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Aging effects of incarceration

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ABSTRACT

Aging Effects of Incarceration

Douglas C. Long

Whether incarceration confers excessive risk for accelerated aging or premature mortality remains an open question. Earlier studies suggested excess risk for aging and premature mortality but the data were either anecdotal or using population comparisons. One of the major risk factors for persons incarcerated is a history of substance abuse which alone is associated with adverse outcomes. Thus, we chose to examine the question of incarceration and adverse outcomes among a sample restricted to drug users, to determine if there was an independent risk related to incarceration. In terms of drug use, it is well documented that the risk of mortality is highest within the first couple of weeks after release. We framed the question, does a history of incarceration have a latency for a long term effect on accelerated aging and premature mortality after accounting for drug use. To examine this question, we used data from the AIDS Linked to the IntraVenous Experience (ALIVE) cohort, which consisted of injection drug users (IDU) presenting to a community clinic in Baltimore and followed semiannually for up to 30 years. Data were collected from 2005-2013 and history of incarceration was based on self-report for when the participant was entered into the cohort study anytime between 1988 – 2005. Outcome data were frailty using Fried's criteria (For frailty, operationalized according to Fried, we used a three-level scale of non-frail, prefrail, and frail) that was collected from 2005 onward, and all-cause mortality collected from NDI-Plus. For statistical analysis, ALIVE participants were divided into two cohorts, those recruited before the introduction of highly active antiretroviral therapy (HAART) when HIV infection was a significant cause of premature mortality, and those recruited after the advent of HAART when

the risk of death from HIV dropped significantly. We started the investigation with a literature review that included scholarly studies published from 1990 until 2017 on the association between incarceration and prevalence of chronic disease. In the cross-sectional study, the independent variable was a history of incarceration, operationalized as the total number of reported incarcerations in the six months prior to baseline. We examined two dependent variables: Frailty and mortality. No statistically significant effect of incarceration on frailty was found even after controlling for age, gender, race, educational attainment, HIV status, or current injection drug use. For mortality by a history of incarceration a survival analysis showed no significant difference even after controlling for age, gender, and HIV status. The adjusted relative hazard (95% CI) of mortality for those with a history of incarceration was 1.14 (0.81, 1.60) among those enrolled in the Pre-HAART era cohort and 1.19 (0.68, 2.10) for those enrolled in the HAART era cohort. Although earlier studies observed excess mortality soon after release, our data suggests that the role of past incarceration may have modest if any impact on the long term occurrence of frailty or mortality.

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Paper 3: Association between incarceration and survival among injection drug users

Introduction

Problem statement

Incarceration is a major public health challenge in the United States. The number of inmates in the United States (U.S.) is currently over two million inmates, which is five times more than any other developed nation (1). While inmates have a legal right to healthcare, health care provided to inmates has been found to be extremely poor and courts have handed down multiple, strong judgments on the poor quality of healthcare provided to inmates (2). The issue is becoming more acute. While the overall number of those incarcerated has started to trend downward, the median age among those incarcerated has been increasing. This is an important observation because aging is associated with the prevalence of chronic disease and the cost of health care increases with age (3). These increasing costs of health care are not confined to the correctional setting. The costs follow the inmates when they are released into the community (4). Unmet health needs while incarcerated create greater problems for the 600,000 to 700,000 that are released annually once they are living as free citizens (5).

Understanding the effect of incarceration on a person's health has proven to be challenging. There are short term effects of incarceration, such as higher mortality in the days after release, and longer term effects, which may be detected years after release. Multiple confounding factors include the selection effects in which some people become incarcerated while others, who seem to share many of the same behaviors and health risks, do not become incarcerated. The direction of the causality is not clear because the behaviors that lead to worse health, such as drug use, also lead to incarceration. Studying the problem is difficult because it does not lend itself to purposeful experimentation, and there is no easily recognizable population that may be comparable in their overall life condition to those who are incarcerated.

Theoretical framework

Urie Bronfenbrenner's bioecological model, also known as the social ecology theory, provides the conceptual framework for this study (6). One needs to look at the "ecological context", studying a person's living environment, to understand him/her. In this case, one's health behaviors and health status may best be understood by looking at a person's environment, such as in the community or in prison. If the prison is having an unhealthy effect, causing the inmate to age faster, one would need to look at the overall picture of incarceration, and not necessarily any one aspect. Massoglia's proposal that it is the stress of prison life likewise posits that it is the overall experience and the resultant stress that leads to those poor health outcomes (7).

Purpose and aims

The first paper, a literature review, includes research articles that focus on the association of incarceration and prevalence of chronic disease. A narrative view is taken, which "summarizes a body of literature and draws conclusions about the topic in question" (8). The review included empirical studies published between 1990 and 2015. The earlier date of 1990 was selected because it encompasses the seminal articles that first mention the aging of inmates. Search terms included the main conceptual groups of institution, inmates, aging, and health. For the institution, search terms included: *prison*, *jail*, *incarceration*, and *correctional*. For inmates, search terms included: *prisoner*, *inmate*, or *incarcerated*. Search terms for old included *old* or *aging*. Search terms for health included *health* or *healthcare*. Specific terms of chronic medical conditions were not used because preliminary analysis demonstrated they did not capture any additional relevant publications. Studies were included if they met the following criteria: (1) empirical research, including both quantitative and qualitative analysis; (2) adult inmates or ex-inmates in prisons or

jails; (3) outcome data on health status; and (4) comparison of the old inmate's health with any other population or that same individual's earlier health. By using the search term *health* or *healthcare*, we captured studies that included multiple chronic medical conditions. This was done because the effects of incarceration should involve a broad range of health effects, and using thus we should see the effects on the individual's overall health.

The second paper is a cross-sectional study to investigate the association of having a history of incarceration and aging. This study uses a sample of individuals engaged in injection drug use, behaviors that are risky both in terms of health outcomes and incarceration, to investigate associations between a history of incarceration and health outcomes. Study participants came from The AIDS Linked to the Injection Experience (ALIVE), a research program using a prospective, observational cohort of injection drug users (IDU) that has been ongoing since 1988 (9). The program is based in Baltimore, Maryland, affiliated with John Hopkins Bloomberg School of Public Health (JHU). The objectives of the program include describing the natural history of HIV infection among drug users that has expanded to include the relationships between drug abuse and other blood borne infections such as hepatitis. The methods include interviews, physical exams, serology including a biological repository, chart abstraction and linkage with repositories including the National Death Index (NDI-Plus). The health outcome used in this study is ageing, which is operationalized as frailty. Ageing has been described in terms of disability, impaired IADL/ADLs, or vulnerable to adverse health events (10). Multiple studies have described frailty as preceding disability. The Frailty Phenotype was developed around 2001 in which frailty is conceptualized as a cluster of issues such as reduced energy and less muscle mass, leading to reduced reserves to handle stressors, leading to a cycle of further risk of decompensation (11).

The third paper presents a survival analysis, using the same ALIVE participants, to investigate the association of history of incarceration and mortality. The data on mortality begins in 2005 and ends in 2015. We investigated long term effects (i.e., greater than six months) of incarceration, in contrast to other studies that have shown short term increases in mortality in the period after release from incarceration. Because of the introduction of highly active antiretroviral therapy in 1996 which significantly reduced HIV related deaths (12), we divided the data set into Pre-HAART and HAART eras. The Pre-HAART group consisted of the original participants recruited in 1988-89 with data right censored in 1996. The HAART era cohort consists of those participants who survived until at least 1996, were recruited after 1996 and right censored in 2015. The variable of incarceration was posed differently by period. In the Pre-HAART cohort, the question was posed as "prison or jail in the past 10 years". In the HAART era, the baseline enrollment visit questionnaire ascertained incarceration history as "ever been incarcerated" and included more detailed questions about the number of incarcerations and the total amount of time incarcerated. Kaplan-Meier curves of all-cause mortality by history of incarceration for each cohort were compared using the log rank test (13). Cox regression models were used to examine mortality by history of incarceration after accounting for putative confounders and expressed as relative hazards (RH) with associated 95% confidence intervals.

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Incarceration and health status:
Review of Literature

Douglas Long

ABSTRACT

Despite large prison populations and their deleterious effects on inmate health, the data are spare on the effects of incarceration on inmate chronic medical conditions. Some have suggested that inmates age faster, but conceptualization and metrics of aging has been underdeveloped. With the observation that chronic disease incidence increases with age, we focused on persons who had a history of incarceration to investigate the possible link with the occurrence of chronic medical diseases. Using a systematic review strategy, the search narrowed to 13 articles that investigated the association between incarceration and health outcomes. Several studies concluded with speculative theories as they observed worse health conditions among inmates compared to the never-incarcerated population. These reports were unable to differentiate whether a higher rate of chronic disease among those with a history of incarceration might be due to stress related factors, access to and quality of health care, or risks prior to incarceration such as substance abuse, which itself has been associated with higher frequency of disease. Likewise, the literature rarely mentioned the potential for accelerated aging due to incarceration, while concepts and metrics of aging were underdeveloped. If incarceration leads to accelerated aging, interventions are needed to reduce the effects of incarceration and for post-release management.

Approximately three million people are incarcerated in the United States (U.S.), five times more than any other Western nation (1). This elevated incarceration rate has been attributed to drug use and the War on Drugs (2), and reincarceration, in which people parole only to commit other offenses (3). Inmates are the only population in the U.S. that have a legal right to healthcare, (4), but the provision of healthcare to the inmate population is costly, estimated to be around $6.5 billion in 2008 (5). In addition to the need for care while incarcerated, there is also a major impact on society when they return to society (3). Unmet health needs while incarcerated create greater problems for the 600,000 to 700,000 that are released annually once they are living as free citizens (6).

Aging is associated with an increase in the prevalence of chronic diseases and demographic trends show that the median age of inmates has been increasing over the past few decades (5). Some reports have speculated that inmates may age more rapidly while incarcerated than their community counterparts (7). To date, research on this issue has tended to focus more on the frequency and severity of chronic medical conditions which may serve as a proxy for aging. This literature review focuses on the question of chronic medical conditions in prison, whether inmates have worse health outcomes in prison, and reasons that may explain such as association.

Methods

We conducted a review of research articles that focus on the association of incarceration and prevalence of chronic disease. A narrative view is taken, which "summarizes a body of literature and draws conclusions about the topic in question" (8). This type of review was chosen because the few reports on this topic, which suggests that systematic review or meta-

analysis may be less helpful (9). Data on females were excluded because they constitute less than 5% of the inmate population and data are limited (1), and there are some fundamental differences between men and women in their experience while incarcerated and their health needs (10). We did not differentiate between studies of prisons and jails because data from studies often made no distinction. Geographically, we accepted any studies regardless of the country in which the study was conducted, despite the fact that legal, political, and cultural issues have been shown to influence the prison environment and thus its potential effects on inmate health (4). This was done because useful information may still be gained from studies done in diverse sociopolitical environments.

The search was conducted using PubMed, PsychINFO, and Web of Science for empirical studies published between 1990 and 2015. The earlier date of 1990 was selected because it encompasses the seminal articles that first mention the aging of inmates. Search terms included the main conceptual groups of institution, inmates, aging, and health. For the institution, search terms included: *prison*, *jail*, *incarceration*, and *correctional*. For inmates, search terms included: *prisoner*, *inmate*, or *incarcerated*. Search terms for old included *old* or *aging*. Search terms for health included *health* or *healthcare*. Specific terms of chronic medical conditions were not used because preliminary analysis demonstrated they did not capture any additional relevant publications. Studies were included if they met the following criteria: (1) empirical research, including both quantitative and qualitative analysis; (2) adult inmates or ex-inmates in prisons or jails; (3) outcome data on health status; and (4) comparison of the old inmate's health with any other population or that same individual's earlier health. By using the search term *health* or *healthcare*, we captured studies that included multiple chronic medical conditions. This was done because the effects of incarceration should involve a broad range of

health effects, and using thus we should see the effects on the individual's overall health. We did not establish an age criterion for the search because many of the studies were of adults (we excluded juvenile inmates). Because the literature distinguishes biological from chronological aging (11), our interest was on the potential for observations of biological aging distinguished from chronical age across the lifespan. Exclusion criteria included: (1) non-empirical studies, such as narratives; (2) mental health status only, lacking medical health outcomes; (3) an absence of comparison between the adult inmate's health with other younger age or external populations.

Results

Using the above search strategy, 845 studies were initially identified. These were screened using the title and abstract, resulting in 54 studies that met inclusion criteria. These 54 studies were retrieved as full text and their reference lists used for a secondary search which yielded five additional articles resulting in 59 related data articles. The 59 articles were evaluated using the criteria of Whittemore and Knafl (12), which are authenticity, informational value, representativeness of sources, and methodological quality of the study. Thirteen studies were selected based on the main factor of informational value. As Table 3 shows, all of the 13 studies included comparisons of the health of old inmates with either younger inmates, non-inmates, or the same individual at an earlier age. Studies outside of the U.S. were not excluded initially because it was possible that they were from prison systems similar enough the U.S. to provide meaningful comparisons. Selected studies included a diverse range of facilities throughout the U.S. and internationally, and included jails, state prisons, federal prisons, and combinations thereof.

The studies captured in this review show initial studies of inmate health status were discussing aging, and a second generation of studies took that theory and tested it using chronic medical conditions as a proxy for aging. We next plumbed those articles that first mentioned the possibility of aging while incarcerated, and the literature reviews that introduced the tipoci as part of the broader body of correctional health research. That section is then followed by a review of the those articles that try to identify and measure aging while incarcerated.

Early reports of aging inmates and reviews

Two studies are used as the original citation for aging while incarcerated, Aday (7), and Mitka (13). Aday's article was written as if the author were addressing correctional officials, outlining what a correctional facility would need to do to accommodate elderly inmates. He notes, "several correctional officials suggested that the typical inmate in his fifties has a physical appearance of at least 10 years older. In addition, the declining health of many inmates contributes to them being 'elderly' before their time" (p. 3). Another source is Mitka, an editorial, noting "a 50-year-old inmate may have a physiological age that is 10 to 15 years older, correctional health experts say. Because inmates generally age faster due to such factors as abuse of illicit drugs and alcohol and limited lifetime access to preventative care and health services" (13). Neither article cited sources for these statements, and they did not propose any reason why there may be accelerated aging.

As the research program in correctional healthcare developed over the past two decades, aging in prison has become a growing topic of interest. Three literature reviews have been published on correctional healthcare, one of which focused on aging inmates while the other two addressed the entire inmate population.

Loeb and AbuDagga's (11) literature review on "health-related research on older inmates" mentions inmates age "10-15 years beyond their chronological age" (p. 557), thus reinforcing this assumption. They note "inmates consistently reported health declines since incarceration". Loeb and AbuDagga's integrative review included 21 articles spanning 1999 to 2005. From their paper, 15 were peer reviewed empirical studies. The authors had four main goals: identify the minimum age used to define an old inmate, determine what health related issues were being studied, what is known about aging while incarcerated, and what prison policies or programs exist that are tailored to the needs of older inmates. Loeb and AbuDagga found the published research tends to focus on three main areas: psychiatric conditions, physical illness, and substance abuse. They noted first that there appears to be no consensus for a definition of old. Next, they found no solid evidence that incarceration accelerates biological aging. However, three articles studied the matter by comparing inmates' self-reported health over time (14, 15, 16). The Koenig article is not further described because outcomes were limited to depression and anxiety, whereas our focus was primarily with physically defined diagnoses. They found three other literature reviews, one of which is to be discussed next. Of the other two reviews, Rubenstein (17) only discussed psychological issues, and Lemieux et al (18) had only 4 of the 12 articles being research reports.

Watson, Stimpson & Hostick's (19) literature review was more general than Loeb and AbuDagga's study, looking at "prison health care". Their purpose was to "identify models of prison health care from which lessons could be learned from the UK prison service…". Articles spanned 1991 to 2002, resulting in90 papers, which included scholarly research plus 21 reports or polity documents. Three papers focused on older prisoners, with the authors noting, "this does not appear to be a major concern of government policy documents" (p. 124). They also

noted an absence of theoretical models of prison health care (p. 125). Their review identifies mental health, substance abuse, and communicable diseases as the main issues of inmate health. This is important because it differs from the findings of Loeb and AbuDagga and may be a significant omission of chronic medical conditions and accelerated aging as a concern for inmate health.

Kerbs and Jolley (20) edited a book in which their introductory chapter lays out the evolution of research on elderly prisoners. The first stages were simply the recognition that some inmates were elderly. This was followed by a period, beginning in the early 1980s, in which scholars developed the conceptualization of what is an elderly inmate. Most relevant to this review is the third stage, in which treatment needs and options were being recognized. In the third stage the authors discuss the accelerated aging hypothesis, but do not cite references. Kerbs and Jolley mention two possible explanations, that inmates have led a hard life prior to incarceration, and the stresses of incarcerated life. Their example, like other authors, was that a 50-year-old inmate is comparable to a 60-year-old in the community. Leigey's chapter is titled "Bio-psycho-social needs" and devoted one page to accelerated aging in prison (21). She notes the inconsistent findings and attributes the inconsistencies to small or non-representative sample sizes.

Maschi, Marmo and Han's (22) literature review of palliative care and end-of-life care in prisons posited inmates reach the end of life at an earlier age than those in the community, but they provided no support for this claim. The articles reviewed were mutually exclusive to the articles recognized in this paper. In other words, they seem to be isolating the issue of end-of-life care in prison with the processes that led that inmate to being at the end of his/her life while still incarcerated.

Direct evidence of incarceration causing increased aging

Since the early purely anecdotal observations that inmates seem to age faster, empirical research on this topic has proven to be challenging. Part of the problem is conceptualizing key parts of the model, such as *incarceration* and *aging* (23), and another issue has been limits on any research involving inmates (24). A total of thirteen articles are included in this discussion (Table 1), of which only a few are explicitly trying to address the question of aging in prison. Many studies have been done that focus on specific health aspects, such as HIV or diabetes, but are not included in this review because incarceration is theorized to affect a range of health outcomes which cannot be isolated to one or a few medical indicators (7). The first two studies are those identified by Loeb and AbuDagga as supporting the idea that incarcerating has an aging effect. After noting these two studies, we move on to consider the other publications that make comparisons such as inmates with non-inmates or individuals when they were incarcerated and when they were not.

Marquart, Merianos, and Doucet (16) did a cross-sectional study of 23 inmates from a geriatric facility in a Texas prison (mean age 69 years) and 51 inmates in the general population of that same facility. A questionnaire given in an interview setting included 160 questions related to demographic/criminal matters, health-related lifestyle, mental health status, perceived health status, and attitudes toward living in their assigned area of prison. The inmates were chosen in a convenience/snowball manner, but the general population inmates selected were only those over the age of 50. While most of both groups rated their pre-incarceration health as good or better, 46% of the geriatric group and 44% of the general population group reported declining health over a five-year time span. The authors did not control for time incarcerated, so it is unclear if the change in health is affected by the amount of time one spends in a prison.

This is important because the incarceration is the exposure theorized to cause the effect, and more time incarcerated should increase the aging process.

Colsher, Wallace, Loeffelholz, and Sales (14) surveyed inmates in 1989 about their health status. Their study consisted of 119 inmates over 50 years old, in Iowa, spread over seven facilities. There were too few female respondees to tabulate, so they were dropped, and the study ended up as an all-male sample. The article includes a one-page summary of percentage of inmates reporting various medical or mental health conditions. A history of hypertension was reported by 39.7% of respondees, and diabetes was reported by 11.2%. This prevalence is similar to two studies that will be considered shortly. Notably, 65% said their health was excellent or good. Asked if their self-perceived health was better or worse since incarceration, 5.4% report "better" and 47% reported "worse". The authors noted that some of the responses seemed anomalous, such as the 61% who reported chest pain, but less than 8% had a history of angina.

Two studies, Binswanger, Krueger, and Steiner (25), and Wilper, Woolhandler, Boyde, Lasser, McCormick, et al (26) compared chronic conditions among inmates versus the general community population. They used the 2004 Survey of Inmates in State and Federal Correctional Facilities (SISFCF) and the 2002 Survey of Inmates in Local Jails (SILJ) for a select list of chronic conditions. This would have been an excellent opportunity to compare their findings, particularly since both studies used the same data and were published in the same year. Unfortunately, they used such different methods that one cannot make any meaningful comparison of their findings.

