clear. That is, when applying the method it becomes apparent for which persons in the "treatment group" no comparable "controls" are available. So, using propensity score matching procedures makes the boundaries visible of the population to whom the effect estimates pertain, whereas in regression-based methods this remains unclear.

In this study, we combined the "matching by variable strategy" with the "propensity score matching strategy" to account for selection bias. First, offenders sentenced to imprisonment were individually matched on age and gender to offenders sentenced to noncustodial sentences. As a second step, the imprisoned offenders were matched to offenders from the control group with similar propensity scores. In order to be matched, the propensity score of imprisoned and matched persons had to be within .05 of each other. Here, the two-step by variable-propensity score matching approach was chosen because propensity score matching alone does not guarantee that, for instance, female offenders are matched to female offenders or that matched controls fall exactly in the same age category of the imprisoned persons.

Propensity Scores

The propensity score is the conditional probability of receiving the treatment, given the observed covariates. In this study, the propensity score is

the conditional probability of imprisonment in 1977 versus non-imprisonment, given the observed covariates.

Using data on the 2,297 convicted persons in the selected CCLS sample, the propensity score for each of the 2,297 individuals was calculated using a logistic regression model with the variable "imprisoned or not in 1977" as the dependent variable and a range of covariates as the independent variables. When comparing two types of criminal justice interventions the list of potential confounding variables is, in principle, endless. Nagin et al. (2009) stated that to reach an acceptable base of comparison between groups, two criminal-case variables (i.e., criminal history and conviction offence type) and three demographic variables (i.e., age, race, and gender) should definitely be accounted for. Our model included these variables and we added more. We used the following individual covariates to estimate a propensity score for each person: gender, age (age and the square root of age), employment situation, marital status, country of birth (the Netherlands or not), and alcohol or drug dependence. Additionally, variables regarding the type of offense (e.g., property, drug, and violence) and the criminal history (i.e., the number of preceding convictions) were taken into account. The logistic regression model demonstrated that male gender, being born outside the Netherlands, alcohol dependence, more severe offenses (violence and drug offenses), and a more extensive criminal history were all substantially and significantly related to an increased odds of imprisonment.[7]

The distribution of the estimated propensity scores for the entire sample of imprisoned and non-imprisoned persons differed. As expected, the two groups differed substantially regarding their probability of being sent to prison; however, sufficient overlap (i.e., common support) between the propensity score distribution of the imprisoned group and the control group was observed. Therefore, it was possible to apply propensity score matching to these data.

Offenders sentenced to imprisonment from the experimental group were matched one by one, without replacement, to offenders from the control group with a comparable propensity (i.e., a difference in propensity score of less than 0.05). As a result, an individual in the control group was matched to an individual in the experimental group in such a way that the multivariate pretreatment covariate distance was minimized.

Balance

We were able to match 408 of the 597 imprisoned persons (68 percent) to a suitably matched control person. Thereby, we have a "treatment group" of 408 imprisoned persons and a "control group" of 408 non-imprisoned

persons. Contrary to the situation before matching (Table 2), the matched imprisoned group and the matched non-imprisoned control group no longer differed significantly on any of the observed variables (Table 3). After matching, no significant differences existed between the two matched groups regarding demographic characteristics, substance dependence, or crime-related variables. For example, the two groups of convicted offenders were now equally likely to be born in the Netherlands, had a similar criminal history, and were just as likely to have been sentenced for crimes of violence, property offenses, or a violation of the opium act. Therefore, the combined method of matching by variable and matching on propensity scores was successful in creating a balance on all observed covariates; consequently, we can be confident that differences in post-sentence mortality do not reflect preexisting differences in the observed variables between the imprisoned and the matched control group.

