Published in final edited form as:

J Addict Med. 2014 ; 8(1): 66–72. doi:10.1097/ADM.0000000000000009.

Association of Recent Incarceration with Traumatic Injury, Substance Use Related Health Consequences, and Health Care Utilization

Nicole Redmond, MD, PhD, MPH¹, LeRoi S. Hicks, MD, MPH^{2,3}, Debbie M. Cheng, ScD^{4,5}, Donald Allensworth-Davies, PhD, MSc⁹, Michael R. Winter, MPH⁶, Jeffrey H. Samet, MD, MA, MPH^{4,7}, and Richard Saitz, MD, MPH^{4,8}

¹Division of Preventive Medicine, University of Alabama at Birmingham, 1717 11th Avenue South, MT 610, Birmingham, AL 35294-4410

²Division of Hospital Medicine, Memorial Campus, 119 Belmont Street, Worcester, MA 01605

³Department of Quantitative Sciences UMass Memorial Health Care, Memorial Campus, 119 Belmont Street, Worcester, MA 01605

⁴Clinical Addiction Research and Education (CARE) Unit, Section of General Internal Medicine, Boston University School of Medicine and Boston Medical Center, Crosstown Center, 801, Massachusetts Avenue, 2nd Floor, Boston, MA 02118

⁵Department of Biostatistics, Boston University School of Public Health, Crosstown Center, 801 Massachusetts Avenue, 3rd Floor, Boston, MA 02118

⁶Data Coordinating Center, Boston University School of Public Health, Crosstown Center, 801 Massachusetts Avenue, 3rd Floor, Boston, MA 02118

⁷Department of Community Health Sciences, Boston University School of Public Health, Crosstown Center, 801 Massachusetts Avenue, 3rd Floor, Boston, MA 02118

⁸Department of Epidemiology, Boston University School of Public Health, Crosstown Center, 801 Massachusetts Avenue, 3rd Floor, Boston, MA 02118

⁹School of Health Sciences, Cleveland State University, 2121 Euclid Avenue, HS 124 Cleveland, OH 44115

Abstract

Objective—The higher risk of death among recently released inmates relative to the general population may be due to the higher prevalence of substance dependence among inmates or an independent effect of incarceration. We explored the effects of recent incarceration on health outcomes that may be intermediate markers for mortality.

Address correspondence and send reprint requests to: Nicole Redmond MD, PhD, MPH, Division of Preventive Medicine, University of Alabama at Birmingham, 1720 2nd Avenue South, MT 610, Birmingham, AL 35294-4410, 205-934-0778 (phone) 205-934-7959 (fax), nredmond@uab.edu.

Contributors: Dr. Redmond conducted the literature search, designed the study, performed significant portions of the initial statistical analysis, drafted and revised the manuscript. Dr. Hicks assisted with the study design and manuscript preparation. Dr. Cheng provided biostatistical expertise for the analytic methods. Dr. Allensworth-Davies and Mr. Winter undertook the final statistical analyses. Drs. Saitz and Samet are the principal investigators of the parent study and provided access to the data. All authors significantly contributed to the study design and interpretation of the data, and contributed to and approved the final manuscript.

Conflicts of Interest: Dr. Hicks is a scientific member of the Board of Directors to Health Resources in Action. The authors have no other disclosures or conflicts of interest to report.

Methods—Longitudinal multivariable regression analysis were conducted on interview data (baseline, 3, 6, and 12 month follow-up) from alcohol and/or drug dependent individuals (n=553) participating in a randomized clinical trial to test the effectiveness of chronic disease management for substance dependence in primary care. The main independent variable was recent incarceration (spending 1 night in jail or prison in the past 3 months). The three main outcomes of this study were: any traumatic injury; substance use-related health consequences; and health care utilization defined as hospitalization (excluding addiction treatment or detoxification) and/or emergency department visit.

Results—Recent incarceration was not significantly associated with traumatic injury (adjusted odds ratio (AOR)=0.98, 95% CI 0.65–1.49) or health care utilization (AOR=0.88, 95% CI: 0.64–1.20). However, recent incarceration was associated with higher odds for substance use-related health consequences (AOR=1.42, 95% CI: 1.02–1.98).

Conclusions—Among people with alcohol and/or drug dependence, recent incarceration was significantly associated with substance use-related health consequences but not injury or health care utilization after adjustment for covariates. These findings suggest that substance use related health consequences may be part of the explanation for the increased risk of death faced by former inmates.

Keywords

Incarceration; substance dependence; trauma; health care utilization

Introduction

The United States population of adults under correctional supervision has risen steadily over the past thirty years (Glaze, 2011). A growing body of literature has documented the increased mortality of individuals recently released from prisons and jails when compared to non-incarcerated populations (Binswanger, et al., 2007; Lim, et al., 2012; Spaulding, et al., 2011), and they report poor access to health care pre-incarceration and upon release (Glaser & Greifinger, 1993; Lincoln, et al., 2006; Wang, et al., 2008). Post-release mortality studies have predominantly been data-linkage studies between prison release records and vital statistics or small surveys of recently released inmates (Merrall, et al., 2010). Furthermore, they were limited in their ability to explore the role of clinical and socioeconomic characteristics and pre-incarceration health status and health behaviors (Kinner, 2010). Few longitudinal studies exist to examine such characteristics that may contribute to increased morbidity and mortality associated with incarceration.