Binswanger et al (25) is one of the most cited of all articles on corrections and aging. Odds ratios (OR) were produced for an inmate to have a given diagnosis of chronic medical

conditions compared to someone in the community. Data on the community sample came from the 2002-4 National Health Interview Study (NHIS). Their results included a table comparing jail, prison, and non-institutionalized groups, broken down by age groups (18-33, 34-49, 50-65). Three models controlled for different variables including age, sex, race, education, U.S. as birthplace, marital status, work, and alcohol consumption. They found higher odds of hypertension and diabetes for both prison and jail inmates compared to community dwellers (Table 2). The medical condition in which there was the greatest difference was hepatitis, with an OR of 3.26 (95% CI 2.82 to 3.77) in the full model. No theoretical reason was provided on why there may be these differences between those incarcerated and those not incarcerated.

Wilper, et al (26) did an analysis similar to that of the previous study, to compare the prevalence of chronic conditions among inmates versus community dwellers. They used the same databases for inmates, and included mental illness, which Binswanger's study did not include. Another difference was that the results were presented as prevalence rates. It would be possible to convert percentages to ORs, but the results were presented in a manner that makes that impossible. Federal, state and jail inmates were listed separately, and the only control variable is age. The Wilper study concluded that prisoners have worse health overall as indicated by higher prevalence rates of the chronic medical conditions (Table 3).

Comparison of the studies are further hampered because the Binswanger study used the 2002-4 National Health Interview Studies (NHIS), and Wilder used the 2003-4 National Health and Nutrition Examination Survey (NHANES). Binswanger included comparisons for hepatitis, but Wilper did not, ostensibly because NHANES did not include hepatitis. Binswanger noted that inmates had higher odds of chronic conditions compared to the non-institutionalized with the exception of diabetes, angina or myocardial infarction, or obesity. Wilper, however, showed

higher rates of diabetes among inmates. Prior myocardial infarction rates were not uniformly higher among inmates, and no information was provided on angina or obesity.

Fazel, Hope, O'Donnel, Piper and Jacoby (27) compared the health of older (age > 60) male inmates compared to the general population and to younger inmates. They sought any prison with more than 10 men over 60 years of age. Only 15 prisons out of 90 penal institutions qualified. The team then surveyed 203 men who were greater than 60 years old. Notably, the 30 men that refused to participate had the same age (65.6 versus 65.5), but had been incarcerated 59 months compared to 16 months for those that did participate. The researchers compared the survey results done in 1999/2000, with another survey, done by other researchers, of prisoners aged 18-49 done in 1994 (28), and an English survey of community-dwelling men aged 65-74 done in 1996 (29). Thus, Fazel et al are comparing data from three different studies by different researchers. They note "there seems to be important differences between the health problems of this sample and those of younger prisoners and elderly people at home reported in other studies", but did not cite what those studies were. Their methods do not allow for easy comparison with the other studies just mentioned here, but there are some rough analogies. According to the medical notes of inmates and self-reported information from community dwellers, cardiovascular problems were reported by 36% of old prisoners, 3% of young prisoners, and 29% of community dwellers. Endocrine problems were reported by 9% of old prisoners, 2% of young prisoners, and 9% of community dwellers. Self-reported general health as being good or very good was reported by 36% of old prisoners, 61% of young prisoners, and 62% of community dwellers.

Massoglia (30) was one of the few studies that had an explicit theoretical basis for why there might be an accelerated aging process. Using Perlin's (31) work on stress, Massoglia

noted there are health effects to stress that can be measured. Incarceration by itself is not causing accelerated aging, he argues, but the stress of life in prison. Pearlin's work on stress differentiates between primary and secondary stressors. In this example, the primary stressor is incarceration, and the secondary stressor is the stigma of having a history of incarceration which makes life after release more difficult. No biological mechanism is provided by Perlin or Massoglia connecting stress with physiological outcomes. Massoglia treats this stress as axiomatic. That life in prison is stressful was based on two citations, both anecdotal. For example, one of the citations was Jack Henry Abbott's personal account of prison life, *In the belly of the beast* (32).

Massoglia compared the prevalence of health conditions associated with stress against those that are not associated with stress. Data came from the National Longitudinal Survey of Youth (NLSY), which began in 1979 with approximately 12,000 participants and the study remains ongoing. The data set included 20 different health related outcomes. The "Health 40) questionnaire began in 1998, given to those who reached the age of 40. This survey in 1998 was done by 5,556 out of 8,000 remaining respondents. Logistic regression was done comparing those with a history of incarceration with those that do not. Those with a history of incarceration had higher prevalence of those conditions affected by stress, including nervous/psychological problems, hypertension, heart problems, and chronic lung problems. Conditions considered by the author as not related to stress (arthritis, cancer, diabetes) were not statistically significant.

Loeb, Steffensmeier and Lawrence (33) was another study that used an explicit theoretical basis connecting incarceration to health outcomes. They compared incarcerated and community dwelling men. Their null hypothesis was that "older male inmates will report less self-efficacy for health management, engage in fewer help-promotion behaviors, attend fewer

health programs, and have poorer self-rated health". This study was based on Bandura's (33) social cognition theory, in which people are posited to recognize their behavior leading to certain outcomes, and that in turn affects how they behave afterwards. Specifically, this study posits that inmates' behaviors are a result of their prior experiences, both in prison and in the community. They interviewed 51 incarcerated men at a low security level Pennsylvania prison, and 33 men aged 50 and older from three senior centers. Average age of the inmates was aged 57, and for community dwellers 72. Barriers as conceptualized by Bandura were operationalized by questions in the Older Men's Health Program and Screening Inventory, and benefits of health-promoting behaviors were operationalized by questions on anticipated health benefits in the Health Promotion Activities of Older Adults Measure.

Loeb found inmates reported less participation in health-promoting behaviors ($p < .01$) and attended fewer programs ($p < .05$) than community dwellers. Self-reported health status and self-efficacy was the same among the two groups. In seeking what barriers may exist that would prevent these individuals from receiving care, they found the inmates mostly "didn't know that any programs or screenings were available" (programs and screening were, in fact, available at that prison), but among community dwellers the major barrier to care was "lack of interest".

Wangmo, Meyer, Bretschneider, Handtke, Kressig, et al (35) compared the effect of age versus time in prison. The study was done in Swiss prisons, and the inmates were divided into those greater than 50 years old and less than 50 years old. There are 109 prisons in Switzerland, and 26 met inclusion criteria of having long term inmates (i.e., greater than 1.5 years), at least 20 places (i.e., beds or cells), and had older (defined as greater than 50 years old) inmates at the time of the research. Exclusion criteria were detention/remand facilities, juvenile facilities, and deportation centers. Of 26 prisons approached, 15 consented to participate. The combined

sample included 380 men in 15 different prison. Of the young inmates, average age was 34 and they had been incarcerated an average of 2.5 years. Of the old inmates, the average age was 59 years and they had been incarcerated an average of 5.2 years. There are different language areas in Switzerland, so the language mix of different facilities was noted but not apparently controlled for. Further complicating the situation was the fact that 70% of the inmates were non-Swiss. Their dependent variable was the total number of somatic diseases reported on medical records.

The researchers found a disease burden in which old inmates had 4.27 diagnoses (range 0-19), and younger inmates had 1.62 (range 0-9). The disease burden relative to time spent incarcerated was assessed by looking at the number of diagnosed chronic medical conditions as a factor of time. Among the old prisoners, there was a curvilinear relationship, in which the disease burden increased most during first year in prison, then remained relatively constant. The researchers interpreted the data to suggest the disease burden was more strongly associated with age and not with time incarcerated. If incarceration were causing the increased disease burden, one would expect a more linear relationship, in which more time consistently causes more disease. Wangmo identified a relationship in which a prisoner tends to get new diagnoses at the onset of incarceration, and less afterwards. This is because prisoners are given medical screenings upon arrival, and thus learn of their health status. Changes in their health come slowly over the ensuing years, with less new diagnoses.

Kratcoski and Babb (36) studied the effect of institutional structure and gender on "institutional adjustment in the areas of educational, recreational, and security needs, physical and mental health, and social relations" (p. 266). The study took place in eight federal prisons (3 in Florida, 3 in Ohio, 1 in Pennsylvania) and included 20% women. Age range was from 50 to

84 with a mean of 57.9. The sample was divided into four groups: programmed for older men, minimum security/camp men, medium/max security men, and medium/max security/women. Health outcome variables included two questions: self-reported health (excellent, good, poor/terrible), and most persistent health problem (substance abuse/overeating/no exercise, worry/depression, combination physical/psychological/other). In a table of self-reported health (Excellent, good, poor/terrible) among the four groups, "a significantly larger proportion of the older female inmates than the older male inmates claimed their health was poor or terrible…regardless of institutional structure" ($p < .001$). As for most persistent health problem, "almost half of the women and more than two-fifths of the men" denied any persistent health problem. The men housed in the facility for older inmates has more complaints than any other group. The researchers noted, "substance abuse, overeating, worry, depression, heart, respiratory, and degenerative illnesses were quite common". They conclude that most of the adjustment comes from the institutional structure (i.e., level of security) rather than gender. This study is important and relevant to this review because it was one of the few studies that included factors of incarceration such as level of control (i.e., security level). If incarceration is affecting aging, variance in the prison environment should affect health outcomes, including aging.

Yu, Sung, Mellow, and Koenigsmann (37) studied the self-perceived health status of inmates that were about to parole. Their sample consisted of 136 maximum security prisoners in northeastern U.S., interviewed from 2011 to 2012, who were expected to parole within 30 days. Health was operationalized based on Hammett et al (38) as: health in general, physical pain, and emotional problems. In the survey, developed by the researchers, inmates were asked about their life prior to incarceration. The inmates ranged in age from 20 to 59, with a mean of 32.5, and the results were not broken down the by age groups. We therefore do not know how these

self-reports vary with age. The picture is one of widespread difficulties, in which 54% reported significant medical problems, 50% reported excellent general health, 20% reported poor health, and 18% using hard illicit substances at least weekly. However, this study is noteworthy for finding self-reported improvements in health, in which 55% reported improved health while incarcerated and 10% said worse health, 31% reported lower pain while incarcerated, 17% reported worse pain, and 32% reported fewer emotional problems while incarcerated while 28% reported worse emotional problems. Their study is important because it found self-perceived health improvements, and has been cited in other studies as an example of how the effects of prison on health defies simple generalizations.

Harzke, Baillargeon, Pruitt, Pulvino, Paar, et al (39) surveyed the prevalence of chronic conditions in Texas prisons and compared those rates with the U.S. general public. This was one of the largest of all the studies, including all those incarcerated in the Texas state prison system from 2006 to 2007 (n = 234,031). Inmate healthcare was provided by the University of Texas medical system, including management of the electronic medical records. Prevalence rates were compared with U.S. general population using NHANES and NHIS data.

Compared to the U.S. general population, inmates had similar prevalence of hypertension and diabetes, slightly less asthma, and much less heart disease, COPD, and cerebrovascular disease, controlling for age. The main exception was that prevalence of diabetes, adjusting for race/ethnicity, was highest among Hispanics in the study population when the general public has a higher prevalence in African Americans. The researchers offered as possible explanations for the different prevalence rates of these two groups: a. inmates are naturally healthier, or resulting from less risk factors such as smoking; b. Detection bias because

inmates tend to be younger and have shorter stays in prison; c. Lower rates of inmate self-reporting of symptoms, which may be due to mistrust of the system.

Their findings conflict with the Wilper and Binswanger reports, which found higher prevalence of hypertension, ischemic heart disease, asthma, and diabetes. The difference cannot be attributed to the data on the public because both used same sources (NHANES and NHIS). There may be difference in the inmates of Texas versus the rest of the nation. Another possible explanation is the difference of inmate self-report versus clinical assessment.

Lindquist & Lindquist (40) surveyed jail inmates on their health status, although they did not compare it to any other population. Whereas the other studies discussed here use a comparison, this work is still important because it was one of the few that focused on jails and not prisons. Jail inmates are incarcerated for shorter periods that prison inmates. Therefore, the data may illuminate factors about the health status of those with shorter periods of incarceration. The sample included 198 males and females in a large county jail in a medium sized southern U.S. city. The survey included 10% of males but 100% of the females (because there were so few females), resulting in 95 males and 103 females. The length of incarceration ranged from less than a week to 2.5 years, with a median of nine weeks. The researchers noted that data on jail inmates were skewed because these individuals were the ones that could not afford bail. The Physical Symptoms Checklist by Anderson & Anderson (41), consisting of 20 common physical complaints was used to assess health status, which ranged from 0 (poor) to 3 (excellent). Inmates were asked about their health care utilization and perceived access. Accessibility and quality of care were both measured in a scale from 0 to 3.

Lindquist found that the longer the time incarcerated, the greater the number of health problems. Inmates with longer incarceration may either be more aware of their health status, or

"attempted to highlight or exaggerate health problems" (p. 300). Utilization is a function of length of incarceration with 80% of the sample showing less than six visits, and the remaining 20% had from six visits to as much as 84 visits. They therefore capped the number of visits at 10, and logged the duration of incarceration. The researchers suggest that lack of programming may lead to abuse of healthcare to relieve monotony, referred to as "latent" benefits of healthcare. Overall, the study showed the health status of inmates appear constant across time, and that it may be factors prior to prison that matter more in explaining an inmate's health status.

Lindquist's findings of increased health problems as a function of time is different from Wongmo's study, but that can easily be explained. Inmates in the Lindquist study had a median stay of only nine weeks, whereas Wangmo's inmates were in a prison, and thus the average length of incarceration is far greater. We do not know the length of incarceration in the Wangmo study, but prisons typically do not take someone unless they have at least a year of their sentence left. The entire period of the Lindquist study is that time when inmates are getting screened and they are learning of their health status. Also, the "health problems" described by Lindquist are often not chronic medical conditions, and thus not new diagnoses.

Patterson (42) studied the effect of time incarcerated on post-release mortality. After the seminal article by Binswanger et al (43) which found a death rate up to twelve times greater for the ex-incarcerated compared to the general public, there has been significant attention paid to the health effects of incarceration especially immediately after release. In our case, we are interested in what this may contribute to our understanding of the aging process. Patterson's study focused on how the amount of time served affects post-release mortality. If incarceration does age a person at a greater rate than the general population, we should see not only higher

morbidity and mortality while incarcerated, but also after release. Binswanger attributed the increased post-release mortality to drug overdose. This is a specific event that is directly attributable to the change in life circumstances. By contrast, we are interested in whether the effects of incarceration, such as stress or lack of access to healthcare, can affect one's post-release mortality. There is a difference in that post-release health status may tell us something of a person's resilience or change when no longer incarcerated, or lack of resources in the communities that were available while incarcerated. Data was taken from the New York State parole administration, in which a total sample size of 111,509 individuals paroled between 1989 and 2003. The study only included those who served less than 10 years. Note that the paroles occurred between 1989 and 2003, and his study was conducted in 2013, so he had between 10 and 14 years to follow these parolees. Survival analysis and maximum likelihood estimation was used to identify the mortality risk of each parolee for each month on parole. Results indicate each year incarcerated equates to a 15.6% increase in the odds of death, for an overall reduced life expectancy of two years. He found those who survive parole return to a normal pre-prison mortality curve.

The average age of parole was 30.9, so these are not older adults. However, if incarceration ages a person, nothing at this point indicates that the aging process should only begin at any particular point in life. The dynamics of the accelerated aging may be identifiable even in this population. The fact that there was only a period of accelerated mortality suggests that the effect is something other than aging. If it were aging that increased the mortality rate, we should see that effect continue for the rest of the lifetime.

Discussion

This review encompassed three review articles/chapters and thirteen articles that help answer the question on whether a person ages faster while incarcerated than a comparable person living in the community. Multiple sources have posited that this phenomenon of accelerated aging exists, and it has been treated as an assumption in multiple other published sources. This research program has resulted in the articles discussed here, which are scant given the significance of correctional healthcare in this country. None of the studies explicitly sought to answer the fundamental question of whether or how a person might age faster while incarcerated. What they did contribute was evidence that may lead us to a better understanding of the phenomenon and possibly an answer to the question. Two major themes are found in these articles. One theme was the inconsistent findings in which some studies found detrimental effect of incarceration on inmates' health, exemplified by Fazel et al (27), whereas other findings suggest that incarceration does not affect the inmates' health, or that it may help them. This line of reasoning is exemplified by Yu et al (37), in which 55% of inmates self-reported improved health and 31% reported lower pain.

The second theme was the lack of an explicit theoretical basis to explain the relationship between incarceration and health. One clear presentation of a causal connection was by Massoglia (30), who tested the hypothesis that stress-related illnesses would be more common among inmates than the general population, and that illnesses that are not stress-related should have no difference. The other article that proposed a causal connection was Loeb et al (33), claiming that a sense of self efficacy leads one to seek medical care, and barriers to care in the prison environment discourages this drive.

Although aging is the central concept to this entire research program, none of the articles explicitly addressed the issue of what aging means and how it is measured. The standard was to simply use chronic medical conditions as a representative of the aging process. Even this conceptualization lead to diverse interpretations, and no two studies used the same variables. This finding is consistent with an expert panel that recognized a need for an evidence-based and consistent definition of "older prisoner" (44). In Table 4 we see the different variables used by various researchers, and in Table 5 we see the different patterns of evidence.

Substance abuse has been shown to be one of the most important causes of deteriorating health, particularly among inmates and those with a history of incarceration (45). It has already been noted that one of the greatest challenges in studying the association of health outcomes of incarceration and health is to identify a population that shares the same essential characteristics of those incarcerated and yet has no history of incarceration (46). One of the most important confounding variables in any such study would be substance use. However, none of the studies identified in this review controlled for substance use or abuse. Further complicating the matter are the sequelae of substance use, such as blood borne infections, which further affect health outcomes. Again, none of the studies explicitly controlled for this variable.

These studies spanned from 1992 to 2015, and there was no temporal concentration in which multiple researchers were looking at the same problem at the same time. The closest to this was Binswanger et al (25) and Wilper et al (26), in which both were using the same national data set for inmates, but different national data sets for the general public. A research program on a given phenomenon may assume the causal forces and its effects on the subject of interest are essentially the same over time. If the subject of the study is varying over time, researchers may be looking at something different and thus their conclusions are only generalizable for that

point in time. As Bronfenbrenner notes, there are cohort, generational and historical effects on any ongoing process (47). In the case of aging while incarcerated, there have been important developments in the conditions in prisons in the past few decades that may affect this matter (48).

Authors differed on whether they believed the length of time incarcerated mattered. Massoglia (30) states that any contact with incarceration is significant, and the length of time incarcerated makes no difference to health outcomes. The stress which was causal mechanism between incarceration and certain health outcomes was described as a major change in adjustment in a short period of time. Since time is a factor in this case, there seems to be an inherent contradiction. Patterson (42) showed an increase in mortality post-release based on the amount of time incarcerated. This study did not discuss its different view on the issue, but it seems that it would differ from Massoglia on the importance of time incarcerated.

Whereas a well-established research program will have gaps that may be pursued for future study, the question of aging while incarcerated is still new enough and underdeveloped that there are more gaps than studies. There is thus a diverse range of opportunities for future study. What is clear based on the research question is that an answer may ideally be found from a longitudinal study comparing inmates and community dwellers on their health status, with an emphasis on those aspects of one's health that may be affected by incarceration. There are a few challenges to this project which may be why it has not yet been done. First, the project would need to be quite large and expensive. An appropriate sample size would be large to capture the numerous variables of demographics and diverse health outcomes. The time line would need to be long enough to capture an aging process, and this is obviously quote long. Because inmates

often cycle in and out of incarceration, the sample size would need to be long enough to control for this variable.

Another research opportunity would be to develop the theory of aging and incarceration. There has been essentially nothing published on this. A clearer understanding of why we think there might be a connection would help direct the above longitudinal study. It would also help break the problem down into manageable parts that could be studied in lieu of or while waiting for the ideal study. For example, many of the studies were based on inmates' self-reports of health. It may help to know how accurate is the connection between one's self-reported health and one's actual health as documented in medical records.

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Table 1: Articles reviewed

Author, Year	Comparison	DV	Population	Main Points
Binswanger, Krueger, & Steiner, 2009.	U.S. inmates vs public	Prevalence of chronic conditions.	U.S. nationwide	Inmates have overall greater prevalence of chronic medical problems.
Colsher, Wallace, Loeffelholz, & Sales, 1992.	Older male prisoners	All health/psych outcomes.	Iowa old inmates	65% reported health was excellent or good, yet 47% reported health declined while incarcerated.
Fazel, Hope, O'Donnell, Piper, & Jacoby, 2001.	Older male prisoners vs younger male prisoners	All health/psych outcomes.	England and Wales: old inmates vs public	83% reported chronic illness or disability, 36% reported health as good or very good.
Harzke, Bailargeon, Pruitt, Pulvion, Paar, & Kelley, 2010.	Prisoners vs public	Common medical diagnoses.	Texas state prisons	Controlling for age, no difference between inmates and the public.
Kratcoski & Babb, 1990.	Institutional level and gender	Self-reported health, most persistent complaint.	U.S. federal prisons	Adjustment problems from institutional level, not gender.
Lindqust & Lindquist, 1999.	Jailees	Physical health status, utilization of medical care, healthcare quality/accessibility.	Male and female in a U.S. jail	Age and gender greatest predictor of health status and utilization. Longer incarceration predicts more self-reported health problems.
Loeb, Steffensmeier, & Lawrence, 2008.	Old male inmates : old male public	Self-efficacy for health management, health-promotion behaviors, self-report health status.	Pennsylvania: inmates vs public	Same self-reported health status. Same health but different age suggests prison ages them faster.
Marquart, Merianos, & Doucet, 2000.	Old male inmates vs young male inmates	Self-reported health change over past 5 years.	Texas state prisons	Almost half of both groups reported health declines

Table 1: Articles reviewed, continued.

Author, Year	Comparison	DV	Population	Main Points
Massoglia, 2008	NLSY with/without Hx of incarceration	Infections, Stress-related illnesses.	NLSY cohort	Those with Hx of incarceration had more medical conditions.
Patterson, 2013.	Length of incarceration	Mortality after release.	New York parolees	Each year in prison = 1.5% increased odds of death, so 2-year decline in life expectancy.
Wangmo, Meyer, Bretschneider, Handtke et al., 2015	Old inmates vs young inmates	Diagnoses in medical records.	Swiss inmates	Old had 4.27 diagnoses (range 0-19). Young had 1.62 diagnoses (range 0-9). Most new diagnoses in first year of incarceration, then leveled off.
Wilper, Woolhandler, Boyd, Lasser, McCormick, Bor, & Himmelstein, 2009.	Inmates : U.S. public	Prevalence of chronic conditions.	U.S. nationwide	Inmates have overall greater prevalance of chronic medical problems.
Yu, Sung, Mellow, & Koenisgmann, 2015.	Health: current vs beginning of incarceration	Self-reported perceived health status.	One U.S. prison	Poor health at intake predicts health improvements while incarcerated, independent of sociodemographics.

Table 2: Odds ratios of diagnoses (Binswanger, Krueger, and Steiner, 2009)*

Hypertension: OR_{jail} 1.19; 95% CI 10.08 to 1.31.
Hypertension: OR_{prison} 1.17; 95% CI 1.09 to 1.27.
Diabetes: OR_{jail} 1.06; 95% CI 0.89 to 1.28.
Diabetes: OR_{prison} 1.12; 95% CI 0.98 to 1.26.

* Controlling for age, sex, race, education, U.S. as birthplace, marital status, work, and alcohol consumption.

Table 3: Prevalence of diagnoses (Wilper, Woolhandler, Boyd, McCormick, et al, 2009)

Hypertension: Federal inmate 29.5% (SE 2.9).
Hypertension: State inmates 30.8% (SE 1.5).
Hypertension: Jail inmates 27.9% (SE 2.1).
Hypertension: US population 25.6% (SE 1.0)
Diabetes: Federal inmates 11.1% (SE 3.6).
Diabetes: State inmates 10.1% (SE 2.0).
Diabetes: Jail inmates 8.1% (SE 1.7).
Diabetes: US population 6.5% (SE 0.5).

Table 4: Variables and Data Sources

Health behaviors	(Loeb, Steffensmeir, & Lawrence)
Mortality post-release	(Patterson)
Chronic conditions	(Binswanger et al; Fazel, Hope et al; Loeb, Massoglia; Steffensmeier & Lawrence; Harzke, Baillergeon et al.; Wangmo, Meyer, et al.; Wilper, Woolhandler, et al.)
Self-reported health status	(Colsher, Wallace, et al; Loeb, Steffensmeier, & Lawrence; Lindquist & Lindquist; Marquart, Marianot, et al; Yu, Sung, et al.)

Table 5: Patterns of Evidence

Older inmates: young inmates. The health status of old inmates was compared with the health status of young inmates. (Fazel Baillergon; Harzke Baillergeon).
Older inmates: old public. The health status of old inmates was compared with the health status of old members of the community. (Loeb Steffensmeier)
Inmates: public. Adult inmates of all ages where compared with adult members of the community of all ages. (Binswanger Krueger; Wilper).
Older inmates: time vs age. The health status of old men was regressed on time served versus age. (Wangmo).
Inmate mortality by time served. The mortality rates of inmates were regressed on time served and time since incarceration (Patterson).

Incarceration and frailty

Douglas Long

ABSTRACT

Anecdotal reports suggested inmates appear to be older, which may be associated with stressors in prison or substance abuse, but the relationship between a history of incarceration and premature aging has not been well elucidated. This cross-sectional study investigated the relationship between having a history of incarceration and a marker of aging. To minimize potential confounding, we restricted analysis to a sample of injection drug users. Phenotypes for aging are limited and we settled on frailty as an objective, validated measure. Among 1,528 participants in an ongoing cohort study where frailty was assessed, 77% had a history of incarceration. A history of incarceration was not associated with frailty among injection drug users, even after controlling for age, gender, HIV, or education. These data suggest that other factors in addition to prior incarceration and substance use may be associated with frailty after incarceration.

Introduction

The United States has been experienced a drastic increase over the past few decades in the number of incarcerated individuals, and particularly the number of older adults in prison (1). The disease burden and health status of those incarcerated has been shown to be worse than the general population (2). It has been posited that inmates have worse health outcomes and age faster than those without any history of incarceration. It has been argued that incarceration causes an increase in the aging process (3), or that individuals with predisposing behaviors or conditions are more likely to become incarcerated.

A literature review found studies describing 'frailty' in terms of disability, impaired activities of daily living (ADL), or vulnerable to adverse health events (4). Multiple studies have described frailty as preceding disability (5). The Frailty Phenotype was developed around 2001 in which frailty was conceptualized as a cluster of issues such as reduced energy and less muscle mass, leading to reduced reserves to handle stressors, leading to a cycle of further risk of decompensation (6). The effects of incarceration may be detected while in jail or prison, and may follow a person after release. Comparing the frailty status of those with a history of incarceration with those without a history of incarceration may help us understand this relationship.

Multiple theories have been put forward to explain the relationship between incarceration and health outcomes. One is that the poor medical care and the stress of incarceration leads to worsened health outcomes of prisoners. This suggests a linear and cumulative relationship in which the more time incarcerated, the worse one's health. By contrast, Massoglia argues that any contact with incarceration is significant due to the stigma of having incarceration on one's record and the stress of life in jail (7). Binswanger argued that the

reentry into the community is important because lack of coordination in one's health care and daily routine endangers one's health (8).

A major challenge for any study of the effects of incarceration on inmate health is to find a similar group of individuals that is comparable in most aspects except for not having a history of incarceration. This study evaluated a population that is engaged in injection drug use, which presents a high risk for incarceration, and thus shares many of the attributes of an incarcerated population.

Methods

The AIDS Linked to the IntraVenous Experience (ALIVE) cohort was established in 1988-89 and is still ongoing (9). Participants consisted of injection drug users (IDU) aged 18 or older presenting to a community clinic in Baltimore who completed semiannual visits. The primary goal of ALIVE is to study the epidemiology and life cycle of HIV infection and its progression to AIDS. Participants also provided a broad range of information about their lifestyle, drug use, and socio-economic factors.

Data Collection

ALIVE participants completed an audio-computer assisted interview at the initial visit and, if they met the program's criteria, were invited to return for semiannual follow-ups which included clinical tests such as biological specimen collection. Questions included demographics and socio-economic factors, substance use, sexual history, and incarcerations in the previous six months. Those who had tested negative for HIV in the past were assayed by enzyme-linked immunosorbent assay, with Western blot confirmation. A separate cohort of HIV negative participants was included in ALIVE as a control group.

Because of the introduction of highly active antiretroviral therapy (HAART) in 1996 which significantly reduced HIV related deaths (10), we divided the data set into those enrolled Pre-HAART and HAART eras, respectively. The Pre-HAART group consisted of the original participants recruited in 1988-89. The HAART era cohort consists of those participants who were recruited after 1996. The variable of incarceration was posed differently by period. In the Pre-HAART cohort, the question was posed as "prison or jail in the past 10 years". In the HAART era, the baseline enrollment visit questionnaire ascertained incarceration history as "ever been incarcerated" and included more detailed questions about the number of incarcerations and the total amount of time incarcerated. Analyses were performed only on those participants who answered the question on history of incarceration.

Frailty and Incarceration

Frailty tests included the five Fried criteria: slow gait, decreased grip strength (weakness), poor endurance (exhaustion), low physical activity, and physical shrinking (weight loss) (6). The physical activity domain was assessed by the self-reported response to a standardized question on the difficulty of walking various distances (11). This was used in lieu of Fried's Minnesota Activity assessment of kilocalorie expenditure. Physical shrinking was defined as measured weight loss of ≥5% body weight from the prior visit. Frailty parameters were treated as binary variables (0,1), so a sum of 0 is not frail, 1 or 2 is considered prefrail, and 3 or greater is frail. The reliability and validity of the Fried criteria has been assessed for reliability and validity, in which it was compared to other measurement instruments of frailty, and was shown to be the only tool that covers all the frailty factors (12).

Incarceration may include jail or prison, in which the person may be confined for as little as a few hours or the rest of one's life. ALIVE collected incarceration history over the participant's lifetime at the initial visit, and updated with each return visit.

Statistical Analysis

Cross-sectional analysis was performed from the data on all active participants as of May, 2017, comprising 1,528 individuals. Age was included as a continuous variable. Race was dichotomized as either "black" or "other" given the preponderance of African Americans in the cohort. Incarceration history included variables on short stays (7 to 30 days) and longer stays (≥31days), which were combined for total time incarcerated. Jail time of less than 7 days were not included because many dynamics of incarceration, such as the provision of health services and the effects of long stays, may not be present in short jail stays.

Logistic regression and descriptive statistics were analyzed using SPSS (13). Approval of the study protocols and consents was obtained from John Hopkins Institutional Review Board and the University of California, San Francisco IRB.

Results

Of the 1,528 ALIVE participants, 549 were in the Pre-HAART cohort, and 657 were in the HAART era cohort. For all ALIVE participants, Table 1 shows the demographics based on whether they answered the question on how many times they were incarcerated, which could be zero or more incarcerations. The age of the two groups were similar, with the median age of those ever incarcerated 51 years, and those never incarcerated 52 years old ($p = .004$). Of the males, 72.9% reported a history of incarceration, and of the females, 27.1% reported a history of incarceration ($p < .001$, $X^2 = 42.88$). Of the African Americans, 88.1% reported a history of incarceration ($p = .086$, $X^2 = 2.95$). Of those with less than high school education, 8.1% reported

a history of incarceration (p = .488, X^2 = 4.66). Of those not married, 93.4% reported a history of incarceration (p = .076, X^2 3.15). Of those that reported a period of homelessness in the previous six months, 10.1% reported a history of incarceration (p = .031, X^2 = 4.66). Finally, of those reporting injection drug use in the previous six months, 30.2% claimed to have a history of incarceration (p = .027, X^2 4.89).

Using binomial logistic regression, the relationship between incarceration and frailty (not frail, frail) was tested for both cohorts, controlling for age, gender, and education. As Table 2 and 3 shows, for the Pre-HAART cohort and HAART era cohort, respectively, none of the variables were significant. Comparing the two cohorts, the association between HIVseropositive status and frailty were not statistically significant in either cohort, but there was far less of an association in the HAART era cohort. The association between incarceration and frailty were also much less in the HAART era cohort compared to the Pre-HAART era cohort.

The only variable that came close to statistical significance was age, and only in the HAART era cohort (p < 0.055, 95% CI 0.999-1.054). Frailty was designed as a marker of aging, so it should be closely correlated with age (6). As Table 4 shows, the ALIVE cohort (both eras combined) did not show any such relationship using the three-tier approach (non-frail, pre-frail, frail). The mean age of each of the three frailty groups were within a few months of each other, and did not have a linear relationship. Those in the group who were not frail had a mean age of 52 (range 27 to 72), prefrail had a mean age of 51 (range 20 to 75), and the frail group had a mean age of 53 (range 23 to 80).

Discussion

This study examined the association between incarceration and frailty, using both a two-tiered and three-tiered measure. We found no association of frailty with a history of incarceration, whether it be any incarceration or total number of incarcerations.

Limitations of the study were identified that prevented a better understanding of the relationship between incarceration and health outcomes. Massoglia argued that any contact with incarceration has a detrimental effect on one's health (7). We did not have records of jail stays less than a week. If stigma was what drives the negative health effects of incarceration, it may be helpful to see if that relationship holds true in a population already stigmatized for injection drug use, race, and the socio-economic factors. There was the possibility that health care while incarcerated was poor, but that was not easily identified in this data. However, the roughly equal health status of those with more time incarcerated does not support this hypothesis. Six-month follow-up visits were not possible if the participant was incarcerated at that time, so we could not see if their health status while under current incarceration was different from when they were in the community. There may be a systemic bias toward collecting data for shorter periods of incarceration, because those with long periods of incarceration would be more likely to miss the six-month follow-ups.

Binswanger noted the period immediately after release from jail has significantly higher risks of mortality (2). Everyone in this cohort that had any incarcerations survived those periods. For those ALIVE participants that died prior to 2005, we did not examine their cause of death because our focus was on long term effects. We thus had a survival effect in which over half of those included in this data set where the ones that survived often multiple incarcerations. There may be a systemic bias in which those with longer incarcerations had fewer reentry

periods, and thus those participants with shorter incarcerations and more reentry periods were at greater risk of increased mortality.

The “healthy prisoner hypothesis” suggests that one needs to be healthy enough to commit crimes resulting in incarceration. There may have been a selection effect in which those with a history of incarceration were initially healthier than others that may also have committed crimes. The healthy prisoner hypothesis was not supported in the study by Bacak and Wildeman, in which they found future inmates were no healthier than matched cases that did not become incarcerated (14). In contrast, the healthcare received while incarcerated may reduce morbidity and mortality compared to those never incarcerated who had poor access and utilization of health care. This study, being cross-sectional, did not address cause and effect or predictors of frailty over time.

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Table 1. Characteristics of ALIVE Participants, by incarceration status.[a].

	Never incarcerated (n = 645)	Ever incarcerated (n = 883)	
	mean, SD	mean, SD	
Age, median (range)[y]	52 (21, 81)	51 (21, 75)	
	%	%	p value
Male	56.7	72.9	< .001
Female	43.3	27.1	< .001
African American	85.0	88.1	.086
Less than high school education	7.0	8.1	.488
Not married	90.9	93.4	.076
Homeless	6.8	10.1	.031
Recent injection drug use[b]	25.0	30.2	.027

y – years
ALIVE – AIDS Linked to the Intravenous Experience
CI – confidence interval
SD – standard deviation
[a] Data are no. (%) of participants, unless otherwise indicated.
[b] Within the previous 6 months.

Table 2. Binomial logistic regression and 95% CI of frailty by variables identified at enrollment among drug users in the cohort enrolled in the Pre-HAART era, Baltimore, Maryland, 1988-1996.

		95% CI	
Variable	Odds Ratio	Lower	Upper
Age	1.02	0.99	1.06
Gender	1.39	0.84	2.30
HIV	1.27	0.80	2.03
Education	1.03	0.81	1.30
Incarceration	.71	0.46	1.14

CI – confidence interval

Table 3. Binomial logistic regression and 95% CI of frailty by variables identified at enrollment among drug users in one cohort (HAART era), Baltimore, Maryland, 1996-2015.

		95% CI	
Variable	Odds Ratio	Lower	Upper
Age	1.03	0.99	1.05
Gender	1.38	0.86	2.19
HIV	0.99	0.62	1.59
Education	1.02	0.79	1.30
Incarceration	1.10	0.57	2.12

CI – confidence interval

Table 4. Average age (range) by frailty (non-frail, prefrail, frail), among ALIVE participants, Baltimore, Maryland, 1988-2015.

Frailty	Mean (years), (SD*)	Range (years)
Non-frail	48 (.19)	47, 50
Pre-frail	48 (.08)	47, 49
Frail	50 (.32)	48, 52

* Standard deviation

Association between incarceration and survival among injection drug users

Douglas Long

ABSTRACT

Whether incarceration confers excessive risk for accelerated aging or premature mortality remains an open question. Earlier studies suggested excess risk for aging and premature mortality but data were either anecdotal or using population comparisons. One of the major risk factors for persons incarcerated is a history of substance abuse which alone is associated with adverse outcomes. Thus, we chose to examine the question of incarceration and adverse outcomes among a sample restricted to drug users, to determine if there was an independent risk related to incarceration. In terms of drug use, it is well documented that the risk of mortality is highest within the first couple of weeks after release. We framed the question, does a history of incarceration have a sustained effect on accelerated aging and premature mortality after accounting for drug use. To examine this question, we used data from the AIDS Linked to the IntraVenous Experience (ALIVE) cohort, which consisted of injection drug users (IDU) presenting to a community clinic in Baltimore and followed semiannually for up to 30 years. Outcome data were collected from 2005-2013 and history of incarceration was based on self-report for when the participant was entered into the cohort study anytime between 1988 – 2005. Outcome data were frailty using Fried's criteria (operationalized according to Fried, using a three-level scale of non-frail, prefrail, and frail) that was collected from 2005 onward, and all-cause mortality collected from NDI-Plus. For statistical analysis, ALIVE participants were divided into two cohorts, those recruited before the introduction of highly active antiretroviral therapy (HAART) when HIV infection was a significant cause of premature mortality, and those recruited after the advent of HAART when the risk of death from HIV dropped significantly. For mortality by a history of incarceration a survival analysis showed no significant difference even after controlling for age, gender, and HIV status. The adjusted

relative hazard (95% CI) of mortality for those with a history of incarceration was 1.14 (0.81, 1.60) among those enrolled in the Pre-HAART era cohort and 1.19 (0.68, 2.10) for those enrolled in the HAART era cohort. Although earlier studies observed excess mortality soon after release, our data suggests that the role of past incarceration may have modest if any impact on the long term occurrence of frailty or mortality.

Introduction

In general population studies, individuals with a history of incarceration have been shown to have mortality rates in excess of their community peers (1) and a period of excess mortality has been associated with recent release from prison (2). Differences in the health status between those with a history of incarceration and those without may be attributable to deleterious physical conditions (e.g., overcrowding, physical assaults) of life in a penal institution with latent effects of stress from having been incarcerated or behaviors and conditions before or since any contact with the judicial system (e.g., drug use, HIV infection). The latter is an important consideration as incarceration may have a direct effect but also may be confounded by pre- and post-incarceration characteristics (e.g., drug abuse) that have been established as risk factors for premature mortality. To disentangle the effects of incarceration and the role of pre- and post-incarceration risk factors, restrict our sample frame to those with a current or former history of drug abuse with variables that could be potential confounders for an association of remote history of incarceration and premature mortality (e.g., race/ethnicity, income, neighborhood conditions, HIV infection, drug use). The purpose of this study was to examine the role of a history of incarceration on premature mortality among injection drug users.

Methods

Participants for this study were part of The AIDS Linked to the IntraVenous Experience (ALIVE), which has been described in detail elsewhere (3). In brief, ALIVE recruited injection drug users through community outreach, with an initial cohort beginning in 1988-89 and five subsequent recruitments until the time of this analysis.

Data Collection

Recruitment and consenting ALIVE participants underwent semiannual visits completing a standardized questionnaire, physical exam and venipuncture at baseline and subsequent visits. Interview items included demographics, socio-economic factors, substance use, sexual history, and a history of incarceration. Serum were assayed for antibody to HIV using commercial enzyme-linked immunosorbent assay with Western blot confirmation. Some items were added or modified to update information due to changes in practice such as the introduction of highly active antiretroviral therapy (HAART). Mortality was ascertained using the National Death Index-Plus (NDI-Plus) beginning in 2005 until the end of the study period, 2015.

Statistical Analysis

Because of the introduction of highly active antiretroviral therapy in 1996 which significantly reduced HIV related deaths (4), we divided the data set into those enrolled during the Pre-HAART and those enrolled in during HAART eras. The Pre-HAART cohort consisted of the original participants recruited between1988-89 and 1996 and survived until at least 2005. The HAART era cohort consisted of those participants who were recruited between 1996 and 2005. We used 2005-2015 as the period for observation as this coincided with real time data collection on frailty which is the subject of a companion paper. The variable of incarceration was posed differently by period. In the Pre-HAART cohort, the question was posed as “prison or jail in the past 10 years”. In the HAART era cohort, the baseline enrollment visit questionnaire ascertained incarceration history as “ever been incarcerated” and included more detailed questions about the number of incarcerations and the total amount of time incarcerated.

Kaplan-Meier curves of all-cause mortality by history of incarceration for each cohort were compared using the log rank test (5). Cox regression models were used to examine

mortality by history of incarceration after accounting for putative confounders and expressed as relative hazards (RH) with associated 95% confidence intervals. Assumption of proportionality was assessed. Analyses were performed using SPSS (7). Approval was obtained from the Institutional Review Boards at John Hopkins Bloomberg School of Public Health and the University of California, San Francisco.

Results

Of 1,528 participants were enrolled and eligible for these analyses, 1,206 participants had history of incarceration recorded and thus were included in analyses. The Pre-HAART era cohort included 549 participants with data on incarceration defined as "in the 10 years prior to enrollment"; the overall mortality rate from 2005-2015 was 30.0%. The HAART era cohort consisted of 657 participants with history of incarceration defined as "ever been incarcerated; the overall mortality rate from 2005-2015 was 17.3%.

As Table 1 shows, for the Pre-HAART cohort, 66% has a history of incarceration, and mortality was 28.5% for those with a history of incarceration and 33.5% for those without a history of incarceration. Median age was 56 (range 38 to 80) and 35% were HIVseropositive. Current drug users, defined as injection drug use in the previous six months, constituted 20% of the cohort. A statistically significant association was detected in the mortality rates based on HIV serostatus ($p < .001$), and current drug use ($p < .001$).

For the HAART era cohort (Table 1), 86% reported a pre-enrollment history of incarceration, and mortality among those with and without a history of incarceration was 15.9% and 18.7%, respectively. The mortality rate among those HIV serostatus positive was 21.9% and those who tested negative was 14.9%. Current injection drug users had a 20.3% mortality rate, while former drug users had a 15.6% mortality rate. Mortality rates of men and women

were similar. Statistically significant relationships were found between mortality and HIV serostatus ($p < .030$).

Univariate Analysis

Figures 1 and 2 depict time to death beginning in 2005 until the end of the data collection period in 2015, for the two cohorts, respectively. Neither demonstrated significant differences in the timing and pattern of mortality over this time period.

Multivariate Analysis

Table 2 provides the relative hazards (RH) from the Cox regression. Mortality did not differ by a history of incarceration; older age was ($p < .005$) but only within the Pre-HAART cohort. Of those that survived to 2005, age seems to be a neutral or even protective factor. Being HIV infected was a risk factor for mortality in the earlier cohort (RH = 1.85), but less so in the latter period (RH = 1.46). Current drug use was a risk factor in both eras (RH = 2.20, 2.22, respectively). Male gender was an increased risk factor in the pre-HAART era (RH= 1.25), but not in the HAART era (RH = 0.98).

Interaction effects were examined on incarceration against each other predictor variable (age, HIV, drug use, gender) one at a time. We hypothesized that continued drug use among those with a history of incarceration would have long term effects on mortality. The one significant variable that interacted with incarceration was current injection drug use in the Pre-HAART cohort only ($p < .004$),.. As Table 3 shows, in the Pre-HAART cohort, Cox regression examining the relationship between incarceration, drug use and mortality, showed the RH for current drug user and pre-enrollment incarceration was 1.79 (95% CI 1.19, 2.70), drug use and no history incarceration was 3.13 (95% CI 1.68, 5.83), no drug use and incarceration was 0.839 (95% CI: 0.51, 1.23) against a reference group of no drug use and no history of incarceration.

These data suggest that current drug use but not incarceration is the primary predictor of premature mortality.

Discussion

The major finding of this study was an overall lack of statistically significant relationship between a history of incarceration and mortality examined decades after release.. Our results differ from those reported in earlier studies which noted an increased mortality among formerly incarcerated individuals, in the period immediately after release from incarceration (8), and in one study, for a period extending years after release but using a general population sample as the reference group (1). Restricting our sample of injection drug users controlled for a well-known major risk factor for mortality. We also accounted for other factors associated with mortality including socioeconomic status, and HIV infection. This is not to say that incarceration has no effect on adverse outcomes. What this study suggests is that these other factors likely overwhelmed an effect of prior incarceration on premature mortality.

Limitations on the study included survivor bias, and censorship on both the left and right sides. Regarding survival bias, mortality immediately after release from prison has been shown to be dramatically higher. Left truncation occurred because the data on mortality begins in 2005. We did not have data about the pattern of mortality for the period of 1988 and 2005. If one considers the results among those enrolled in 1988-1989 as survivors until 2005 to start the analyses for incarceration and mortality, then the premise for inference would be that of a delayed onset of effect. If so, there is no evidence from this analysis to suggest such an effect.

Cohort effects may be occurring given the more than 25-year span of the ALIVE program, which included the introduction of HAART. The sample used in this study was entirely from the post-1996 period, which means anyone that died prior to the introduction of

HAART was not included. Another cohort effect may come from the experience of incarceration. The questionnaire did not ask where one was incarcerated, and the quality of health care and the overall health effects of incarceration may be different from one penal facility to another.

The findings of this study have implications for practice, policy, and future research. Healthcare provided to those currently incarcerated need to address the long-term risk factors such as substance abuse and not just their immediate needs. The absence of an observation for a delayed impact of incarceration among injection drug users in this study should not be interpreted to suggest that there is no effect among the majority of former inmates who entered and exited correctional facilities without a history of injection drug use. These data also add to the evidence that correctional facilities can be sites for treatment of drug abuse that may have lasting effects.

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Table 1. Mortality by frequency distribution of variables identified at enrollment among drug users in two period cohorts (Pre-HAART Era 1988-1996,; HAART Era 1996-2005), Baltimore, Maryland.

Variable	N	Dead: %	p-value
Pre-HAART	549	30.0	
Incarcerated prior to enrollment:			
Yes	358	28.5	.262
No	191	33.5	
Median Age, years (range)	56 (38,80)		
HIV serostatus:			
Positive	192	40.6	<.001
Negative	357	24.6	
Injection drug use:			
Current	110	50.0	<.001
Former	439	25.3	
Gender:			
Male	411	29.7	.704
Female	138	31.9	
HAART Era	657	17.3	
Incarcerated prior to enrollment:			
Yes	309	15.9	.396
No	348	18.7	
Median Age, years (range)	47 (20,75)		
HIV Serostatus:			
Positive	233	21.9	.030
Negative	424	14.9	
Injection Drug use:			
Current	246	20.3	.147
Former	411	15.6	
Gender:			
Male	406	17.5	.991
Female	251	17.1	

Table 2. Relative Hazards and 95% CI for mortality between 2005-2015 by variables identified at enrollment among drug users enrolled in two period cohorts (Pre-HAART Era; HAART Era), Baltimore, Maryland, 1988 – 1996, 1996 – 2015.

Variable	Univariate	Multivariate
	RH (95% CI)	aRH (95% CI)
Pre-HAART enrollment		
Incarcerated (yes)	1.01 (0.73, 1.40)	1.14 (0.81, 1.60)
Age (continuous)	0.96 (0.94, 0.99)	0.98 (0.95, 1.00)
HIV Serostatus (Positive)	1.85 (1.36, 2.52)	1.71 (1.25, 2.33)
Drug use (Current)	2.20 (1.59, 3.05)	2.01 (1.49, 2.82)
Gender (Male)	1.25 (0.88, 1.77)	1.27 (0.88, 1.83)
HAART Era enrollment		
Incarcerated (yes)	1.28 (0.76, 2.16)	1.19 (0.68, 2.10)
Age (continuous)	1.00 (0.98, 1.02)	1.01 (0.98, 1.03)
HIV Serostatus (Positive)	1.46 (1.01, 2.13)	1.54 (1.05, 2.25)
Drug use (Current)	2.22 (1.51, 3.25)	2.32 (1.56, 3.45)
Gender (Male)	0.98 (0.70, 1.44)	1.13 (0.76, 1.69)

RH – relative hazard; aRH – adjusted relative hazard; CI – confidence interval
Assessed for assumption of proportionality.
Drug use – injection drug use in the previous 6 months.

Figure1. Kaplan-Meier curves for mortality by history of incarceration among injection drug users enrolled in the ALIVE Study, for persons enrolled in the Pre-HAART Era cohort of 1988-1996 Baltimore, Maryland 2005-2015.

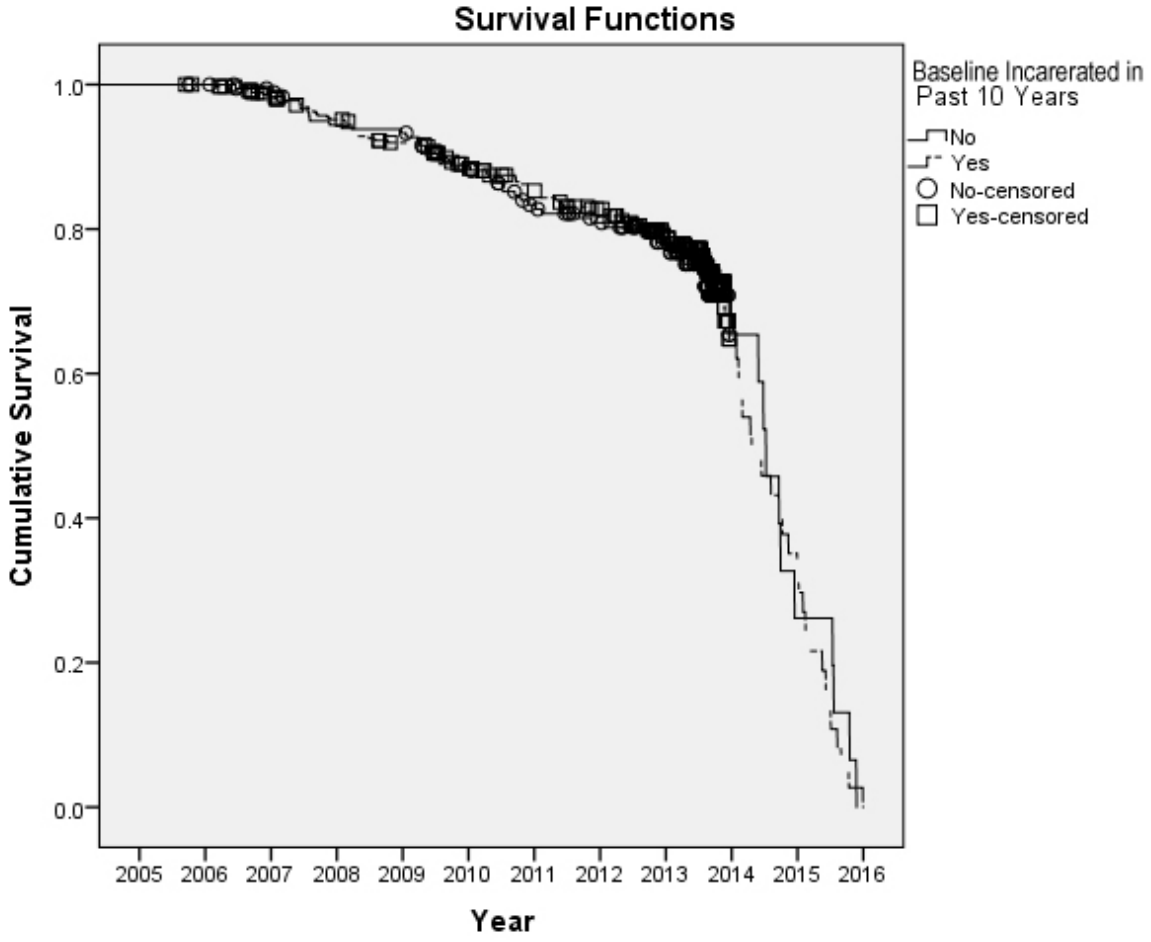

Figure 2. Kaplan-Meier curves for mortality between 2005-2015 by history of incarceration among injection drug users enrolled in the ALIVE Study, HAART Era cohort, Baltimore, Maryland 2005-2015.

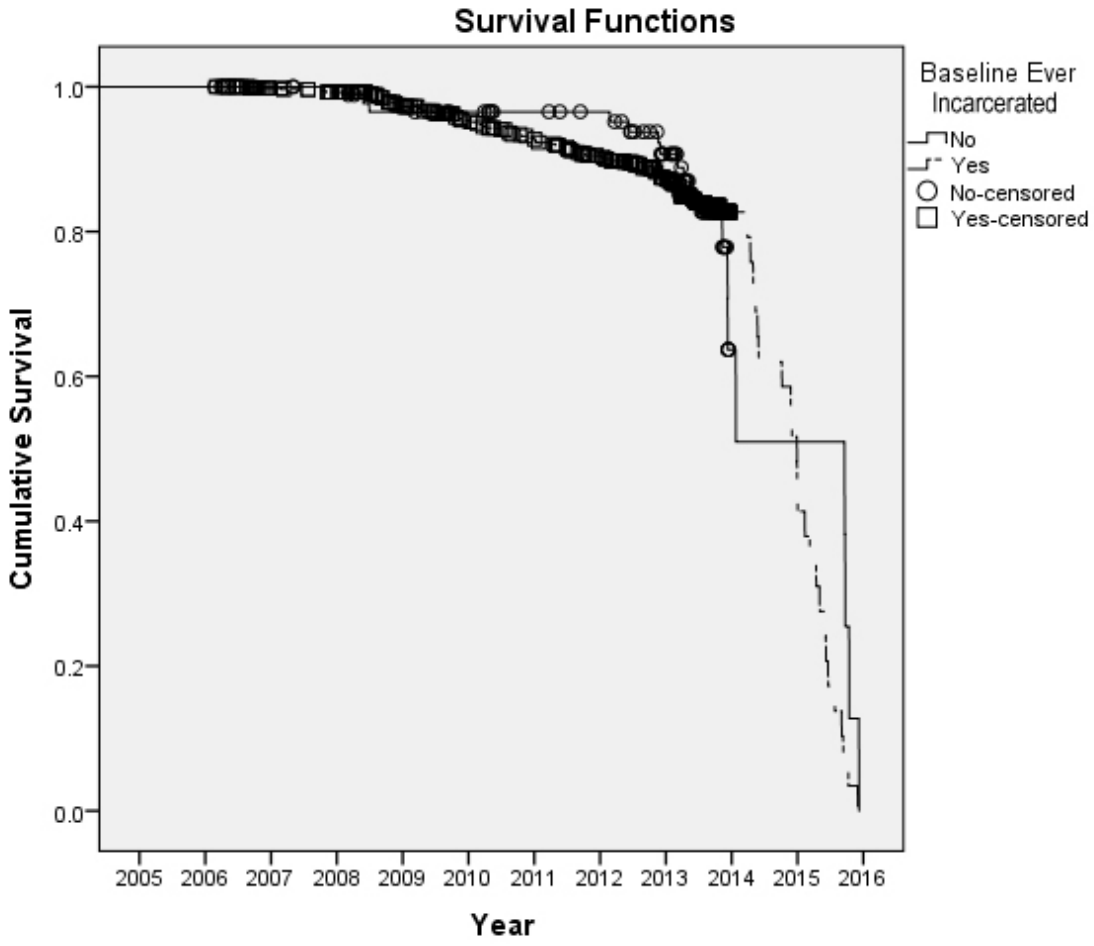

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Table 3. Relative Hazards and 95% CI for mortality between 2005-2015 by injection drug use among drug users[a] enrolled in the Pre-HAART Era cohort, Baltimore, Maryland, 1988 – 1996.

Current Drug use*	Incarceration	RH	95% CI
Yes	Yes	1.79	1.19, 2.67
Yes	No	3.13	1.68, 5.83
No	Yes	0.84	.57, 1.23
No	No	1.00	

[a] Injection drug use in the previous 6 months.

Discussion

Summary of research

The literature review identified three review articles/chapters and thirteen articles that help answer the question of whether a person ages faster while incarcerated than a comparable person living in the community. Two major themes are found in these articles. One theme was the inconsistent findings in which some studies found detrimental effect of incarceration on inmates' health, whereas other findings suggest that incarceration does not affect the inmates' health, or that it may help them. The second theme was the lack of an explicit theoretical basis to explain the relationship between incarceration and health. One clear presentation of a causal connection was by Massoglia (1), who tested the hypothesis that stress-related illnesses would be more common among inmates than the general population, and that illnesses that are not stress-related should have no difference. The other article that proposed a causal connection was Loeb et al (2), claiming that the sense of self efficacy leads one to seek medical care, and barriers to care in the prison environment discourages this drive. Although aging is the central concept to this entire research program, none of the articles explicitly addressed the issue of what aging means and how it is measured. The standard was to simply use chronic medical conditions as a representative of the aging process. Even this conceptualization lead to diverse interpretations, and no two studies used the same variables. These studies spanned from 1992 to 2015, and there was no temporal concentration in which multiple researchers were looking at the same problem at the same time. The closest to this was Binswanger et al (3) and Wilper et al (4), in which both were using the same national data set for inmates, but different national data sets for the general public.

In the second paper, a cross-sectional analysis was conducted with the dependent variable being any history of incarceration, and the dependent variable was frailty. Using binomial logistic

regression, the relationship between incarceration and frailty (not frail, frail) was tested for both cohorts, controlling for age, gender, and education. For the Pre-HAART cohort and HAART era cohort, respectively, none of the variables were significant. Comparing the two cohorts, the association between HIVseropositive status and frailty was not statistically significant in either cohort, but there was far less of an association in the HAART era cohort. The association between incarceration and frailty was also must less in the HAART era cohort compared to the Pre-HAART era cohort. The only variable that came close to statistical significance was age, and only in the HAART era cohort. The ALIVE cohort (both eras combined) did not show any such relationship using the three-tier approach (non-frail, pre-frail, frail). The mean age of each of the three frailty groups were within a few months of each other, and did not even have a linear relationship.

In the survival analysis study, the Pre-HAART cohort comprised 549 participants with data on incarceration in the 10 years prior to enrollment, and the HAART Era cohort consisting of 657 participants, included data on ever been incarcerated. Mortality did not differ by a history of incarceration. Older age was only variable that was noteworthy ($p < .005$), and only within the Pre-HAART cohort. Plots of the Kaplan-Meier models for both cohorts showed near identical curves that suggest mortality rates were the same for those with and without a history of incarceration. An interaction effect between drug use and incarceration on mortality showed an increased risk of death for those current using injection drugs, with or without a history of incarceration.

Contributions to literature

The literature review was the first such study to look at the literature on incarceration and aging. One prior published study had looked at the body of literature on prisoners and health in

general, and that article showed how broad is the field of health and thus a need for a more focused approach. Prior studies on the health effects of incarceration were challenged by finding a comparison group of community members to those currently incarcerated. By using ALIVE participants, the cross-sectional analysis on frailty and the survival analysis on mortality investigated the effects of incarceration by using an at-risk population, which may be a better comparison with current prisoners than simply using community members. The cross-sectional study on incarceration and frailty found no significant association between a history of incarceration and frailty in this sample group. Furthermore, there was no significant association between age and frailty for the entire cohort, despite the fact that frailty is intended to be a marker of aging. Regarding the third paper, prior studies had found increased mortality rates among those recently released from incarceration (3) and for longer periods of time (5). This survival analysis study contrasts with those studies by showing no significant difference in mortality in the long term.

Future research

This study underscores the complex relationship between incarceration and health outcomes. Future studies should seek greater access to those currently incarcerated, particularly for longitudinal research in which the same individuals can be tracked while incarcerated and after release. The literature review suggests the need for studies to build on past research, such as the way concepts are operationalized and the analysis of the data. For example, the frailty phenotype is one of several measurement tools intended to capture the concept of aging. It would be helpful if future studies used the same tools when trying to measure the same concept.

Policy implications of this study include the need for greater access to prisons and jails. Access to penal institutions for research should be of a long-term relationship that would allow

for longitudinal studies. Another implication of this study is the need for better healthcare of those currently incarcerated, during release, and in the long term. Those who have a history of incarceration that may have been years in the past may still be affected by the experience.

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