Non-Matched Imprisoned Group

For 189 imprisoned persons, we could not find a matched control with a similar propensity score, therefore, these 189 imprisoned individuals were dropped from further analysis. These unmatchable individuals disproportionately consisted of offenders from the more active criminal group (Table 3). Their mean number of prior convictions exceeded that of the matched individuals (3.62 vs. 2.39 for the matched imprisoned and 1.96 for the matched controls; $F = 16.57$; $p < .001$). Unmatchable imprisoned individuals were significantly more likely to have been convicted for more serious crimes like violence and drug offenses and were less often convicted for traffic offenses ($\chi^2 = 46.4$; $p < .001$). Moreover, the group of unmatched persons disproportionately consisted of female offenders ($\chi^2 = 42.8$; $p < .001$), offenders born outside the Netherlands ($\chi^2 = 22.9$; $p < .001$) and older individuals ($F = 28.8$; $p < .001$). They were also convicted to longer prison sentences compared with the successfully matched persons ($t = -3.2$; $p < .01$).

Of the unmatched imprisoned individuals, 44 (23.3 percent) had died during the 25-year follow-up, which is significantly higher compared with the two groups that could be matched ($\chi^2 = 11.2$; $p < .01$).

Propensity score matching only works in situations where there is some discretionary freedom in the decision who is sent to prison and who is not. When all individuals with certain characteristics are imprisoned, the ability to match is lost. The fact that we could not identify suitable controls for this group of incarcerated individuals shows that judges in the Netherlands use

Table 3. Characteristics of Matched Imprisoned, Matched Controls, and Non-Matched Imprisoned

	Matched Imprisoned		Matched Controls		Not matched Imprisoned	
	N = 408		N = 408		N = 189	
	N	%	N	%	N	%
Gender						
Male	405	99.3	405	99.3	173	91.5
Female	3	0.7	3	0.7	16	8.5
Age						
12-20 years	113	27.7	113	27.7	16	8.5
21-24 years	103	25.2	103	25.2	42	22.2
25-34 years	133	32.6	133	32.6	69	36.5
35-44 years	38	9.3	38	9.3	38	20.1
45+ years	21	5.1	21	5.1	24	12.7
Ethnicity						
Dutch	357	87.5	353	86.5	138	73.0
Non-Dutch	51	12.5	55	13.5	51	27.0
Marital status						
Unmarried, no children	249	61.0	265	65.0	75	39.7
Unmarried, children	5	1.2	4	1.0	16	8.5
Married, no children	27	6.6	22	5.4	13	6.9
Married, children	101	24.8	94	23.0	43	22.8
Divorced, no children	7	1.7	9	2.2	7	3.7
Divorced, children	19	4.7	14	3.4	35	18.5
Employment						
High-prestige occupation	120	29.4	124	30.4	51	27.0
Low-prestige occupation	160	39.2	174	42.6	75	39.7
Unemployed	128	31.4	110	27.0	63	33.3
Alcohol dependent						
Yes	158	38.7	157	38.5	83	43.9
No	250	61.3	251	61.5	146	56.1
Drug dependent						
Yes	11	2.7	8	2.0	10	5.3
No	397	97.3	400	98.0	179	94.7
Type of conviction						
Crime of violence	180	44.1	180	44.1	113	59.8
Property offense	71	17.4	71	17.4	23	12.2
Traffic offense	75	18.4	89	21.8	11	5.8
Damage	15	3.7	16	3.9	8	4.2

Table 3 (continued)

	Matched Imprisoned		Matched Controls		Not matched Imprisoned	
	N = 408		N = 408		N = 189	
	N	%	N	%	N	%
Drug offense	26	6.4	26	6.4	25	13.2
Other offenses	41	10.0	26	6.4	9	4.8
Number of convictions						
No prior convictions	143	35.0	135	33.1	46	24.3
1-10 prior convictions	256	62.7	267	65.4	123	65.1
11+ prior convictions	9	2.2	6	1.5	20	10.6

their discretionary freedom for less serious offenders, but not for serious offenders. This implies that the results of our analyses apply to those with relatively low to moderate probability of imprisonment. The advantage of using such a matching strategy is that it clarifies the boundaries of the population to whom the analyses pertain. If these serious offenders were included in the analyses, despite the fact that we could not identify appropriate matches, this could have increased rather than decreased the risk of selection bias.