Substance use and dependence are highly prevalent among correctional populations and can contribute to all of the leading causes of death (e.g., overdose, cardiovascular disease, cirrhosis, cancer) among former inmates (Chandler, et al., 2009; The National Center on Addiction and Substance Abuse (CASA) at Columbia University, 2010). Drug-involved offenders are four times more likely to have substance dependence than those among the general public; yet there is a paucity of intensive clinical drug or alcohol treatment programs during incarceration and post-release that adequately meet the needs of such individuals (Taxman, et al., 2007a; Taxman, et al., 2007b; The National Center on Addiction and Substance Abuse (CASA) at Columbia University, 2010). Given the high prevalence of substance dependence among recently released inmates, it is unclear if substance dependence related morbidity (e.g., trauma, accidents, overdose) is *independent* of the experience of incarceration. In addition, mortality and morbidity among those with past incarceration, with or without concomitant substance use, could be related to decreased access and/or utilization of the health care system. Although at least one study has explored predictors of health utilization within correctional systems (Lindquist & Lindquist, 1999), it

is not clear how contact with the correctional system influences utilization of community based health care providers.

We conducted a secondary analysis of prospectively collected data to ascertain if recent incarceration was independently associated with trauma, substance use related health consequences, and/or health care utilization (defined as hospitalization for reasons other than substance dependence treatment or detoxification, or an emergency department visit for any reason). We analyzed data collected in a randomized clinical trial of a chronic disease management program for substance dependent individuals. We hypothesized that among substance dependent people, those with a history of recent incarceration would be more likely to have traumatic injury, substance use related health consequences, and higher health care utilization.

Methods

Study Population

The Addiction Health Evaluation And Disease management (AHEAD) Study was a randomized clinical trial to test the effectiveness of chronic disease management (CDM) for substance dependence in primary care. The details of this study are described in detail elsewhere and the data are publicly available at the Inter-university Consortium for Political and Social Research website (<http://www.icpsr.umich.edu/icpsrweb/NAHDAP/studies/33581>) (Kim, et al., 2012; Saitz, et al., 2013; Saitz & Samet, 2012). Briefly, alcohol dependent patients with at least 2 recent heavy drinking episodes and drug dependent subjects with recent opioid or cocaine use were recruited primarily from detoxification programs. All subjects were assessed using an in-person interview to obtain information about demographics, past incarceration, and medical and addiction treatment utilization. An audio computer-assisted self-interview (ACASI) was utilized to obtain information about history of physical or sexual assault and suicide attempts. The Addiction Severity Index (ASI) was used to assess substance use severity and consumption (McLellan, et al., 1992). Several items from modified versions of the Short Inventory of Problems (SIP) (Allensworth-Davies, et al., 2012; Alterman, et al., 2009; Bender, et al., 2007; Blanchard, et al., 2003), in conjunction with questions asked during the ACASI, were used to evaluate health-related problems due to alcohol and/or other drug use and generate a composite variable for substance use-related health consequences as described below. History of traumatic injury was assessed utilizing questions from a previously published study (Rees, et al., 2002). After assessment at baseline, subjects were randomized to usual care consisting of a written notice to be discussed with their physician that indicated their substance dependence diagnosis and specialty treatment referral information, or to the intervention arm consisting of a substance dependence chronic disease management program comprised of integrated medical, psychiatric, and social services with substance dependence treatment. All received facilitated referrals (i.e., specific prompt appointments) to an identified primary medical care clinician. In-person follow-up surveys were conducted at 3, 6, and 12 months and assessed interval incarceration, substance use-related health consequences, traumatic injury, and health care utilization. Interviews were conducted even if the participant was incarcerated. For the secondary analyses that are the focus of this paper, all AHEAD study participants completing at least one follow-up evaluation and with complete data on incarceration status at baseline were included. The Boston Medical Center Institutional Review Board (IRB) approved the original trial (including US Department of Health and Human Services and IRB approval to assess incarcerated subjects in follow-up) and the use of data for these secondary analyses; Partners Healthcare (Brigham and Women's Hospital) also approved the analyses presented in this paper.

Study Variables

Our main independent variable was self-reported recent incarceration, defined as spending at least one night in jail or prison 3 months prior to assessment. The survey question assessed total number of nights in jail and did not discern if they represented single versus multiple incarceration periods. Incarceration during the study period was incorporated as a time-lagged variable where the value of incarceration at a given time point was used to predict outcomes at the subsequent follow-up time (e.g., the value for incarceration at 3 months was used to predict the outcome at 6 months). Recent incarceration was also modeled as a time-dependent variable, i.e. the value was updated at each follow-up time.

