Title: Traumatic Brain Injury and Recidivism among Returning Inmates

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Authors' Note:
We would like to thank Brooke Hiltbold, Spencer Lawson, and Jennifer Lutz for their help in collecting and preparing the data for analysis.

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This is the author's manuscript of the article published in final edited form as:

Ray, B., & Richardson, N. J. (2017). Traumatic Brain Injury and Recidivism Among Returning Inmates. Criminal Justice and Behavior, 44(3), 472–486. https://doi.org/10.1177/0093854816686631

Traumatic Brain Injury and Recidivism among Returning Inmates

In recent years, traumatic brain injury (TBI) has been the subject of increasing scholarly attention. While there have been many definitions of TBI proposed over the years, the most recent consensus suggests it is an alteration in brain function caused by an external force to the head (Menon, Schwab, Wright, Maas, & Common, 2010). Thus, TBI refers to disruptions to the normal function of the brain caused by blows or jolts to the head. Moreover, recent definitions recognize that not all head injuries result in TBI, but also that the severity of TBI can range from mild (a brief change in mental status or consciousness) to severe (a sustained period of unconsciousness or amnesia). In the United States, an estimated 1.7 million people sustain TBI each year (Faul, Xu, Wald, & Coronado, 2010). As a result of this large number, TBIs have been referred to as a “silent epidemic” as there is little public awareness and because the symptoms of TBI are not always readily evident (Goldstein, 1990). Most adults, at some point in their lives, experience a bump on the head, but never experience adverse psychological or behavioral changes from the injury; though for some, TBI can result in impairments in brain functioning that can affect decision making and social skills (Ferguson, Pickelsimer, Corrigan, Bogner, & Wald, 2012). Unless these individuals are identified early on, and diverted into appropriate treatment programs, the TBI can lead to a host of negative outcomes such as attention problems, increased aggression, hypersexual behavior, and a lack of impulse control, all of which are particularly salient if the injury occurs during childhood (Eghwrudjakpor & Essien, 2008; Fazel, Lichtenstein, Grann, & Langstrom, 2011; Leon-Carrion, Javier, & Ramos, 2003; Turkstra, Jones, & Toler, 2003).

Involvement in the criminal justice system is another potentially negative outcome from TBIs that has received attention among researchers; however, much of this research consists of case studies or descriptive samples comparing the offending population to the general population. For example, the rate of TBI in the general population is estimated to be at about 8.5% (Silver, Kramer, Greenwald, & Weissman, 2001**)** while studies of offending populations have found rates between 25% and 87% (Barnfield & Leathem, 1998; DelBello et al., 1999; Langevin, 2006). While these results illustrate higher rates of TBI among criminally involved populations, they are not able to assess a causal relationship between offending or reoffending rates as a function of TBI. Moreover, it is possible that offenders with TBI have repeated experiences with the criminal justice system and so understanding how to screen for TBI is important in helping to deliver appropriate treatment while incarcerated and post release.

The Ohio State University Traumatic Brain Injury Identification (OSU-TBI-ID) instrument was designed for clinical purposes to capture the prevalence and severity of TBI and has been utilized in numerous studies and across a variety of populations including military personnel, veterans, and prisoners (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007a, 2007b; Corrigan, Bogner, & Holloman, 2012; Ferguson, et al., 2012). However, while extant research suggests that the OSU-TBI-ID accurately captures the presence of TBI, it has not been used to determine whether having TBI is associated with subsequent involvement in the criminal justice system.

In this study we examine data from a statewide cohort of adult male inmates who were screened for TBI, using the OSU-TBI-ID, over a one month period in 2012. From this cohort we follow-up a subsample of inmates who were released and returned to the same county (N=150) to examine whether those with TBI were more likely to recidivate than those without.