Results

Mortality in the Total Sample of the Imprisoned Group

Table 4 presents the number of deaths and main causes of death for the total sample of offenders who were sentenced to imprisonment in 1977. A total of 107 (17.9 percent) of the 597 imprisoned offenders in 1977 had died in the 25-year period thereafter.

About 13 percent of the imprisoned individuals died from natural causes. Within this group, mortality due to cancer and cardiovascular diseases was most prevalent. About 5 percent of the imprisoned offenders died from unnatural causes: 2 percent died because they committed suicide and 1 percent died because they were murdered.

Comparisons between the Imprisoned Group and the Dutch General Population

Next, we examined the extent to which the mortality rates and causes of death of the imprisoned group differed from those of the general Dutch

Table 4. Number of Deceased Respondents According to Causes of Death

	A: Total imprisoned group		B: general population[1,2]	C: control group[1]		Odds ratios (95% confidence interval)	
	N = 597		N = 11,332,232	N = 1,700		A vs B: Imprisoned vs General population	A vs C: Imprisoned vs control group
	N	%	%	N	%		
Natural causes of death	76	12.7	5.7	165	9.7	2.41 1.89-3.06	1.35 1.01-1.81
Cancer	29	4.9	2.1	61	3.6	2.41 1.66-3.50	1.38 0.88-2.17
Cardiovascular diseases	24	4.0	2.0	53	3.1	2.03 1.35-3.06	1.33 0.82-2.17
Digestive disorders	7	1.2	0.2	15	0.9	4.97 2.36-10.47	1.30 0.53-3.19
Infectious diseases	3	0.5	0.2	8	0.5	3.27 1.05-10.17	1.12 0.30-4.21
Respiratory organ disorders	6	1.0	0.4	2	0.1	2.49 1.11-5.56	10.74 1.79-64.36
Endocrine diseases	1	0.2	0.1	3	0.2	1.20 0.17-8.50	1.12 0.11-11.29
Mental illnesses	2	0.3	0.1	5	0.3	3.99 1.00-16.01	1.23 0.23-6.46
Diseases of nervous system	1	0.2	0.1	1	0.1	1.33 0.19-9.45	2.54 0.15-44.22
Unnatural causes of death	30	5.0	0.7	50	2.9	7.98 5.53-11.52	1.71 1.08-2.72
Suicide	12	2.0	0.3	17	1.0	7.30 4.12-12.93	2.05 0.97-4.35
Murder and manslaughter	6	1.0	0.0	5	0.3	24.14 10.80-53.98	3.32 1.01-10.85
Traffic accidents	3	0.5	0.3	15	0.9	1.56 0.50-4.86	0.56 0.16-1.92
Other accidents	9	1.5	~	13	0.8	~	1.90 0.81-4.47
Cause of death unknown	2	0.3		5	0.3		
Total number of deaths	107	17.9	6.4	220	12.9	3.21 2.60-3.95	1.47 1.14-1.89
N	597			1700			

Note: ~ = unknown.
[a] Distribution is age*gender adjusted to distribution in total imprisoned group in 1977.
[b] General population of 12 years or older.

405

population in 1977 (age and gender adjusted). Almost all prior studies on the effects of incarceration on mortality used this approach.

The standardized mortality rates (SMRs) for the total imprisoned group and the general population are shown in Table 4. Of the imprisoned offenders, 17.9 percent had died, compared with only 6.4 percent in the general population. Therefore, compared with the (age-and gender-adjusted) general population, the mortality rate among the imprisoned offenders is more than three times higher (OR = 3.21). This means that individuals in the total group of former prisoners were three times as likely to die.

Table 4 also shows that the risk of dying from natural causes of death was 12.7 percent for the imprisoned offenders, compared with 5.7 percent in the general population. This means that for imprisoned offenders, the risk of dying from a natural cause of death was about two times higher than for the general population. Among imprisoned offenders as well as the general population, the leading natural causes of death were cancer and cardiovascular diseases. Relative to the average population, the former prisoners had a high risk of dying due to digestive disorders, mental illnesses, infectious diseases, and respiratory disorders. Cautiousness is required, however, because the results on the causes of death involve very small numbers. Particularly former prisoners were at elevated risk of dying from unnatural causes (OR = 7.98): 5 percent of the total imprisoned group died an unnatural death, whereas on the basis of the age and gender distribution, only 0.7 percent of these imprisoned persons would have been expected to die due to unnatural causes. Former prisoners were particularly at risk of dying as a result of murder or suicide (ORs 24.14 and 7.30, respectively).

Comparisons between the Imprisoned Group and the Non-Imprisoned Group

As mentioned before, offenders convicted to noncustodial sentences will be more similar to imprisoned offenders than individuals from the general population and will therefore constitute a more appropriate comparison group. Therefore, we also examined the extent to which the mortality rates and causes of death of the imprisoned group differed from those of persons in the CCLS sample who were convicted in 1977 but sentenced to a noncustodial sentence, again corrected for age and gender differences (Table 4).

Compared with the group of non-imprisoned offenders, the former prisoners had a significantly higher risk of dying during the 25-year follow-up period: 17.9 percent of the imprisoned versus 12.9 percent of the
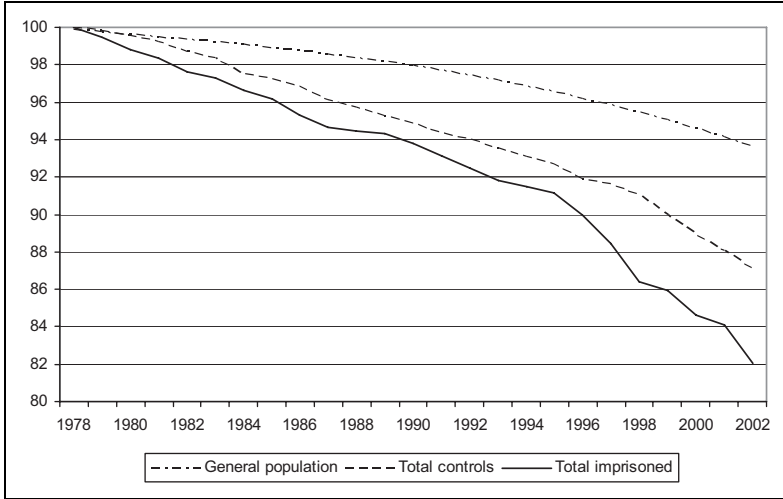
Figure 1. Survival curves for the total imprisoned group, the total control group and the general population.

non-imprisoned group (OR = 1.47). The two groups differed significantly with respect to their risk of dying from natural causes of death in general (12.7 percent vs. 9.7 percent, respectively).[8] When examining unnatural causes of death, we observed that 5 percent of the imprisoned group died from unnatural causes of death compared with 2.9 percent in the convicted but non-imprisoned group. Thus, imprisoned offenders were 1.7 times more likely to die from unnatural causes of death than offenders convicted to non-custodial sentences (OR = 1.71; 95% CI = 1.08-2.72). More specifically, former prisoners were at a significantly elevated risk of premature death as a result of murder (OR = 3.32; 95% CI = 1.01-10.85).

Figure 1 summarizes our results and presents the observed survival chances for the total group of imprisoned offenders. The figure shows that after 25 years, 17.9 percent of the former prisoners had died and thus 82.1 percent were still alive. Furthermore, the course of the survival rates is gradually decreasing: as individuals age their risk of dying in a calendar year increases. Figure 1 also presents the survival chances for the general population and for the group of offenders who were not imprisoned, standardized on an age and gender distribution of the total imprisoned group. During the entire 25-year follow-up period, individuals from the general population had the highest survival chance, followed by offenders who were not imprisoned and finally followed by the former prisoners.

Table 5. Numbers of Deceased Respondents According to Causes of Death

	D: Matched Imprisoned Group		E: Matched Control Group		Odds Ratios (95% CI)
	N	%	N	%	
Natural causes of death	44	10.8	37	9.1	1.21 0.77-1.92
Cancer	15	3.7	12	2.9	1.26 0.58-2.73
Cardiovascular diseases	16	3.9	13	3.2	1.24 0.59-2.61
Digestive disorders	3	0.7	4	1.0	0.75 0.17-3.36
Infectious diseases	2	0.5	0	0.1	~
Respiratory organ disorders	4	1.0	0	0.0	~
Endocrine diseases	1	0.2	1	0.2	~
Mental illnesses	2	0.5	1	0.2	~
Diseases of the nervous system	0	~	1	2.0	~
Unnatural causes of death	22	5.4	13	3.2	1.73 0.86-3.49
Suicide	9	2.2	4	1.0	2.28 0.70-7.46
Murder and manslaughter	4	1.0	1	0.2	4.03 0.45-36.21
Traffic accidents	3	0.7	4	1.0	0.75 0.17-3.36
Other accidents	6	1.5	4	1.0	1.51 0.42-5.39
Cause of death unknown	2	0.5	1	0.2	2.00 0.18-22.20
Total number of deaths	68	16.7	51	12.5	1.40 0.95-2.07
N	408		408		

Note: Matching was done on age, gender and propensity score. ~ = number is too small for risk calculation and distribution.

Comparisons between the Matched Imprisoned and Matched Non-Imprisoned Group

Finally, we examined the extent to which the mortality rates and causes of death of the matched imprisoned group differed from those of the matched non-imprisoned persons (Table 5; Figure 2). From a methodological viewpoint, this comparison is the soundest one because it controls for a variety of observed preexisting differences and therefore minimizes selection bias. In this way, no comparisons are made between individuals who are not comparable to begin with. After 25 years, 16.7 percent of the matched former prisoners had died versus 12.5 percent of the matched non-imprisoned controls (OR = 1.40; 95% CI = 0.95-2.07). Former prisoners were no longer statistically significantly more likely to die when compared with the matched offenders who were not imprisoned in 1977.
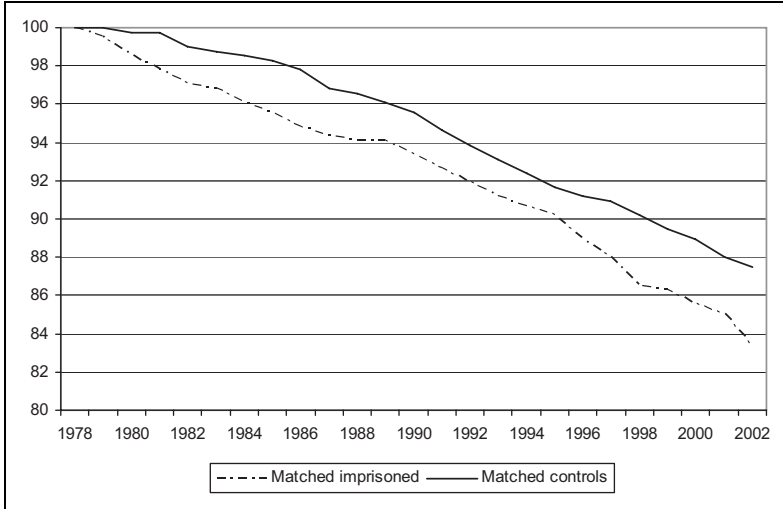
Figure 2. Survival curves for the total matched imprisoned group and the matched control group.

The risk of dying from natural causes of death was similar between the two matched groups. Compared with the matched non-imprisoned offenders, the matched imprisoned individuals had a higher risk of dying due to unnatural causes of death (5.4 percent vs. 3.2 percent); however, this difference was no longer significant.

Discussion

Main Findings

To our knowledge, the present study is the first to examine postprison mortality using propensity score matching to more adequately control for selection into imprisonment. In this way, the treatment group (i.e., former prisoners) and the control group (i.e., offenders sentenced to noncustodial sentences) were made comparable on a large number of pre-intervention, observable variables.

In line with the available research, our results demonstrate significantly elevated mortality rates among former prisoners when compared with age- and gender-adjusted individuals from the general Dutch population. In the present study, ex-prisoners were three times more likely to die during the 25-year follow-up period than persons from the general population. The

difference in mortality rates between former prisoners and non-imprisoned offenders of similar age and gender was substantially smaller and even became nonsignificant when former prisoners were compared with non-imprisoned offenders who were similar regarding age, gender, *and* propensity score.

Our finding that former prisoners were more likely to die after release from prison is in line with other reports (e.g., Binswanger et al. 2007; Farrell and Marsden 2007; Joukamaa 1998; Kariminia et al. 2007; Pratt et al. 2006; Spaulding, Allen, and Stone 2007). The magnitude of the standardized mortality risks of ex-prisoners observed in our study, and in the other 24 studies, differed substantially between studies (Table 1). For instance, Australian ex-prisoners were 10.4 times more likely to die during 6 months to 10.5 years after release from prison compared with the general population (Graham 2003), whereas American ex-prisoners were 3.5 times more likely to die on average 1.9 years after their prison experience (Binswanger et al. 2007). Although previous studies comparing mortality rates among former prisoners with those in the general population consistently concluded that former prisoners were more likely to die prematurely, in the present study former prisoners were *not* more likely to die when compared with their matched controls. This contrast in findings is probably related to the fact that the present study compared the mortality rates of ex-prisoners with those of a well-matched control group of offenders sentenced to noncustodial sentences, controlling for a large number of pre-intervention variables. Due to more preexisting differences between ex-prison populations and the general population, the results from other studies may be biased and may overestimate the effects of imprisonment on postprison mortality. Replication of the current study will be needed, however, to test for the robustness of this finding and to rule out other explanations such as a lack of power.

Putting the Main Findings in Perspective

Although our findings are relatively straightforward and methodologically stronger than previous studies, the results of the present study need to be put into a social and cultural context. In order to enlarge the understanding and meaning of the results of the present study, we briefly describe some relevant considerations and key characteristics of the Dutch penal system.

The present study, for example, is based on data from the 1970s in the Netherlands, at that time a country with a relatively well organized and humane prison system, as well as relatively lenient sentencing practices (Tonry and Bijleveld 2007). However, similar to some other European

countries (e.g., the United Kingdom) and the United States, crime control practices have become increasingly punitive in the Netherlands during the last 30 years. The imprisonment rate in the Netherlands increased from about 35 per 100.000 of the national population in the 1970s to 100 per 100.000 in 2008, which is one of the highest imprisonment rates in the countries of Western, Northern, and Southern Europe today (Tonry and Bijleveld 2007; Walmsley 2009).

Another point is that, in the Netherlands, prison sentences are much shorter compared with, for instance, the United Staes. In 2007, the average length of sentence (overall) was 147 days (Boone and Moerings 2007; Eggen and Kaldien 2008). Nowadays, about 80 percent of all prisoners in the Netherlands are serving a prison sentence of six months or shorter (Eggen and Kaldien 2008). The present study refers to Dutch offenders sentenced to a prison sentence for the first time in 1977. Their prison sentences ranged from less than 2 weeks to one person being sentenced to 18 years; 72 percent of the prisoners in the present study were serving a prison sentence of 6 months or less. Therefore, it is important to note that the present study focuses on the effects of relatively short-term prison sentences.