Several variables were included as potential confounders of the association between incarceration and the outcomes of interest. Race, sex, and age reported at baseline were all included in the models due to known associations with incarceration (Freudenberg, et al., 2007; Yates, 1997), substance use and dependence (Binswanger, et al., 2009; Compton, et al., 2007), and utilization of health care services in community settings (Hatzenbuehler, et al., 2008; Perron, et al., 2009; Smedley, et al., 2003). Lower socioeconomic status--as measured by education, income, homelessness and health insurance coverage--is associated with higher incarceration risk (Wakefield & Uggen, 2010) as well as poorer health status and decreased access to health services (Adler & Newman, 2002; Adler & Rehkopf, 2008). Homelessness and insurance status during the study period were incorporated as time-varying covariates.

Because our study population included subjects that had drug dependence, alcohol dependence, or both, we included dependence type due to the potentially higher risks of incarceration for drug-related crimes among those with drug dependence. Smoking status and presence of medical co-morbidity as measured by a validated questionnaire (Plugge, et al., 2009) were included as markers of health status that could result in increased use of health services. Assignment to the AHEAD intervention group could have reduced risk of incarceration and/or the risk of the outcomes of interest and therefore was also included in the models. Finally, the baseline value of the outcome and time since study entry were also included as covariates in the regression models.

The three outcomes of interest in this study (each assessed at 3, 6, and 12 months, for the past 3 months) were: (a) any traumatic injury; (b) a composite variable for substance use-related health consequences; and (c) a composite variable for hospital and/or ED utilization excluding addiction treatment or detoxification; all defined as an affirmative response to any of their respective survey questions. Past three month traumatic injury was not incorporated into the composite variable for substance use-related health consequences because the question did not ask specifically about drug and/or alcohol use during injury. In secondary analyses, we studied the individual components of the two composite variables.

Statistical Analysis

We generated descriptive statistics and compared demographic, clinical, and socioeconomic characteristics by recent incarceration status at baseline using chi-square or Fisher's exact tests for categorical variables and *t*-tests for continuous variables (or non-parametric Wilcoxon rank sum test if the distribution was not normal). Spearman correlations for each pair of independent variables and covariates were evaluated to avoid potential collinearity. No pair of variables included in the regression models had $r > 0.4$.

We used generalized estimating equations (GEE) logistic regression analyses to model the odds of each outcome during the follow-up period (i.e., months 3, 6, and 12). We used an independent working correlation and report results using empirical standard errors.

Preliminary, minimally adjusted regression models evaluated recent incarceration status controlling only for time (categorical) as covariates (referred to as “unadjusted” in the results and tables). Fully adjusted regression models included the baseline status of the outcome and added demographic, socioeconomic, and clinical variables as previously described (referred to as “adjusted” in the results and tables). Odds ratios and 95% confidence intervals were generated for all independent variables and covariates. All analyses were conducted using two-sided tests and a significance level of 0.05, using SAS software (version 9.1; SAS Institute, Cary, NC).

Results

Sample characteristics

Of the 563 subjects completing the baseline interview, 553 (98.2%) completed at least one follow-up interview. Follow-up rates were 88.8%, 86.5%, 94.5% at 3, 6, and 12 months, respectively. Among the 553 subjects eligible for our analyses, 404 (73%) were male with a mean ($\pm$ SD) age of 38.3 ($\pm$ 10.1) years; 260 subjects (47%) were non-Hispanic White, 175 (32%) were non-Hispanic Black, 73 (13%) were Hispanic, and 45 (8%) were of other race/ethnicity; 95 (17%) had alcohol dependence only, 144 (26%) had drug dependence only, and 314 (57%) had both drug and alcohol dependence; 93 (17%) reported recent incarceration (in the past 3 months) at baseline.

Sample characteristics by incarceration status at study entry are presented in Table 1. Compared to subjects with never or remote (i.e., >3 months prior to baseline) incarceration, subjects with recent incarceration were younger and a higher proportion reported income from all sources (which may include illegal income) totaling \$50,000 or more. Although a higher proportion of subjects with recent incarceration had both drug and alcohol dependence, fewer of them reported one or more medical co-morbidities when compared to those reporting never or remote incarceration; however, neither of these differences reached statistical significance. Although the AHEAD study intervention was assigned based on randomization, more subjects with recent incarceration were in the AHEAD study intervention group when compared to those reporting never/remote incarceration. Lastly, compared to those reporting never or remote incarceration, a higher proportion of subjects reporting recent incarceration at baseline also reported recurrent incarceration during the follow-up period.

Association of recent incarceration with traumatic injury, substance use related health consequences, and health care utilization

Recent incarceration was not significantly associated with traumatic injury or health care utilization in unadjusted or adjusted analyses (Tables 2 and 3, respectively). However, recent incarceration was associated with significantly higher odds for substance use-related health consequences in both unadjusted and adjusted analyses; after multivariable adjustment, those recently incarcerated had 42% higher odds of substance use-related health consequences (AOR=1.42, 95% CI 1.02–1.98), as shown in Table 2. In secondary analyses, recent incarceration was associated with significantly higher odds of overdose and having an accident while driving under the influence of drugs in unadjusted models. However, these associations were attenuated and no longer statistically significant after adjustment for other covariates (Table 2). Recent incarceration was not significantly associated with accidents while driving under the influence of alcohol, suicide attempts, or interpersonal trauma. Secondary analyses of the components of the composite health care utilization outcome (i.e. any medical or psychiatric hospitalization or any ED visit) did not reveal any significant associations. Post-hoc analyses explored the impact of adding drug of choice (none, alcohol, opiates [heroin/methadone/other opiates], stimulants [cocaine/amphetamines], other

[sedative/hypnotics, hallucinogens, marijuana, inhalants, multiple drugs]), use of addiction treatment and/or detoxification medications, and legal status (none vs. any of the following: probation, parole, pretrial release, diversion program (drug court), incarcerated, other) separately to the original adjusted models for each outcome. Addition of drug of choice and the use of addiction treatment and/or detoxification medications resulted in similar ORs for incarceration for all outcomes. For some outcomes, the OR for incarceration changed somewhat after adjustment for legal status suggesting potential confounding, however the conclusions remained the same in all cases and there was no change in statistical significance.

Discussion

In this secondary analysis of longitudinal data collected from substance dependent people, we found a significant association of recent incarceration with substance use-related health consequences. These data add to the literature exploring the health consequences of incarceration by examining longitudinal data collected from a cohort with detailed characterization of clinical and socioeconomic status.

Recently released inmates have a higher risk of death when compared to the general population (Binswanger et al, 2007; Spaulding et al, 2011). In an examination of data from Washington state, Binswanger, et al. documented a 12.7 increased adjusted relative risk of age-adjusted mortality for recent prisoners within the first two weeks of release with the majority of the increase in mortality accounted for by deaths related to drug overdose, cardiovascular disease, homicide and suicide (Binswanger et al, 2007). Similarly, Lim et al. reported a higher relative risk of drug-related and homicide deaths within the first two weeks of release from New York City jails (Lim, et al., 2012). As a result, we hypothesized that the recently incarcerated participants in our cohort would be more likely to report substance use-related consequences and trauma than their counterparts. Although we did not detect significant effects of recent incarceration on traumatic injury, we did find that participants with recent incarceration had higher odds of substance use-related health consequences overall, where the largest observed effects appeared to be from overdose and accidents while under the influence of drugs. These observations may be explained in part by the *de facto* withdrawal that occurs during incarceration that results in decreased drug and/or alcohol tolerance. Upon release, relapse and use of the pre-incarceration dose of the substance in the setting of decreased tolerance increases one's risk of unintentional overdose or heightened impairment while driving a motor vehicle. Among inmates, those that meet criteria for substance dependence or abuse have a higher recidivism rate (i.e., had a prior probation/incarceration at time of substance dependence assessment) than inmates not meeting criteria for dependence (Mumola, 2006). One consequence of recidivism is a repeated pattern of withdrawal that may contribute to a "kindling" phenomenon further heightening sensitivity to subsequent withdrawals from alcohol and/or drugs (Ballenger & Post, 1978; Becker, 1999; Newlin, 1994). The findings in the New York City jail study reported that shorter, rather than longer incarceration periods were associated with a shorter time to death; however, having multiple incarceration episodes was associated with a shorter time to death thus supporting the notion of a "kindling" phenomenon (Lim, et al., 2012).

Since formerly incarcerated individuals are more likely to seek care in the emergency department (ED) rather than from primary care clinicians (Conklin, et al., 2000), we hypothesized that recent incarceration results in discontinuity in health care leading to illness presenting in more acute and/or late stages and thereby resulting in increased ED utilization and/or inpatient admissions for non-substance use treatment-related indications. However, it is also plausible that contact with the correctional system and the concomitant medical screening procedures that often occur in the correctional setting may actually

decrease the odds of subjects with recent incarceration needing subsequent inpatient or emergency medical care. In our study, many subjects were recruited from health care settings or obtained access to health care through study participation, and as a result may have been less likely than other similar populations to use health care ineffectively.

This study has a number of limitations. First, our measure for incarceration is heterogeneous. For the purposes of longitudinal analyses, this binary measure of incarceration does not capture the variability in the frequency and/or duration of incarceration (e.g., subjects with one night in jail are included with those with many months in jail and those with multiple jail stays are treated similarly as those with a single incarceration period). In post-hoc analyses, we utilized a 4-level version of the independent variable (none, <4, 4–14, >14 nights) and repeated the regression models. Incarceration status, particularly 4–14 nights, was associated with substance abuse health consequences (unadjusted and adjusted analyses) and accident while using drugs (unadjusted analyses only) consistent with the findings utilizing the 2-level variable. This finding, along with the Lim *et al.* study, supports the notion that brief incarcerations, not just long prison terms, may be associated with poor health outcomes. Because the survey question only assessed total number of nights in jail and did not discern if they represented single versus multiple incarceration periods, we are not able to explore this issue in further analyses. Second, a larger sample size and/or longer follow-up may be necessary to detect significant effects of incarceration on traumatic injury or health care utilization. Although longer follow-up might uncover an effect, it seems that the effects of incarceration would be more likely to occur in the short term, and other studies suggest the short term is a period of particularly increased risk for health consequences (e.g. overdose, as supported by our findings) and death. Third, information on health behaviors such as diet, physical activity, medication adherence, and self-management of health during or shortly after incarceration, which may potentially impact health status and health utilization measures, was not available in this data set. However, we were able to adjust for variables (e.g., socioeconomic indicators, substance dependence type, and the presence of medical co-morbidities) which have previously been shown to be associated with high health service utilization (O'Toole, et al., 2007). Fourth, data provided by subject self-report could be subject to recall bias and/or misclassification. On the other hand, the main variables of interest were important recent events likely to be recalled accurately (e.g. incarceration, injury, hospitalization). Fifth, subjects were required to have current substance dependence for entry into the study and consequently factors that may be more important for recent inmates without substance use problems could not be explored. This entry criterion, however, was a strength for the question of interest. Substance dependence itself is well known to be associated with injury, health consequences and emergency department and hospital utilization—having all subjects with dependence more clearly allows assessment of the contribution of incarceration, our particular focus.

Conclusions

This study suggests that recent incarceration has an independent effect on substance use-related health consequences. This association may be a significant contributor to the previously documented higher risk of mortality among recent inmates. These data support the notion that more intensive clinical drug and alcohol treatment programs should be considered within correctional settings and post-release, as one means to mitigate adverse substance use-related health outcomes among people with substance dependence.

Acknowledgments

We thank Julie Witas, MSW, AHEAD study project manager, for her assistance with obtaining IRB and other regulatory approvals, preparing funding applications, supervising data collection, and facilitating communication with AHEAD study investigators.

Disclosures

Role of Funding Source: Analyses were conducted while Drs. Redmond and Hicks were affiliated with the Division of General Medicine and Primary Care, Brigham and Women's Hospital, Boston MA. Dr. Redmond was supported by an Institutional National Research Service Award for Primary Medical Care funded by the Health Research Services Administration of the Department of Health and Human Services (T32HP10251-02), a National Institutes of Health (NIH) Research Supplement to Promote Diversity in Health-Related Research (3R01DA010019-11S2) through the National Institute on Drug Abuse, and the Harvard Medical School Post-Graduate Fellowship in Health Disparities. Currently, Dr. Redmond is supported by grants from the Center for Medicaid and Medicare Innovation and a National Institutes of Health (NIH) Research Supplement to Promote Diversity in Health-Related Research (3R01HL080477-07S1) through the National Heart, Lung, and Blood Institute.

Dr. Hicks was supported by the Health Disparities program of Harvard Catalyst | The Harvard Clinical and Translational Science Center (1UL1RR025758-01 and financial contributions from participating institutions).

The Addiction Health Evaluation And Disease management (AHEAD) Study (also known as the Enhanced Linkage of Drug Abusers to Primary Medical Care) was funded by grants from the National Institute of Drug Abuse to Dr. Samet (5R01DA010019), the National Institute of Alcoholism and Alcohol Abuse to Dr. Saitz (5R01AA010870), the National Center for Research Resources (UL1RR025771) and was based at Boston Medical Center.

The study's contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Institutes of Health, the National Institute on Drug Abuse, the National Institute of Alcoholism and Alcohol Abuse, the National Center for Research Resources, or the Department of Health and Human Services.

References

- Adler NE, Newman K. Socioeconomic disparities in health: Pathways and policies. *Health Aff (Millwood)*. 2002; 21:60–76. [PubMed: 11900187]
- Adler NE, Rehkopf DH. U.S. Disparities in health: Descriptions, causes, and mechanisms. *Annu Rev Public Health*. 2008; 29:235–252. [PubMed: 18031225]
- Allensworth-Davies D, Cheng DM, Smith PC, Samet JH, Saitz R. The short inventory of problems-modified for drug use (sip-du): Validity in a primary care sample. *The American journal on addictions / American Academy of Psychiatrists in Alcoholism and Addictions*. 2012; 21:257–262. [PubMed: 22494228]
- Alterman AI, Cacciola JS, Ivey MA, Habing B, Lynch KG. Reliability and validity of the alcohol short index of problems and a newly constructed drug short index of problems. *J Stud Alcohol Drugs*. 2009; 70:304–307. [PubMed: 19261243]
- Ballenger JC, Post RM. Kindling as a model for alcohol withdrawal syndromes. *Br J Psychiatry*. 1978; 133:1–14. [PubMed: 352467]
- Becker HC. Alcohol withdrawal: Neuroadaptation and sensitization. *CNS Spectrums*. 1999; 4:38–40. 57–65. [PubMed: 18438320]
- Bender RE, Griffin ML, Gallop RJ, Weiss RD. Assessing negative consequences in patients with substance use and bipolar disorders: Psychometric properties of the short inventory of problems (sip). *The American Journal on Addictions / American Academy of Psychiatrists in Alcoholism and Addictions*. 2007; 16:503–509. [PubMed: 18058418]
- Binswanger IA, Krueger PM, Steiner JF. Prevalence of chronic medical conditions among jail and prison inmates in the USA compared with the general population. *Journal of Epidemiology and Community Health*. 2009; 63:912–919. [PubMed: 19648129]
- Binswanger IA, Stern MF, Deyo RA, et al. Release from prison--a high risk of death for former inmates. *N Engl J Med*. 2007; 356:157–165. [PubMed: 17215533]

- Blanchard KA, Morgenstern J, Morgan TJ, Lobouvie EW, Bux DA. Assessing consequences of substance use: Psychometric properties of the inventory of drug use consequences. *Psychol Addict Behav*. 2003; 17:328–331. [PubMed: 14640829]
- Chandler RK, Fletcher BW, Volkow ND. Treating drug abuse and addiction in the criminal justice system: Improving public health and safety. *JAMA : the Journal of the American Medical Association*. 2009; 301:183–190. [PubMed: 19141766]
- Compton WM, Thomas YF, Stinson FS, Grant BF. Prevalence, correlates, disability, and comorbidity of dsm-iv drug abuse and dependence in the united states: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*. 2007; 64:566–576. [PubMed: 17485608]
- Conklin TJ, Lincoln T, Tuthill RW. Self-reported health and prior health behaviors of newly admitted correctional inmates. *Am J Public Health*. 2000; 90:1939–1941. [PubMed: 11111273]
- Freudenberg N, Moseley J, Labriola M, Daniels J, Murrill C. Comparison of health and social characteristics of people leaving new york city jails by age, gender, and race/ethnicity: Implications for public health interventions. *Public Health Reports*. 2007; 122:733–743. [PubMed: 18051666]
- Glaser JB, Greifinger RB. Correctional health care: A public health opportunity. *Ann Intern Med*. 1993; 118:139–145. [PubMed: 8416310]
- Glaze, LE. Correctional populations in the united states. Bureau of Justice Statistics, US Department of Justice; 2011.
- Hatzenbuehler ML, Keyes KM, Narrow WE, Grant BF, Hasin DS. Racial/ethnic disparities in service utilization for individuals with co-occurring mental health and substance use disorders in the general population: Results from the national epidemiologic survey on alcohol and related conditions. *J Clin Psychiatry*. 2008; 69:1112–1121. [PubMed: 18517286]
- Kim TW, Saitz R, Cheng DM, Winter MR, Witas J, Samet JH. Effect of quality chronic disease management for alcohol and drug dependence on addiction outcomes. *J Subst Abuse Treat*. 2012; 43:389–396. [PubMed: 22840687]
- Kinner SA, et al. Commentary on merrall. Understanding mortality and health outcomes for ex-prisoners - first steps on a long road. *Addiction*. 2010; 105:1555–1556. (2010). [PubMed: 20707778]
- Lim S, Seligson AL, Parvez FM, et al. Risks of drug-related death, suicide, and homicide during the immediate post-release period among people released from new york city jails, 2001–2005. *Am J Epidemiol*. 2012; 175:519–526. [PubMed: 22331462]
- Lincoln T, Kennedy S, Tuthill R, Roberts C, Conklin TJ, Hammett TM. Facilitators and barriers to continuing healthcare after jail: A community-integrated program. *J Ambul Care Manage*. 2006; 29:2–16. [PubMed: 16340615]
- Lindquist CH, Lindquist CA. Health behind bars: Utilization and evaluation of medical care among jail inmates. *Journal of Community Health*. 1999; 24:285–303. [PubMed: 10463472]
- McLellan AT, Kushner H, Metzger D, et al. The fifth edition of the addiction severity index. *J Subst Abuse Treat*. 1992; 9:199–213. [PubMed: 1334156]
- Merrall EL, Kariminia A, Binswanger IA, et al. Meta-analysis of drug-related deaths soon after release from prison. *Addiction*. 2010; 105:1545–1554. [PubMed: 20579009]
- Mumola, CJ. Drug use and dependence, state and federal prisoners, 2004. Bureau of Justice Statistics. , editor. Washington, DC: U.S. Department of Justice; 2006.
- Newlin DB. Drug sensitization, substance abuse, and chemical sensitivity. *Toxicol Ind Health*. 1994; 10:463–480. [PubMed: 7778108]
- O'Toole TP, Pollini R, Gray P, Jones T, Bigelow G, Ford DE. Factors identifying high-frequency and low-frequency health service utilization among substance-using adults. *J Subst Abuse Treat*. 2007; 33:51–59. [PubMed: 17588489]
- Perron BE, Mowbray OP, Glass JE, Delva J, Vaughn MG, Howard MO. Differences in service utilization and barriers among blacks, hispanics, and whites with drug use disorders. *Subst Abuse Treat Prev Policy*. 2009; 4:3. [PubMed: 19284669]

- Plugge EH, Foster CE, Yudkin PL, Douglas N. Cardiovascular disease risk factors and women prisoners in the uk: The impact of imprisonment. *Health Promot Int.* 2009; 24:334–343. [PubMed: 19854844]
- Rees VW, Horton NJ, Hingson RW, Saitz R, Samet JH. Injury among detoxification patients: Alcohol users' greater risk. *Alcoholism, clinical and experimental research.* 2002; 26:212–217.
- Saitz R, Cheng D, Winter M, et al. Chronic care management for dependence on alcohol and other drugs: The AHEAD randomized trial. 2013 *In Press.*
- Saitz, R.; Samet, JH. Addiction health evaluation and disease (AHEAD) management study in boston, massachusetts, 2006–2010. Ann Arbor, MI: Inter-university Consortium for Political and Social Research (ICPSR); 2012. [distributor]
- Smedley, BD.; Stith, AY.; Nelson, AR. Institute of Medicine (U.S.). Unequal treatment : Confronting racial and ethnic disparities in health care. Washington, D.C.: National Academies Press; 2003. Committee on Understanding and Eliminating Racial and Ethnic Disparities in Health Care; p. xvip. 414p. 739-764.
- Spaulding AC, Seals RM, McCallum VA, Perez SD, Brzozowski AK, Steenland NK. Prisoner survival inside and outside of the institution: Implications for health-care planning. *Am J Epidemiol.* 2011; 173:479–487. [PubMed: 21239522]
- Taxman FS, Cropsey KL, Young DW, Wexler H. Screening, assessment, and referral practices in adult correctional settings : A national perspective. *Crim Justice Behav.* 2007a; 34:1216–1234. [PubMed: 18458758]
- Taxman FS, Perdoni ML, Harrison LD. Drug treatment services for adult offenders: The state of the state. *Journal of Substance Abuse Treatment.* 2007b; 32:239–254. [PubMed: 17383549]
- The National Center on Addiction and Substance Abuse (CASA) at Columbia University. Behind bars ii: Substance abuse and america's prison population. 2010
- Wakefield S, Uggan C. Incarceration and stratification. *Annual Review of Sociology.* 2010; 36:387–406.
- Wang EA, White MC, Jamison R, Goldenson J, Estes M, Tulskey JP. Discharge planning and continuity of health care: Findings from the san francisco county jail. *American journal of public health.* 2008; 98:2182–2184. [PubMed: 18381994]
- Yates J. Racial incarceration disparity among states. *Social Science Quarterly* (University of Texas Press). 1997; 78:1001–1010.

Table 1

Sample characteristics by incarceration status at baseline (n=553 except where noted)*

	Incarceration Status upon study enrollment		
	Never/Remote Incarceration	Recent Incarceration	p-value
Total	466 (84.3)	87 (15.7)	
Mean age (years ± SD)	39.0 ± 10.3	34.7 ± 9.1	<0.001
Race/ethnicity			0.41
Non-Hispanic white	217 (46.6)	43 (49.4)	
Non-Hispanic black	153 (32.8)	22 (25.3)	
Hispanic	61 (13.1)	12 (13.8)	
Other race	35 (7.5)	10 (11.5)	
Male	338 (72.5)	66 (75.9)	0.52
Years of education completed			0.19
Less than high school	103 (22.1)	27 (31.0)	
High school graduate	234 (50.2)	38 (43.7)	
Post-secondary education	129 (27.7)	22 (25.3)	
Income[†]			0.02
\$19,999 or less	202 (43.4)	30 (34.9)	
\$20,000–\$49,999	152 (32.7)	23 (26.7)	
\$50,000 or more	111 (23.9)	33 (38.4)	
No health insurance	95 (20.4)	17 (19.5)	0.86
Homeless (1+ nights in shelter OR on street)	270 (57.9)	57 (65.5)	0.19
Substance dependence and recent use			0.17
Alcohol only	86 (18.5)	9 (10.3)	
Drug only	118 (25.3)	26 (29.9)	
Alcohol and drug	262 (56.2)	52 (59.8)	
Drug of choice			0.04
None	5 (1.1)	1 (1.2)	
Alcohol	144 (30.9)	20 (23.0)	
Opioids	213 (45.7)	55 (63.2)	
Stimulants	98 (21.0)	11 (12.6)	
Other	6 (1.3)	0	
Any addiction medications prescribed in the past 3 months[‡]	30 (6.5)	3 (3.5)	0.28
Current smoker	408 (87.6)	78 (89.7)	0.58
At least 1 comorbidity in past 3 months[‡]	177 (38.2)	23 (26.4)	0.04
Currently on probation, parole, pre-trial release, or diversion program (drug court)[†]	133 (28.6)	65 (75.6)	<0.0001
Randomization group			0.08
Control	241 (51.7)	36 (41.4)	

	Incarceration Status upon study enrollment		
	Never/Remote Incarceration	Recent Incarceration	p-value
Intervention	225 (48.3)	51 (58.6)	
Number of nights incarcerated past 3 months at baseline			
0 nights	466 (100.0)	0	
1–3 nights	0	28 (32.2)	
4–14 nights	0	22 (25.3)	
>14 nights	0	37 (42.5)	
Median (range)	0	9 (1–81)	
Mean $\pm$ SD	0	19.1 $\pm$ 21.3	
Incarceration in past 3 months reported at follow-up			
Three months (n=500)			
Any	60 (14.2)	32 (41.6)	<0.0001
0 nights	363 (85.8)	45 (58.4)	<0.0001
1–3 nights	19 (4.5)	10 (13.0)	
4–14 nights	10 (2.4)	9 (11.7)	
>14 nights	31 (7.3)	13 (16.9)	
Median (range)	19.5 (1 – 90)	8.5 (1 – 90)	
Mean $\pm$ SD	27.9 (29.2)	23.3 (26.7)	
Six months (n=487)			
Any	64 (15.6)	25 (32.5)	<0.001
0 nights	346 (84.4)	52 (67.5)	0.01
1–3 nights	17 (4.2)	8 (10.4)	
4–14 nights	10 (2.4)	3 (3.9)	
>14 nights	37 (9.0)	14 (18.2)	
Median (range)	27.5 (1 – 90)	18.0 (1 – 90)	
Mean $\pm$ SD	33.0 (31.2)	34.6 (35.4)	
Twelve months (n=532)			
Any	81 (18.2)	33 (38.4)	<0.0001
0 nights	365 (81.8)	53 (61.3)	<0.0001
1–3 nights	19 (4.3)	2 (2.3)	
4–14 nights	10 (2.2)	2 (2.3)	
>14 nights	52 (11.7)	29 (33.7)	
Median (range)	38.0 (1 – 90)	66.0 (1 – 90)	
Mean $\pm$ SD	43.0 (36.7)	59.5 (29.5)	

Recent incarceration=spending at least one night in jail or prison 3 months prior to assessment

* All numbers reported as n (%) unless otherwise specified. p-values calculated based on analysis of variance or chi-square test as appropriate.

[†] n=551, 2 missing observations

[‡] n=552, 1 missing observation

Table 2

Unadjusted and adjusted association between recent (past three month) incarceration and any traumatic injury, and substance use-related health consequences

	Recent incarceration (vs. Remote/Never incarceration)	
	Unadjusted OR* 95% CI	Adjusted OR† 95% CI
<i>Primary Outcomes</i>		
Any traumatic injury	1.16 (0.77, 1.74)	0.98 (0.65, 1.49)
Substance use-related health consequences	1.60 (1.19, 2.18)	1.42 (1.02, 1.98)
<i>Secondary Outcomes</i>		
Overdose requiring ED/medical attention	2.69 (1.40, 5.18)	2.09 (1.05, 4.16)
Accident while using drugs	1.97 (1.40, 2.76)	1.44 (0.99, 2.08)
Accident while using alcohol	1.16 (0.78, 1.71)	1.18 (0.77, 1.83)
Suicide attempt while using drugs or alcohol	0.76 (0.26, 2.23)	1.01 (0.33, 3.06)
Physical/sexual assault while using drugs or alcohol	1.26 (0.79, 2.02)	1.25 (0.75, 2.07)

OR=odds ratio, CI=confidence interval, Recent incarceration=spending at least one night in jail or prison 3 months prior to assessment

* Adjusted for incarceration (time-lagged and time-varying) and time.

† Adjusted for incarceration (time-lagged and time-varying), outcome at baseline, age, race, sex, education, income at baseline, insurance status (time-varying), homelessness (time-varying), dependence type at baseline, randomization group, and time.

Table 3

Unadjusted and adjusted associations between recent (past three month) incarceration and health care utilization outcomes

	Recent incarceration (vs. Remote/Never incarceration)	
	Unadjusted OR [*] 95% CI	Adjusted OR [†] 95% CI
<i>Primary outcome</i>		
Overall health care utilization (composite)	0.92 (0.69, 1.22)	0.88 (0.64, 1.20)
<i>Secondary outcomes</i>		
Any hospitalization in past 3 months		
<i>Medical</i>	1.10 (0.73, 1.65)	1.11 (0.72, 1.72)
<i>Psychiatric</i>	0.82 (0.42, 1.61)	0.86 (0.40, 1.88)
Any emergency department visit in past 3 months	0.92 (0.68, 1.24)	0.84 (0.61, 1.16)

OR=odds ratio, CI=confidence interval, Recent incarceration=spending at least one night in jail or prison 3 months prior to assessment

* Adjusted for incarceration (time-lagged and time-varying) and time.

† Adjusted for incarceration (time-lagged and time-varying), outcome at baseline, age at baseline, race, sex, education, income at baseline, insurance status (time-varying), homelessness (time-varying), dependence type at baseline, randomization group, smoking status, co-morbidity (dichotomous), and time.