Traumatic Brain Injury and Criminal Behavior

Much of the research establishing a relationship between TBI and criminal behavior comes from descriptive studies that compare rates of TBI in offender populations to those in the general population. Meta-analyses estimate that approximately 60% of adult offenders (Farrer & Hedges, 2011; Frost, Farrer, Primosch, & Hedges, 2013; Shiroma, Ferguson, & Pickelsimer, 2012) and 30% of juvenile offenders (Farrer, Frost, & Hedges, 2013) have TBI compared to 8.5% of the general population (Silver, et al., 2001). However, many of these studies have targeted specific populations—homicide offenders (Blake, Pincus, & Buckner, 1995; Freedman & Hemenway, 2000; Lewis, Pincus, Feldman, Jackson, & Bard, 1986), sex offenders (Langevin, 2006), or those with mental health or a substance abuse problem (DelBello, et al., 1999; Hawley & Maden, 2003; Martell, 1992; Walker, Staton, & Leukefeld, 2001)—rather than the general offender population. Moreover, sampling strategies have varied considerably with most relying on convenience samples (Blake, et al., 1995; DelBello, et al., 1999; Diamond, Harzke, Magaletta, Cummins, & Frankowski, 2007; Freedman & Hemenway, 2000; Lewis, et al., 1986; Turkstra, et al., 2003; Williams, Cordan, Mewse, Tonks, & Burgess, 2010).

Given that the above studies were cross-sectional and descriptive, they are unable to determine a direct causal relationship between TBI and involvement in the criminal justice system leading researchers to speculate about how TBIs lead otherwise law-abiding people to engage in criminal behavior. Biological explanations suggest that damages to certain parts of the brain—namely the frontal lobe, prefrontal cortex, and temporal lobes[i]—can impair judgement, reasoning, and impulse control, which might, in turn, contribute to criminal behaviors (Chayer & Freedman, 2001). Damage to this area has been associated with changes in personality traits, attention deficits, short-term memory loss, and impaired learning, speech, and language functions (Grafman, et al., 1996; Pardini et al., 2011; Barkley, Grodzinsky, & Dupaul, 1992;

Bechara & Van der Linden, 2005; Fellows, 2006). Similarly, damage to the prefrontal cortex has been associated with violence, aggression, and antisocial behavior (Fabian, 2010; Martell, 1996; Raine, 2002), while damage to the temporal lobe is linked to unprovoked anger, memory problems, intellectual impairment, and the regulation of responses to cues that indicate threat (Fabian 2010).

Despite the behavioral changes that can result from TBI, the causal relationship between TBI and crime is likely complex with multiple causal pathways. For example, several studies have found high co-occurring rates of TBI and substance abuse among juvenile and adult offenders (Barnfield & Leathem, 1998; Perron & Howard, 2008; Sacks et al., 2009; Walker, Hiller, Staton, & Leukefeld, 2003; Williams, et al., 2010) as well as non-offender adolescent populations (Ilie, Boak, Adlaf, Asbridge, & Cusimano, 2013). Also, a recent retrospective study among inmates found that TBI early in life was associated with earlier onset of substance abuse and the severity of drug use (Fishbein et al., 2014). However, such studies are unable to determine a causal relationship and so it is still unclear whether substance abuse is the result of TBI or, as other studies have suggested, substance abuse is what places one at a higher risk for TBI (Kolakowsky-Hayner et al., 2002; Vickery et al., 2008). A similar line of research which explores a potentially indirect mechanism in the relationship between TBI and crime focuses on mental illness following brain injury. These studies suggest that those with TBI, including both adolescents and adults, are more likely to have symptoms of a psychiatric disorder (e.g., ADHD, bipolar disorder, major depression, panic disorder, depression) as well as increased aggressive behaviors at follow-up (Bloom et al., 2001; Cole et al., 2008; Dinn, Gansler, Moczynski, & Fulwiler, 2009; Gerring et al., 2009; Hesdorffer, Rauch, & Tamminga, 2009; Koponen, 2005; Max, Castillo, Lindgren, & Arndt, 1998; Max, Robertson, & Lansing, 2001; McKinlay, Grace, Horwood, Fergusson, & MacFarlane, 2009; VanReekum, