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The Impact of Incarceration on the Health Outcomes of Formerly Incarcerated Middle-Aged Men[1]

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Abstract:
In this paper, we investigate the relationship between incarceration and various health outcomes for middle aged men ages 39-49. Incarcerated individuals typically have worse health outcomes than non-incarcerated individuals. However, incarcerated individuals tend to be poorer and less educated, among other observable characteristics, meaning these individuals would likely be less healthy even were they not incarcerated. To control for this selection effect, we use a two-step approach that first estimates propensity scores to match previously incarcerated individuals to otherwise similar non-incarcerated individuals. We then estimate covariate adjusted average treatment effects on the treated. Although most of the unadjusted differences in health seem to be accounted for by observable characteristics, we still find that health outcomes related to stress and environmental factors are worse for the formerly incarcerated after controlling for selection. Specifically, the formerly incarcerated have a greater likelihood of reporting a doctor's diagnosis of chronic lung disease, heart problems, or psychological problems; and reporting problems with lameness and paralysis (including polio), certain infectious diseases, and having a traumatic brain injury. These results suggest that the negative aspects associated with incarceration may outweigh any protective effects from increased access to social services for men that survive to ages 39-49.This study highlights the importance of exposure to incarceration on the aging process among men, and sheds light on the multifaceted needs, and, therefore, the comprehensive services and programs necessary to successfully transition individuals from incarceration to society.

Key words: mass incarceration; health disparities; reentry; aging

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I. Introduction

Over the past 40 years the United States has seen a massive expansion of its incarcerated population. According to Raphael and Stoll (2014) the increase in the prison population has been driven by public policies that enhanced the amount of time spent incarcerated for each offense, and expanded the scope of offenses subject to an incarceration. As sentences have lengthened, the incarcerated population has gotten older. The number of prisoners age 55 or older has increased by 400% between 1993 and 2013, and the median age of prisoners increased from 30 years to 36 years (Carson & Sabol, 2016). Although 95% of prisoners are released at some point (Hughes & Wilson, 2003), there has been very little focus on aging within the prisoner reentry literature (Williams & Abraldes, 2007). Moreover, although not a focus of this paper, blacks have historically been disproportionately incarcerated, the prison boom that began in the mid 70's exacerbated these disparities to the point that a Black male born in 2001 has a 1 in 3 chance of going to prison over his lifetime (Bonczar, 2003). Given the aging of the prison population, the disproportionate incarceration of Blacks, and the potential effects of incarceration on health, it is likely that failure to incorporate incarceration in life course analyses has led to biased estimates of aging outcomes and racial health disparities (London and Myers, 2006). In order to adequately address health and aging inequalities, it is important to understand how incarceration has contributed to health differences and whether this effect varies with age. This is especially salient in light of the current coronavirus-19 (COVID-19) pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, which has disproportionately impacted older adults, men, and minorities.

The incarcerated disproportionately suffer from poor emotional and physical health (Maruschak, 2008). In particular, they have higher prevalence of communicable diseases (e.g., tuberculosis, hepatitis, etc.; see Figure 1), and certain chronic illnesses (such as heart problems, asthma, and poor mental health; see Figure 1) than the general population, while other illnesses (e.g., cancer, arthritis, etc.) seem to be less common among this group. These differences could result from being incarcerated, or it could be that people with poor emotional and physical health tend to become incarcerated, or, of course, both. Therefore, to understand the effect of incarceration on health, one must first control for selection.

Understanding the relationship between incarceration and health is complicated not only due to the selection bias discussed previously, but also because social services are administered to individuals who are incarcerated. On the one hand, prisons and jails are unsafe environments in many ways. On the other hand, incarcerated individuals have access to human capital investments and social services (e.g., access to health care, non-cognitive skills development programs, substance abuse programs, job training programs, etc.) that may be less accessible outside of jails and prisons. There is evidence that the formerly incarcerated have a high risk of death within the first two weeks of release, and are at elevated risk of death from homicide, suicide, infectious disease, and certain cancers even when compared to the currently incarcerated (Rosen et al., 2011; Rosen et al.; 2008; Binswanger et al., 2007), implying that incarceration offers some protective benefits (Patterson, 2010).

At the same time, jails and prisons are stressful places to live. The strain of being separated from family, living in what could be a hostile environment, and increased risk of

exposure to communicable diseases, have all been associated with a deterioration in health status (Bick 2007; Institute of Medicine & National Research Council 2013; Patterson, 2013;Wolf et al. 2007; Wolf et al. 2006; Niveau 2006). Finally, incarceration may affect health indirectly, through barriers the formerly incarcerated face when transitioning back into society (e.g., stigma, obstacles to employment, and housing insecurity, etc.) (Binswanger et al., 2014; Cox et al., 2020; Cox, 2018, 2016).

Understanding the link between incarceration, aging, and health is important for a number of reasons. First, although an individual's physical health is an important part of their human capital, it is often overlooked when discussing successful reentry. Reentry discussions often focus on labor market outcomes, substance abuse, criminogenic factors, and mental health, with less discussion about how these factors interact with physical health. More recent research has shown that individuals under criminal justice supervision have different needs in programming and services (Taxman & Caudy, 2015); understanding these needs are vital to successful rehabilitation and reintegration. Second, due to the significant role that the penal system has played in the lives of African Americans, the link between incarceration and health may be crucial in understanding population-wide differences in health (and aging) outcomes by race and socioeconomic status. Indeed many previous studies suggest a need to better understand the health experiences of the incarcerated upon release (e.g., London & Myers, 2006; Freudenberg, 2004).

Similar to this study, prior research using a quasi-experimental study design to investigate the impact of incarceration on specific health outcomes has found that incarceration leads to severe health limitations (Schnittker & John, 2007), increases the

likelihood of having an infectious disease, and increases stress related illnesses (Massoglia, 2008a). This study distinguishes itself from previous studies in multiple ways. First, it focuses on the health of formerly incarcerated middle-aged (ages 39-49) men. Figure 2 shows that incarcerated women tend to have worse health than incarcerated men (see also Maruschak , Berzofsky, and Unangst 2015; Patterson, 2010,), which suggests that perhaps incarceration affects men and women differently. For instance, it may be that the protective benefits are larger for men than women, or that the environment (or services) offered in jails and prisons is harsher (worse) for women than men. On the other hand, it could be that incarceration selects healthier men and less healthy women, which is quite plausible given that incarcerated women are typically more disadvantaged than incarcerated men (Cox, 2012). Moreoverly, formerly incarcerated women's health merits separate attention given the added complexity stemming from the overlap between reproductive health and various disadvantaged populations that disproportionately make up the incarcerated population (Knittel, 2019). Second, the study most similar to this one was conducted before the final two waves of the survey were collected, missing approximately one-third of the eligible sample (representing 1, 484 men and 1,393 women). Therefore, this study will contain additional information to minimize bias and improve efficiency of the estimates. In addition, unlike other studies, this study is framed from an aging perspective. Specifically, it seeks to improve understanding of the link between the United States' experiment in mass incarceration and aging outcomes. Finally, I use state of the art causal inference techniques to improve estimation of "treatment" effects.

Using the NLSY79, this study measures the impact of incarceration on various health outcomes for men born between 1957 and 1964. The evidence suggests that, after

controlling for selection, middle-aged formerly incarcerated men are more likely to report having lameness or paralysis, having an infectious disease, or being knocked unconscious due to a head injury over their lifetime. They are also more likely to report being diagnosed with chronic lung disease, heart problems, and a psychological problem. Overall, formerly incarcerated men are more likely to experience health symptoms linked to infectious diseases and chronic inflammation. These results suggest that the negative aspects associated with incarceration may outweigh any protective effects from increased access to social services and programs for men that survive to ages 39-49.

II. Relationship Between Incarceration and Health

The incarcerated population is highly selected, pulling from the most disadvantaged areas of society where human capital investments are generally low, and thus health is generally poor. The direct, theoretical causal effect of an exposure to incarceration on health is ambiguous. On the one hand, there are opportunities to invest in human capital while incarcerated. Most states provide rehabilitation services, which might include counseling, educational programs, vocational programs, substance abuse treatment, soft skills training, etc. The incarcerated in particular are constitutionally afforded the right to health care while confined through the eighth amendment, so they might have access to health services that they could not have accessed prior to incarceration. On the other hand, incarceration is a highly stressful (and potentially violent) environment that isolates individuals from their family and friends (although to the extent that family and friends were negative influences, this might also be a positive), creating a highly stressful and sometimes traumatic experience for incarcerated individuals (see Institute of Medicine and National Research Council 2013). Finally, incarceration may increase exposure to

communicable diseases both inside and outside of prison (see, for example, Bick 2007; Binswanger et al., 2014; Johnson and Raphael, 2009; and Niveau, 2006).

Even if the aforementioned direct effect of incarceration on health did not persist in the long-run post release, incarceration might still impact health through numerous indirect channels. Specifically, the formerly incarcerated are often stigmatized by society, making it harder to find employment (Cox, 2016) and housing (Cox, 2020). Moreover, incarceration may also lead to separation from family and damage to support networks. Certain felony convictions might also result in civil sanctions placed on an individual that typically have nothing to do with the legal consequences of a crime, such as being barred from social safety net programs and licensing in certain professions. These collateral consequences may be felt throughout a person's life, even after an individual has legally fulfilled the requirements of their punishment. All of these barriers might lead to increased emotional and economic stress, homelessness (Cox et al., 2020), and further participation in unhealthy behaviors for either survival (Binswanger et al., 2014; Galea & Vlahov 2002), or as a coping mechanism (e.g., substance use) to deal with the additional stress imposed by the incarceration (Jackson, Knight, & Rafferty 2009), all of which could eventually lead to decreases in overall health (Harding et al. 2014; Jackson et al. 2009; Western et al. 2015).

While there is evidence that the negative effects of an incarceration outweigh the positive effects of incarceration on health (see for example, Patterson, 2013; Schnittker & John, 2007), it is plausible that incarceration may have a differential effect on individual health outcomes and, therefore, the aging process. For example, one could imagine that having access to consistent treatment for chronic illnesses during confinement might improve one's health, but the stressful environment of an incarceration may lead to

increases in the likelihood of obtaining other illnesses related to stress. Moreover, the indirect negative effects of incarceration on other life outcomes post-release, could lead to a greater likelihood of acquiring illnesses related to stress over time. Ultimately, the effect of incarceration on health is ambiguous and, therefore, an empirical question.

Finally, it is important to not only discuss the theoretical relationship between incarceration and health, but also how incarceration is related to the population aging process in general, and successful aging in particular. As previously mentioned, most research investigating the connection between incarceration and aging focus on the prison population. Few studies make the link between aging outcomes (e.g., early onset of chronic conditions) and health disparities, or how the aging process should be factored into reentry planning, even though 95% of prisoners are eventually released. Conceptually, the era of mass incarceration could be viewed as a historical event that has changed the epidemiological environment of those exposed to it, with lasting impacts on the health of surviving members later in life, and to possibly cohort and generational effects (Finch and Crimmins, 2004). Contact with this environment could impact health for the duration of life after exposure, and whether this effect is positive or negative could depend on the relative strength of the aforementioned protective and risk factors, and how the mark of or exposure to an incarceration might impact one's ability to function in everyday life (see Cox, 2018). Prior research has established that the physiological age of prisoners is 10-15 years older than their chronological age due to factors before and during the incarceration (Williams et al., 2012). For this study, this would imply that we should see earlier onset of chronic illnesses relative to the non-inarcerated population, especially those related to stress (e.g., cardiovascular problems) and the environmental factors of incarceration.

IV. Research Design

Ideally, we could answer our research question by randomly assigning incarceration, and then comparing the outcomes of individuals who are treated to those that are not. However, given the highly unethical nature of this type of experiment, it would be impossible to study this question under a randomized controlled trial (RCT) research design. Instead we must use observational data, which suffers from selection bias: the "assignment" of incarceration is non-random, and, therefore, a valid control group does not exist that would allow the identification of the relationship between incarceration and health outcomes

Quasi-experimental techniques can improve estimation of the "treatment" effect by mimicking a true RCT, provided the right data are available. The 1979 National Longitudinal Survey of Youth (NLSY 79) is a panel data set that contains a wide range of variables measuring criminal history, health, employment, education, parental information, cognitive ability, and childhood experiences for each individual over time. It is an ideal data source to study the effect of incarceration on middle-aged men since the cohort consists of individuals born between 1957 and 1964, and were, therefore, between the ages of 14 and 22 during the 1979 baseline survey. Moreover, an extensive midlife health module was administered to these same individuals at ages 39-49 (health 40+) between 1998 and 2006.

The NLSY 79 asked questions about incarceration and criminal participation only in 1980. However, residence at the time of interview was asked in every year of the survey, and this can be used to backout incarceration status, thereby yielding a lifetime incarceration history for each individual. A total of 4,169 men completed the health 40+

module, but only 2,253 men had complete data on all of the covariates and were not incarcerated at the time of the survey. Although the NLSY 79 is longitudinal, the detailed health 40+ survey module was administered for only one year; thus, we create a cross sectional data set consisting of baseline variables and covariates from the year the respondent completed the health 40+ module to analyze different health outcomes.

The base model predicting health outcomes can be written as:

(1) $H_i = \alpha + \beta_1 Inc_i + X_i\delta + \varepsilon_i$,

where H is a vector of health outcomes of chronic health conditions (see Table 1 for a complete list) for individual i, X_{ij} is a vector of control variables (such as substance use, prior health problems, cigarette use, marital status, etc), and Inc is a dummy variable equal to one if the person reported an incarceration in the 1980 wave or if the person subsequently reported being interviewed in jail or prison prior to the year they completed the health 40+ survey module, and 0 if there was no reported incarceration *and* no missing information on the variable capturing residence at time of interview to construct incarceration.

Regression analysis will give a biased estimate of β_j due to the lack of a valid counterfactual. Therefore, propensity score matching was used to match individuals who have experienced an incarceration to those that have no reported exposure to an incarceration, but are comparable in observable characteristics, to minimize selection bias. The main identification assumption of propensity score analysis is unconfoundedness, or conditional independence given selection on observables, which is not testable. However, the sample balance can be used to determine how likely it is that the unconfoundedness condition is met and, therefore, is investigated by comparing the difference in the distribution of covariates using normalized differences, which compare the differences in

the distribution of a variable between two groups by comparing their difference in means to the average standard deviation of the two groups, and, unlike t-tests, are not sensitive to sample size. The second assumption imposed for identification when using the propensity score is the common support assumption, which requires there to be overlap in the probabilities of the propensity scores between the treated and "control" groups. In this analysis, the common support is restricted to individuals with propensity scores greater than .1 and less than .9 (Imbens & Rubin, 2012).

We use the following logistic regression to estimate a propensity score for each individual:

$$(2)\ P(Inc_i = 1|x) = \Lambda(\delta_0 + x_i'\gamma)\ ,$$

where $\Lambda(\cdot)$ is the logistic distribution function and x is a vector of pre-treatment predictors of incarceration such as race, childhood family structure, 1980 criminal history, parental education, early substance use, cognitive ability measured by the Armed Forces Qualification Test (AFQT), and location. Once the propensity score has been estimated, we matched individuals within .01 caliper of each other in log odds of experiencing an incarceration. Within the matched sample, individuals were therefore very similar to each other in likelihood of being incarcerated based on observables. To make this comparison for all matched individuals, we then estimated equation (1) using only individuals on the common support (Angrist & Pischke, 2009; Imbens & Rubin, 2012). The average treatment effect on the treated is given by β_j.

As previously mentioned, propensity score matching relies on two assumptions: 1) selection is on observables (unconfoundedness), and 2) propensity scores for the incarcerated and non-incarcerated overlap (otherwise no incarcerated individual would be

similar enough to another non-incarcerated individual to yield valid comparisons). There is no way to test the first assumption of no selection on unobservables. But the extensive list of covariates in the NLSY 79 makes this assumption more plausible, if many of the most obvious sources of selection are addressed. We analyzed covariate balance before and after propensity score matching to see if the matching does in fact reduce selection on observables. If the sample is balanced and/or the bias in the covariates has been reduced, parameter estimates will improve.

Of course, to the extent that there remains unobserved characteristics that may be driving differences between the "treated" and the "untreated," then the unconfoundedness assumption will fail and the propensity score estimator will be biased. Moreover, since exposure to incarceration is measured through the variable residence at the time of interview, this makes it more likely that individuals with shorter incarceration spells are not captured in the data, which will make it harder to detect a difference between the "treated" and the "untreated" since there may be individuals coded as "untreated" that have actually been exposed to an incarceration.

V. Results

The NLSY 79 health 40+ survey module contains outcomes capturing a range of chronic illnesses and their symptoms such as musculoskeletal problems, urological, respiratory, cardiovascular, internal and psychiatric. Figure 3 shows the prevalence of certain chronic illnesses common in both the NLSY 79 data and Maruschak et al. (2015). Comparison of the general population estimates to the unweighted estimates provide an indication of sample selection in the NLSY sample. While the NLSY 79 sample estimates are not weighted, both the formerly incarcerated and non-incarcerated have lower rates of

almost every chronic illness (except for having been diagnosed with a stroke) than the estimates for both prisoners and the general population, although the differences between the general population and the NLSY 79 non-incarcerated sample are small. Nonetheless, there are large differences between the chronic health outcomes of the general state and federal prison population and the NLSY 79 formerly incarcerated population. These differences could be due to the selection of the NLSY 79 population since the NLSY 79 sample consist of individuals previously exposed to an incarceration that have survived to ages 39-49, while the Maruschak et al. (2015) estimates are not conditional on age and are for currently incarcerated individuals. It is plausible that the unhealthiest prisoners may not survive to their 40s, so we might expect the health outcomes of the general state and federal prison population to look worse than the NLSY 79 sample. It is also plausible that these differences represent the direct effect of incarceration on health, and that this effect dissipates over time.

Figure 4 displays the prevalence of certain chronic illnesses for state and federal prisoners age 35-39, formerly incarcerated men and women in the NLSY 79 sample (unweighted), formerly incarcerated men in the NLSY 79 sample, and state and federal male prisoners in the general prison population. The prevalence of chronic illness in state and federal prisoners ages 35-49 (+2.7 percentage points) are a little higher than the NLSY 79 sample of formerly incarcerated individuals. Nonetheless, the NLSY 79 unweighted prevalence estimate of chronic illness for the sample of formerly incarcerated men aged 39-49 are approximately equal to the prevalence estimate for all men in state and federal prison (note that Figure 3 displays prevalence of reported doctor diagnoses, while Figure 4 also includes stroke- and kidney-related problems).

Overall, the NLSY sample of the formerly incarcerated appear to be healthier than the general prison population when comparing doctor diagnoses of certain chronic illnesses. However, after conditioning on age and gender, and using a more comprehensive measure of chronic illness that include reported problems, there was a much lower gap between the prevalence of chronic illness in state and federal prisoners and the NLSY sample of formerly incarcerated; this gap approached zero when comparing NLSY 79 male formerly incarcerated individuals between the ages of 39-49 to male state and federal prisoners of all ages.

Table 1 presents the unadjusted frequencies of each illness and symptom in the sample. Formerly incarcerated men are only significantly different from non-incarcerated persons in the sample for certain illnesses. In particular, a significantly greater percentage of the formerly incarcerated report being diagnosed with a stroke ($p<.1$), chronic lung disease ($p<.05$), heart problems ($p<.1$), and an emotional/psychiatric problem ($p<.01$). Among reported health problems, formerly incarcerated individuals are more likely to report problems with their feet and legs ($p<.1$), problems with their teeth and gums ($p<.01$), having a fracture or broken bone in the last 10 years ($p<.05$), and to have problems with sleeping ($p<.05$). The formerly incarcerated are also more likely to report problems with lameness and paralysis and experiencing a traumatic brain injury (as measured by having ever been unconscious due to a head injury), but these differences just missed traditional significance levels with p-values equal to .101 and .107, respectively. Moreover, incarcerated individuals in the analytical sample are less likely to report problems with frequent colds, sinus, hay fever, or allergies ($p<.05$), or problems with high cholesterol ($p<.01$). In terms of overall measures of health, middle-aged formerly incarcerated men in

their 40s reported lower mental and physical health scores as measured by the 12 item short form survey (SF-12) ($p<.1$ and $p<.0001$, respectively), and greater depressive symptoms as measured by the 7-Item Center for Epidemiologic Studies Depression Scale (CES-D 7) ($p<.0001$).

Nonetheless, as previously mentioned, incarceration is not randomly assigned, and, therefore, individuals that have been incarcerated are a highly selected group. The summary statistics of demographic variables in Table 2 suggests that individuals that have experienced an incarceration have somewhat large distributional differences (i.e., a normalized difference greater than .5) from non-incarcerated individuals on a number of characteristics that might also influence health such as smoking, education, marital status, family background, criminal behavior, and substance use. This selection biases the estimate of the effect of incarceration obtained by an unadjusted comparison of the incarcerated to the non-incarcerated; and such large distributional differences cannot be controlled for by regression alone.

The results from the logistic model used to estimate the propensity score are shown in Table 3. The model has a reasonably high R-squared of roughly .28. A low R-squared would mean that the model does not predict incarceration very well, and, therefore, the "matched" individuals are not similar in likelihood of being incarcerated. Race, age at first alcohol consumption, AFQT scores, age at mother's death, family structure, substance use, and criminal history are significant predictors of incarceration in the model. All signs of the significant variables are as expected.

Table 2 also compares the normalized differences of human capital, criminal history, demographic, substance use, and certain health variables between those exposed

to an incarceration and those that have no record of an exposure before and after propensity score matching. A positive normalized difference means that the formerly incarcerated have a greater average value than individuals that have not been incarcerated. A value greater than .5 suggests a difference in the distribution between the "treated" (formerly incarcerated) and "untreated" (no record of prior incarceration) that is too large to control for through simple regression. There are seven variables that have large differences in the means of the "treated" and "untreated" in the unmatched sample: having smoked at least 100 cigarettes in one's lifetime, ever charged with an illegal activity, reported drug use (i.e., marijuana, cocaine, or crack), black, highest grade completed, Armed Forces Qualification Test (AFQT), and married. Those that have a history of prior incarceration are more likely to have smoked at least 100 cigarettes in their lifetime, to have been charged with an illegal activity, to report drug use, and to be black; they are less likely to have been married; on average, they have completed fewer years of education; and they have lower AFQT scores. The matched sample has only one variable with a normalized difference above .5: having smoked at least 100 cigarettes in one's lifetime. The common support assumption is verified in Figure 5, which displays the distribution of the propensity scores between the "treated" and "untreated." As the figure shows, the propensity scores between the two groups overlap; in other words, there are "untreated" individuals for each propensity score value of a "treated" individual.

Table 4 provides the results for the regressions of the total analytical sample with and without covariate adjustment, and the results from the propensity score matching technique, with and without covariate adjustment. Column 2 presents results from regression on the analytical sample, without propensity score matching, with controls for

observable characteristics. Middle-aged men that have been exposed to an incarceration and survive to ages 39-49 have significantly lower composite health scores as measured by the SF-12, and report more depressive symptoms as measured by the 7-Item CES-D compared to men with no indication of an incarceration. Formerly incarcerated men are five percentage points more likely ($p<.01$) to report a diagnosis of an emotional, nervous, or psychological problem by a doctor, roughly five percentage points more likely to report a fracture or broken bone in the last 10 years ($p<.1$), and six percentage points more likely to report a traumatic brain injury (TBI), measured as having ever been unconscious due to a head injury ($p<.05$), when compared to non-incarcerated men. None of the other differences in chronic health conditions between previously-incarcerated and never-incarcerated men reported in column 2 of Table 4 are statistically significant.

Column 3 of Table 4 provides the unadjusted average treatment effect on the treated (ATT) from the propensity score analysis. The difference in the SF-12 score between the formerly incarcerated and the non-incarcerated is still negative, but it is smaller and no longer significant. Nonetheless, a greater significant difference persists between the formerly incarcerated and the non-incarcerated in the number of depressive symptoms (.81, $p<.05$) reported in the 7-Item CES-D scale when compared to the imputed control group. Incarcerated men are significantly more likely to report a diagnosis of chronic lung disease (difference +3.2 percentage points, $p<.05$), heart problems (difference +2.7 percentage points, $p<.1$) and a diagnosis of an emotional, nervous, or psychological problem (difference +5.2 percentage points, $p<.01$). Finally, among self-reported health problems, the formerly incarcerated have a greater proportion that report lameness or paralysis (+2 percentage points, $p<.1$), to have severe tooth and gum problems (+4.5 percentage points,

p<.1), and traumatic brain injury (+7.6 percentage points, p<.01) when compared to the "imputed" control group. While the difference between the formerly incarcerated and the "imputed" control group for reporting a fracture or broken bone in the last 10 years is no longer significant, it is still positive and relatively large (4.4 percentage points).

Column 4 in Table 4 shows the results from estimating a covariate-adjusted ATT, which should help to further decrease bias and improve efficiency of the estimates (Angrist & Pischke 2009, Imbens & Rubin 2012). The results are largely similar to the unadjusted analysis, except there is no longer a significant difference in reported depressive symptoms, although still positive, between the formerly incarcerated and the "imputed" control group; in addition, there is now a positive marginally significant difference (2.5 percentage points, p<.1) between the formerly incarcerated and observably similar individuals that have not been incarcerated in the likelihood of reporting having an infectious disease (i.e., scarlet or rheumatic fever, tuberculosis, jaundice, or hepatitis). Finally, the difference in the likelihood of reporting a traumatic brain injury over one's lifetime has increased over 1 percentage point to 8.9 percentage points (p<.01).

VII. Discussion and Conclusion

Previous research suggests that individuals that have been exposed to an incarceration are more likely to suffer from chronic and infectious diseases suggesting that the environment of incarceration and the stresses that it imposes may lead to inferior health. Our analysis for middle-aged men (ages 39-49) suggest that, after controlling for selection on observables for being incarcerated, significant differences remain between those exposed to an incarceration and the non-incarcerated only for certain chronic conditions and infectious diseases. These illnesses are related to the additional stress that

incarceration imposes on one's life (i.e., heart problems, chronic lung disease, psychological problems), and to the environmental factors of incarceration (i.e., increased likelihood of infectious diseases and traumatic brain injury). It should be noted that there were still large distributional differences between the formerly incarcerated and the non-incarcerated for smoking, even after matching observably similar observations, which could be driving some of our results (Colsher et al., 1992). Even after controlling for observable characteristics, for no conditions or symptoms were the previously incarcerated significantly more healthy than the non-incarcerated. These results suggests that the negative health effects of being incarcerated may outweigh any protective effects.

As previously mentioned, our study is most similar to Massoglia (2008a). Our results differ from this study in that we see a marginally significant increased likelihood in the diagnosis of heart problems, and no significant difference in the diagnosis of hypertension. Moreover, in terms of reported health problems, we do not find significant differences in reported heart problems, problems with depression or excessive worrying, problems sleeping, and problems with chronic headaches or dizziness. Possible reasons for differences in our results are Massoglia (2008a) includes both men and women in their analysis. Moreover, their results use a smaller subsample of the data: at the time of their analysis approximately one-third of the data was not available. If the timing of responses are correlated with incarceration status and gender, this could have also led to differences between our results. Finally, for both studies it should be kept in mind that some of the cell sizes are small, and should be interpreted with caution.

Regardless of the differences, the qualitative conclusions of our studies are very similar. Both studies find that stress and environmental factors of an incarceration may

worsen the health of formerly incarcerated individuals who survive to ages 39-49, however, the differences in diseases leading to this conclusion may reflect our focus on formerly incarcerated men and the differences in health outcomes between formerly incarcerated men and women. In addition, a unique finding of this study suggests that the formerly incarcerated are more likely to suffer from traumatic brain injury, even after controlling for selection on observables. All of this provides further evidence of the multifaceted needs, and, therefore, comprehensive services and programs, necessary to successfully transition individuals from an incarceration to society (Taxman & Caudy, 2015).

These findings are especially salient in light of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, which causes coronavirus disease 2019 (COVID-19). This virus disproportionately impacts men, racial and ethnic minorities, and older individuals, all of whom overlap among the incarcerated population. Given the findings in this study, middle-aged formerly incarcerated men may be at greater risk of infection and greater severity of COVID-19 and any long-term complications.

The results should be interpreted keeping in mind that the analysis is conditional on having survived to the ages of 39 to 49 and having participated in 18-22 rounds of the survey (from 1979-2006). We estimate a simple logit model to understand the relationship between mortality and incarceration status conditional on birth cohort. The results suggest that individuals exposed to incarceration are significantly more likely to have deceased listed as the reason for noninterview (results are available from the author upon request). This reveals another layer of sample selection, which would imply that the estimates in this analysis are conservative because they are conditional on having survived to ages 39-49, something the formerly incarcerated are less likely to do.

Moreover, incarceration is measured using the residence at the time of interview, so this may have caused an underestimation of individuals that have been exposed to an incarceration, thus requiring a larger difference between the formerly incarcerated and the non-incarcerated to detect a significant effect. There were also some outcomes with small cell sizes, and these should be interpreted with caution. In addition, to the extent that there remain unobserved factors that are correlated with both incarceration and health, the estimates of the average treatment effects on the treated will be biased.

Finally, this analysis only includes observations with complete cases, so the results could suffer from sample selection due to unit and item non-response. Nonetheless, analysis of the normalized differences between those with missing responses and those without suggest that the distributional differences between the complete cases and those missing items in the survey are not large (results available upon request). In addition, Macurdy, Mroz, and Gritz (1998) do not find conclusive evidence that sample attrition has an impact on the NLSY 79 sample.

One of the more robust findings in this research is that incarcerated individuals are more likely to experience a traumatic brain injury (TBI) when compared to observably similar individuals that have not been incarcerated. While it is impossible to tie down the timing of the incarceration and traumatic brain injury in the data, the results suggest that the formerly incarcerated are a population that merits further study on the long-term consequences of a TBI. Future research should seek to determine the exact timing of the TBI among the incarcerated population as this may impact a plethora of outcomes including criminal behavior. Moreover, future research should seek to understand the impact of incarceration on women's health, and how treatment effects vary by race.

Finally, future studies should seek to better understand the mechanism through which incarceration impacts health (e.g., determine how the direct effect of incarceration compares to the indirect effects that might operate through stigma, employment outcomes, housing insecurity, heightened contact with the criminal justice system, etc.).

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Tables

Table 1. Unadjusted Mean Differences in Health Outcomes

	Non-Incarcerated			Formerly Incarcerated			
Variable	**Obs**	**Mean**	**S.D.**	**Obs**	**Mean**	**S.D.**	**Difference**
Composite Health Measures:							
SF-12 Physical Component Score	1,996	53.1440	6.5152	257	50.8171	8.8780	-2.3269***
SF-12 Mental Component Score	1,996	54.5322	6.7656	257	53.5895	8.1622	-0.9427^{+}
7 Item CES-D Score	1,996	2.4870	3.4481	257	3.8482	4.4787	1.3613***
Chronic Conditions: Doctor Diagnosis:							
Doctor Ever Diagnosed: High Blood Pressure	1,996	0.1723	0.3778	257	0.1634	0.3705	-0.0089
Doctor Ever Diagnosed: Stroke	1,996	0.0045	0.0670	257	0.0195	0.1384	.0149^{+}
Doctor Ever Diagnosed: Diabetes or High Blood Sugar	1,996	0.0421	0.2008	257	0.0506	0.2196	0.0085
Doctor Ever Diagnosed: Chronic Lung Disease	1,996	0.0135	0.1155	257	0.0389	0.1938	0.0254*
Doctor Ever Diagnosed: Heart Problems	1,996	0.0135	0.1155	257	0.0350	0.1842	0.0215^{+}
Doctor Ever Diagnosed: Emotional, Nervous, or Psychological Problem	1,996	0.0341	0.1814	257	0.0817	0.2745	0.0476**
Doctor Ever Diagnosed: Arthritis	1,996	0.0832	0.2762	257	0.0856	0.2803	0.0024
Reported Chronic Health Problems							
Health Problems: Asthma	1,996	0.0551	0.2283	257	0.0700	0.2557	0.0149
Health Problems: Back	1,996	0.2360	0.4247	257	0.2101	0.4082	-0.0259
Health Problems: Feet and Legs	1,996	0.1573	0.3642	257	0.2062	0.4054	0.0489^{+}
Health Problems: Kidney or Bladder	1,996	0.0235	0.1517	257	0.0195	0.1384	-0.0041
Health Problems: Stomach or Intestinal	1,996	0.0426	0.2020	257	0.0506	0.2196	0.0080
Health Problems: High Cholesterol	1,996	0.1338	0.3405	257	0.0817	0.2745	-0.0521**
Health Problems: Chest Pain/Pressure, Heart Problems	1,996	0.0391	0.1938	257	0.0467	0.2114	0.0076
Health Problems: Frequent Colds, Sinus, Hay Fever or Allergies	1,996	0.2019	0.4015	257	0.1518	0.3595	-0.0502*
Health Problems: Frequent Indegestion, Stomach, Liver, Gallbladder	1,996	0.0701	0.2554	257	0.0739	0.2622	0.0038
Health Problems: Depression, Excessive Worry, Nervous Trouble	1,996	0.0822	0.2747	257	0.1089	0.3122	0.0268
Health Problems: Joints Swell/Pain, Leg Cramps, Bursitis	1,996	0.1082	0.3107	257	0.1245	0.3308	0.0163
Health Problems: Lameness or Paralysis (Including Polio)	1,996	0.0075	0.0864	257	0.0233	0.1513	0.0158
Health Problems: Scarlet or Rheumatic Fever, TB, Jaundice, Hepatitis	1,996	0.0120	0.1090	257	0.0272	0.1631	0.0152
Health Problems: Frequent Severe Headaches, Dizziness, Fainting Spells	1,996	0.0491	0.2161	257	0.0661	0.2490	0.0170
Health Problems: Eye Trouble	1,996	0.0381	0.1914	257	0.0623	0.2421	0.0242
Health Problems: Ear, Nose, or Throat	1,996	0.0411	0.1985	257	0.0389	0.1938	-0.0022
Health Problems: Severe Tooth or Gum	1,996	0.0461	0.2097	257	0.1012	0.3021	0.0551**
Health Problems: Trouble Sleeping	1,996	0.0967	0.2956	257	0.1518	0.3595	0.0551*
Health Problems: Ulcers	1,996	0.0205	0.1419	257	0.0350	0.1842	0.0145
Health Problmes: Fracture or Broken Bone in Last 10 years	1,996	0.1348	0.3416	257	0.1868	0.3905	0.0520*
Health Problems: Ever Unconcious Due To Head Injury	1,996	0.1172	0.3218	257	0.1556	0.3632	0.0384

+ p<.10, * p<0.05, ** p<0.01, *** p<0.001

Notes: means are unweighted

Table 2. Descriptive Statistics of the Control Variables

	Untreated (Not Incarcerated)			Treated (Incarcerated)			Normalized Differences		Absolute Value of Ratio Normalized Differences Matched/ Unmatched
Variable	Obs	Mean	SD	Obs	Mean	Std.	Unmatched Complete Cases	Matched Sample (N=740)	
Health									
Age at Interview	1,996	40.617	0.638	257	40.790	0.941	0.215	0.160	0.743
Body Mass Index	1,996	28.442	5.057	257	28.134	4.645	-0.063	-0.114	1.803
Doesn't Participate in Any Physical Exercise (Time of Health Survey)	1,996	0.124	0.330	257	0.198	0.400	0.203	0.063	0.312
Smoked at Least 100 Cigarettes in Life	1,996	0.560	0.496	257	0.895	0.307	0.812	0.652	0.804
Reported Health Limited or Would Limit Work in 1979 Survey	1,996	0.054	0.225	257	0.043	0.203	-0.050	-0.093	1.842
Father Died Age<30	1,996	0.004	0.059	257	0.008	0.088	0.057	0.071	1.250
Father Died 30<=Age<40	1,996	0.017	0.128	257	0.031	0.174	0.096	0.042	0.437
Father Died 40<=Age<50	1,996	0.030	0.169	257	0.062	0.242	0.157	0.036	0.227
Father Died 50<=Age<60	1,996	0.081	0.272	257	0.136	0.344	0.179	0.044	0.244
Father Died 60<=Age<70	1,996	0.127	0.333	257	0.132	0.339	0.015	-0.005	0.317
Father Died >=70	1,996	0.742	0.437	257	0.630	0.484	-0.243	-0.072	0.294
Mother Died Age<30	1,996	0.002	0.039	257	0.000	0.000	-	0.000	-
Mother Died 30<=Age<40	1,996	0.010	0.097	257	0.031	0.174	0.154	0.054	0.350
Mother Died 40<=Age<50	1,996	0.022	0.147	257	0.043	0.203	0.117	-0.013	0.107
Mother Died 50<=Age<60	1,996	0.057	0.232	257	0.089	0.286	0.124	0.031	0.253
Mother Died 60<=Age<70	1,996	0.064	0.245	257	0.093	0.292	0.109	0.059	0.541
Mother Died >=70	1,996	0.846	0.361	257	0.743	0.438	-0.256	-0.076	0.296
Crime and Substance Use									
Ever Charged with Illegal Activity (1980)	1,996	0.295	0.456	257	0.681	0.467	0.838	0.252	0.301
Age at First Alcohol Consumption<11	1,996	0.104	0.306	257	0.093	0.292	-0.036	-0.022	0.595
11<Age at First Alcohol Consumption<16	1,996	0.156	0.363	257	0.265	0.442	0.268	0.083	0.308
16<=Age at First Alcohol Consumption<21	1,996	0.676	0.468	257	0.560	0.497	-0.240	-0.083	0.347
Age at First Alcohol Consumption>=21	1,996	0.026	0.158	257	0.039	0.194	0.076	0.019	0.253
Never Drink at Time of 1983 Survey	1,996	0.038	0.191	257	0.043	0.203	0.024	0.037	1.560
Ever Reported Using Marijuana, Cocaine, or Crack	1,996	0.826	0.379	257	0.981	0.138	0.541	0.175	0.323
Human Capital and Other Demographic Variables									
Black	1,996	0.249	0.433	257	0.506	0.501	0.549	0.057	0.103
Hispanic	1,996	0.162	0.368	257	0.226	0.419	0.162	0.134	0.826
Highest Grade Completed (Time of Health Survey)	1,996	13.470	2.469	257	11.685	1.669	-0.847	-0.361	0.426
Never Married	1,996	0.168	0.374	257	0.354	0.479	0.434	0.305	0.704
Married (Time of Health Survey)	1,996	0.665	0.472	257	0.350	0.478	-0.664	-0.469	0.706
Separated (Time of Health Survey)	1,996	0.034	0.180	257	0.066	0.249	0.150	0.065	0.430
Divorced (Time of Health Survey)	1,996	0.127	0.333	257	0.226	0.419	0.260	0.208	0.801
Widowed (Time of Health Survey)	1,996	0.006	0.077	257	0.004	0.062	-0.030	-0.138	4.563
AFQT	1,996	48.048	29.687	257	21.357	21.399	-1.031	-0.307	0.298
Sum of Biological Parents Highest Grade Completed	1,996	21.258	7.391	257	17.735	7.162	-0.484	-0.151	0.312
Lived with Both Parents in 1979	1,996	0.695	0.460	257	0.463	0.500	-0.484	-0.201	0.415
Lived in a Town/City in 1979	1,996	0.774	0.419	257	0.821	0.384	0.118	0.034	0.288
Region 1979: Northeast	1,996	0.177	0.382	257	0.117	0.322	-0.172	-0.048	0.281
Region 1979: North Central	1,996	0.292	0.455	257	0.206	0.405	-0.199	0.018	0.089
Region 1979: South	1,996	0.351	0.477	257	0.412	0.493	0.127	-0.029	0.228
Region During Health 40+ Survey: Northeast	1,996	0.151	0.358	257	0.113	0.317	-0.112	-0.051	0.451
Region During Health 40+ Survey: North Central	1,996	0.269	0.443	257	0.187	0.390	-0.196	0.049	0.248
Region During Health 40+ Survey: South	1,996	0.391	0.488	257	0.455	0.499	0.130	-0.033	0.251
Region During Health 40+ Survey: West	1,996	0.189	0.392	257	0.245	0.431	0.136	0.029	0.215
Live in Urban Area (Time of Health Survey)	1,996	0.722	0.448	257	0.802	0.400	0.188	-0.001	0.006
Birth Cohort: 1957	1,996	0.088	0.283	257	0.117	0.322	0.096	0.082	0.852
Birth Cohort: 1958	1,996	0.108	0.310	257	0.093	0.292	-0.048	-0.088	1.853
Birth Cohort: 1959	1,996	0.120	0.325	257	0.078	0.268	-0.141	-0.047	0.331
Birth Cohort: 1960	1,996	0.147	0.354	257	0.132	0.339	-0.043	0.037	0.858
Birth Cohort: 1961	1,996	0.146	0.353	257	0.128	0.335	-0.052	-0.079	1.522
Birth Cohort: 1962	1,996	0.145	0.352	257	0.175	0.381	0.083	0.112	1.348
Birth Cohort: 1963	1,996	0.126	0.332	257	0.160	0.367	0.095	-0.031	0.321
Birth Cohort: 1964	1,996	0.120	0.325	257	0.117	0.322	-0.011	-0.022	2.046

Table 3. Logistic Regression Predicting Incarceration

Variables	Coefficients
Hispanic	0.3529
	(0.2642)
Black	0.6396**
	(0.2161)
11<Age at First Alcohol Consumption<16	0.4919
	(0.3200)
16<=Age at First Alcohol Consumption<21	-0.1274
	(0.2956)
Age at First Alcohol Consumption>=21	0.3946
	(0.5007)
Never Drink at Time of 1983 Survey	0.5071
	(0.4975)
AFQT	-0.0564***
	(0.0110)
AFQT^2	0.0003*
	(0.0001)
Father Died Age<30	0.9943
	(0.7765)
Father Died 30<=Age<40	0.0673
	(0.4671)
Father Died 40<=Age<50	0.6694*
	(0.3394)
Father Died 50<=Age<60	0.3710
	(0.2505)
Father Died 60<=Age<70	0.0488
	(0.2284)
Father Died >=70	Comparison Group
Mother Died Age<30	Omitted
Mother Died 30<=Age<40	1.6354**
	(0.5505)
Mother Died 40<=Age<50	-0.1058
	(0.4586)
Mother Died 50<=Age<60	0.0413
	(0.2962)
Mother Died 60<=Age<70	0.2357
	(0.2753)
Mother Died >=70	Comparison Group
Sum of Biological Parents Highest Grade Completed	0.0012
	(0.0120)
Lived with Both Parents in 1979	-0.5187**
	(0.1647)
Ever Reported Using Marijuana, Cocaine, or Crack	2.1251***
	(0.4907)
Ever Charged with Illegal Activity (1980)	1.3769***
	(0.1567)
N	2250
Pseudo R-squared	0.2755

Standard errors in parentheses.
+ p<.10, * p<0.05, ** p<0.01, *** p<0.001
Notes: 3 Observations had mothers that died before age 30. These observations were dropped and the category was omitted from the analysis due to perfect collinearity. City and regional dummies from the baseline year and the year of the health 40+ survey moduleare included as controls, as well as birth cohort dummies.

Table 4. Comparison of Health Outcomes Between Non-Incarcerated and Formerly Incarcerated

	Unmatched[a]				Matched			
	(1)[b]		(2)[c]		(3)[b]		(4)[c]	
Variables	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
Composite								
SF-12 Physical Component Score	-2.3269***	(0.5719)	-1.1261+	(0.6205)	-0.9451	(0.6927)	-0.8892	(0.7792)
SF-12 Mental Component Score	-0.9427	(0.5305)	-0.3112	(0.5869)	-0.4710	(0.6687)	-0.1807	(0.7461)
7 Item CES-D Score	1.3613***	(0.2894)	0.6057+	(0.3121)	0.8088*	(0.3673)	0.6510	(0.4033)
Diagnosis								
Doctor Ever Diagnosed: High Blood Pressure	-0.0089	(0.0247)	-0.0262	(0.0280)	-0.0429	(0.0297)	-0.0283	(0.0336)
Doctor Ever Diagnosed: Stroke	0.0149+	(0.0088)	-0.0135	(0.0099)	0.0049	(0.0093)	0.0024	(0.0098)
Doctor Ever Diagnosed: Diabetes or High Blood Sugar	0.0085	(0.0144)	-0.0021	(0.0160)	-0.0134	(0.0173)	-0.0258	(0.0187)
Doctor Ever Diagnosed: Chronic Lung Disease	0.0254*	(0.0124)	0.0188	(0.0131)	0.0318*	(0.0148)	0.0275+	(0.0148)
Doctor Ever Diagnosed: Heart Problems	0.0215	(0.0118)	0.0155	(0.0127)	0.0270+	(0.0141)	0.0253+	(0.0146)
Doctor Ever Diagnosed: Emotional, Nervous, or Psychological Problem	0.0476**	(0.0176)	0.0499**	(0.0187)	0.0521**	(0.0197)	0.0605**	(0.0227)
Doctor Ever Diagnosed: Arthritis	0.0024	(0.0186)	-0.0141	(0.0219)	-0.0251	(0.0227)	-0.0269	(0.0273)
Reported Health Problem								
Health Problems: Asthma	0.0149	(0.0168)	0.0194	(0.0197)	-0.0001	(0.0183)	-0.0146	(0.0227)
Health Problems: Back	-0.0259	(0.0272)	-0.0193	(0.0306)	-0.0465	(0.0344)	-0.0311	(0.0394)
Health Problems: Feet and Legs	0.0489+	(0.0266)	0.0223	(0.0306)	0.0155	(0.0329)	0.0065	(0.0381)
Health Problems: Kidney or Bladder	-0.0041	(0.0093)	0.0036	(0.0108)	0.0022	(0.0111)	0.0092	(0.0124)
Health Problems: Stomach or Intestinal	0.0080	(0.0144)	-0.0024	(0.0164)	0.0047	(0.0189)	0.0030	(0.0217)
Health Problems: High Cholesterol	-0.0521**	(0.0188)	-0.0111	(0.0216)	-0.0270	(0.0227)	0.0092	(0.0241)
Health Problems: Chest Pain/Pressure, Heart Problems	0.0076	(0.0139)	-0.0086	(0.0163)	0.0037	(0.0181)	-0.0094	(0.0215)
Health Problems: Frequent Colds, Sinus, Hay Fever or Allergies	-0.0502*	(0.0242)	-0.0357	(0.0275)	-0.0438	(0.0301)	-0.0336	(0.0344)
Health Problems: Frequent Indegestion, Stomach, Liver, Gallbladder	0.0038	(0.0174)	0.0170	(0.0202)	-0.0057	(0.0186)	-0.0075	(0.0221)
Health Problems: Depression, Excessive Worry, Nervous Trouble	0.0268	(0.0205)	0.0092	(0.0225)	0.0197	(0.0251)	0.0240	(0.0292)
Health Problems: Joints Swell/Pain, Leg Cramps, Bursitis	0.0163	(0.0218)	-0.0006	(0.0251)	-0.0047	(0.0267)	-0.0127	(0.0321)
Health Problems: Lameness or Paralysis (Including Polio)	0.0158	(0.0097)	0.0155	(0.0110)	0.0202+	(0.0109)	0.0263+	(0.0147)
Health Problems: Scarlet or Rheumatic Fever, TB, Jaundice, Hepatitis	0.0152	(0.0105)	0.0142	(0.0109)	0.0203	(0.0135)	0.0246+	(0.0148)
Health Problems: Frequent Severe Headaches, Dizziness, Fainting Spells	0.0170	(0.0163)	-0.0069	(0.0178)	0.0040	(0.0210)	-0.0057	(0.0226)
Health Problems: Eye Trouble	0.0242	(0.0157)	-0.0024	(0.0174)	0.0153	(0.0206)	-0.0156	(0.0245)
Health Problems: Ear, Nose, or Throat	-0.0022	(0.0129)	-0.0080	(0.0136)	0.0083	(0.0171)	0.0028	(0.0175)
Health Problems: Severe Tooth or Gum	0.0551**	(0.0195)	0.0253	(0.0215)	0.0450+	(0.0237)	0.0362	(0.0276)
Health Problems: Epilepsy	0.0148	(0.0097)	0.0090	(0.0108)	0.0193	(0.0123)	0.0163	(0.0144)
Health Problems: Trouble Sleeping	0.0551*	(0.0234)	0.0234	(0.0265)	0.0307	(0.0288)	0.0373	(0.0330)
Health Problems: Ulcers	0.0145	(0.0119)	0.0074	(0.0139)	0.0034	(0.0145)	0.0008	(0.0171)
Health Problmes: Fracture or Broken Bone in Last 10 years	0.0520*	(0.0256)	0.0494+	(0.0291)	0.0435	(0.0311)	0.0394	(0.0362)
Health Problems: Ever Unconcious due to Head Injury	0.0384	(0.0238)	0.0595*	(0.0257)	0.0762**	(0.0292)	0.0885**	(0.0325)
Observations			N=2253				N=740	

+ p<.10, * p<0.05, ** p<0.01, *** p<0.001

Heteroskedasticity-robust standard errors in parentheses.

a. The unmatched sample is comprised of all men with no missing data and does not control for the distributional differences between the formerly incarcerated and the non-incarcerated.

b. Equations 1 and 3 are not covariate adjusted differences.

c. Equations 2 and 4 include the following covariates: age, age squared, body mass index, no exercise, health limitation in 1979, education, marital status, age when father died, age when mother died, AFQT score, ever stopped and charged in 1980, parents' education, live with both parents during childhood, ever reported using drugs (marijuana, cocaine, and crack cocaine), Hispanic, black, age at first alcohol use, baseline regional dummies, baseline city type (town/city), regional dummies from the year of the health 40+ survey module, city type (urban/rural) from the year of the health 40+ survey module, and dummy variables for birth cohort.

Figures

Figure 1. Prevalence of Chronic and Infections Health Conditions among the General Population and State and Federal Prisoners

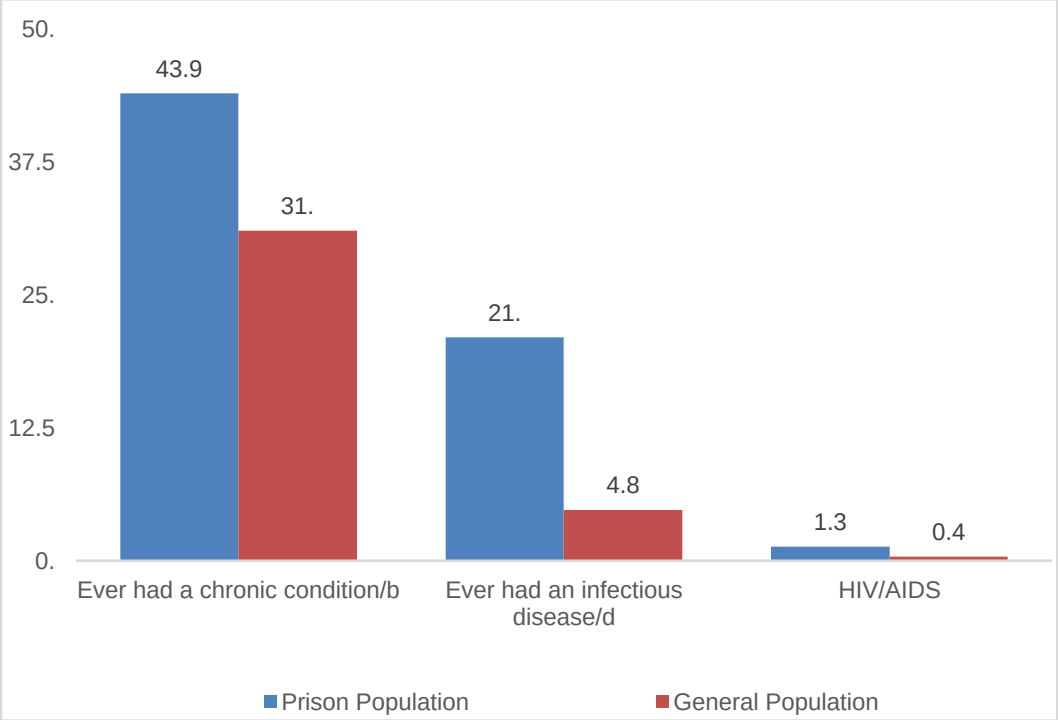
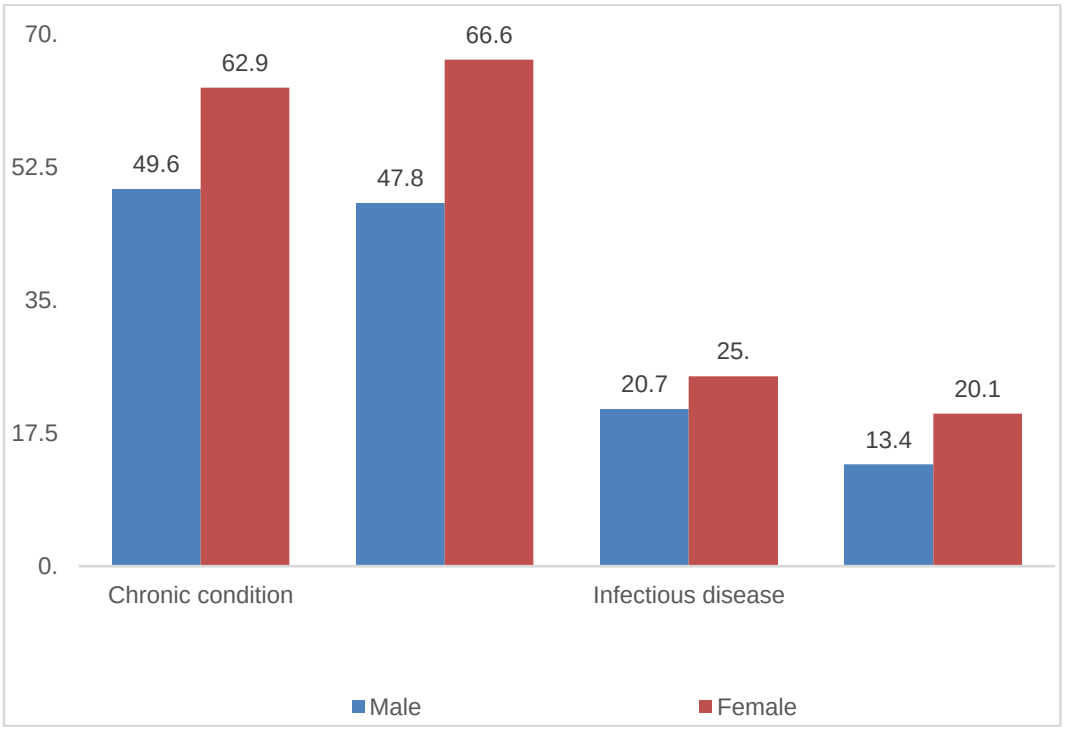


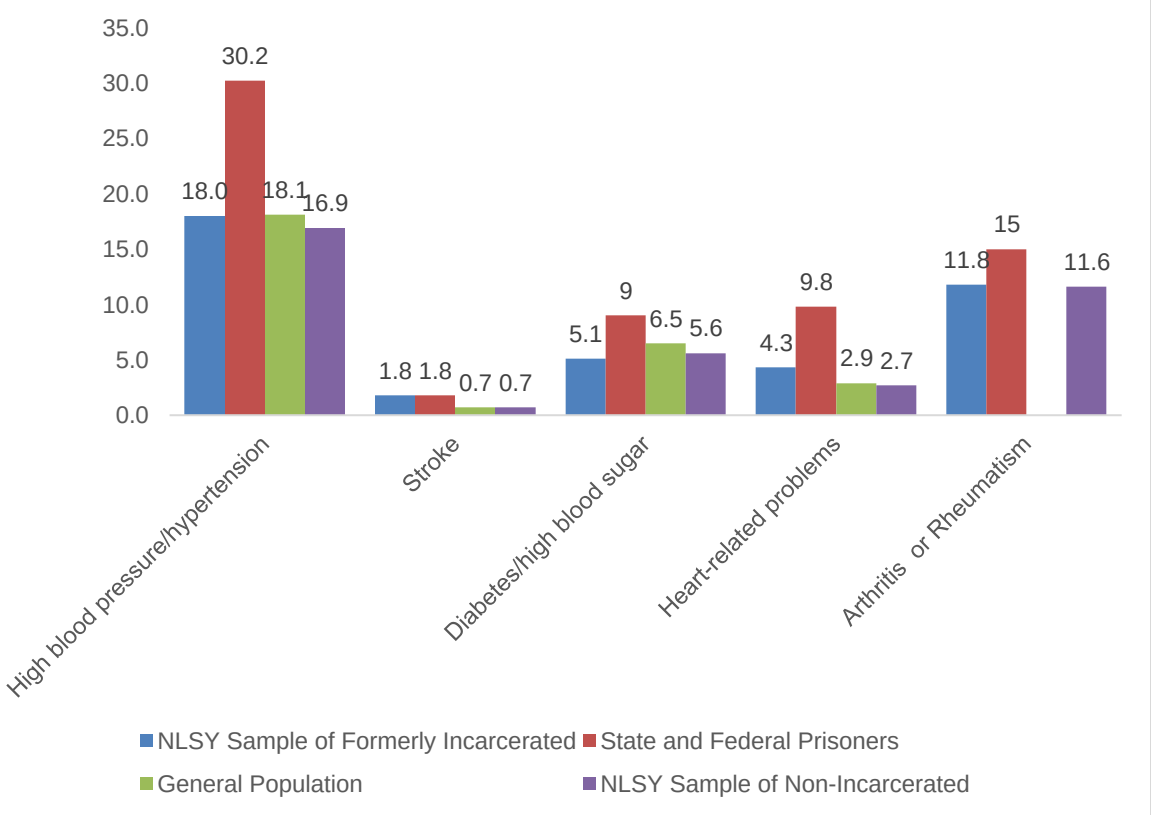
Figure by author, calculations by Maruschak, Berzofsky, and Unangst (2015)

Figure 2. Prevalence of Chronic and Infectious Health Conditions by Gender in 2011-2012



Difference between men and women significant at the: + p<.10, * p<0.05, ** p<0.01, *** p<0.001
Figure by author, calculations by Maruschak, Berzofsky, and Unangst (2015)

Figure 3. Comparison of the NLSY 79 Sample, State and Federal Prisoners, and General Population of Doctor Diagnosis of Select Chronic Illnesses



NLSY 79 calculations by author, general population and state and federal prisoners' calculations by Maruschak, Berzofsky, and Unangst (2015). NLSY79 sample estimates are unweighted.

Figure 4. Comparison of Prevalence of Chronic Illness by Age

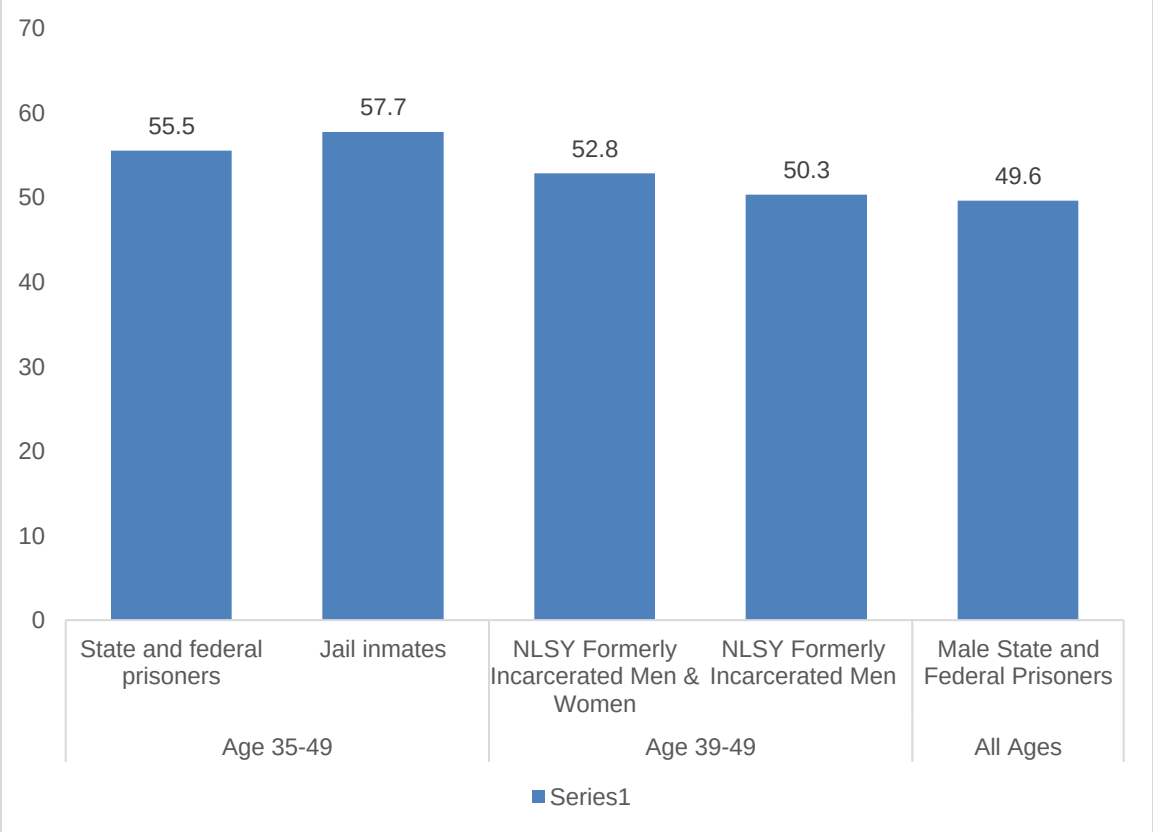


Figure by author, calculations by Maruschak et al. (2015)
Note: Maruschak et al. (2015) estimates include cancer, high blood pressure or hypertension, stroke-related problems, diabetes or high blood sugar, heart-related problems, kidney-related problems, arthritis or rheumatism, asthma, and cirrhosis of the liver, while NLSY 79 estimates include cancer, high blood pressure or hypertension, stroke-related problems, diabetes or high blood sugar, heart-related problems, kidney-related problems, arthritis or rheumatism, asthma, and problems with stomach, liver, or gall bladder.

Figure 5. Overlap Condition of the Propensity Score Estimator