Another relevant characteristic of the Dutch penal system and society at large is the Dutch health system. Dutch prison law states that during imprisonment, individuals maintain the rights they had as free citizens as much as possible. This implies that during imprisonment, Dutch prisoners have the right to medical and psychological health care that must meet the same quality standards as health care outside prison (Bulten and Kordelaar 2005; Moerings 2005). Consequently, Dutch prisoners have access to psychologists, psychiatrists, nurses, and physicians during imprisonment. If necessary, prisoners can be hospitalized in the prison hospital or on a special care unit. Moreover, the Netherlands has a national health insurance system, in which each Dutch citizen has access to standard medical (e.g., primary care, medical specialist, dental care, medication, nursing, and hospital stay) and psychological health care. When a Dutch resident is imprisoned, his or her health insurance continues. Health insurers are not allowed to stop the health insurance in case of imprisonment. Therefore, former Dutch prisoners will probably experience fewer obstacles in getting access to health care than, for instance, former prisoners in the United States.

Some methodological concerns of our study should be addressed. A first concern might be that we were not able to match each imprisoned person to a control person. The individuals that could not be matched had a very high probability of imprisonment because they were the more serious offenders. This implies that the results of the present study

cannot be generalized to the entire prison population but apply to those with a relatively low or moderate probability of imprisonment. Second, the imprisoned group and the control group may have experienced (spells of) imprisonment between 1978 and 2003. More detailed information on the further life course of both groups after 1977 would have been meaningful. However, we think our approach provides valuable information regarding the effects of first-time imprisonment on postprison mortality.

Third, the present study was based on offenders who were sentenced in 1977 in the Netherlands. Therefore, we cannot be certain that the findings are generalizable to other countries or to more recent prison experiences; replication of our findings in other countries and on more recent cohorts is needed. Fourth, although we were able to compare mortality risks among former prisoners with a group of non-incarcerated offenders who were matched on a variety of characteristics, it is possible that the offender groups varied on other non-observed factors, such as a history of mental illness, previous suicide attempts, or neighborhood-level factors. Fifth, due to the relatively small numbers, we were not able to perform more detailed analyses, for example, into the specific causes of death, subgroup analyses (e.g., males vs. females, specific age groups, or people with different lengths of prison sentences), or whether former prisoners were more vulnerable to die early after release from prison. These limitations are offset by the strengths of the study: these include the use of data from a longitudinal study examining criminal behavior and mortality during a long period (25 years) in a representative group of offenders, and a study design that more adequately controlled for selection bias than previous studies.

Declaration of Conflicting Interests

Funding

Notes

1. We omitted studies investigating mortality during imprisonment. These studies typically showed that prisoners are more likely to die, particularly as a result of suicide (e.g., Blaauw et al. 1997; Fazel, Benning, and Danesh 2005; Liebling 1992).

2. For each suspect, the type of job was registered and classified into high or low occupational status work or unemployed, according to the classification system of Van Tulder (1962).

3. Higher prevalence rates (30-44 percent) for drugs dependence among Dutch prisoners have recently been reported (Oliemeulen et al. 2007). This may result in higher postprison mortality in more recent cohorts.

4. Note that we did not restrict the group to first-time noncustodial sentences. Therefore, both the incarcerated group and the control group could have been sentenced to noncustodial sentences before 1977.

5. Each person has a unique identification number in the Municipal Basic Administration of Personal Data. Linkage with the Netherlands National Death Index was done using these unique identifiers.

6. We recoded all causes of death (also of prior versions of the ICD) into the main categories of the ICD-10, version for 2007 (see: http://apps.who.int/classifications/apps/icd/icd10online/) and used these categories in our analyses (Tables 3, 4).

7. The coefficients of the model can be requested from the first author.

8. Compared with the non-imprisoned group, significantly more former prisoners died as a result of respiratory disorders.

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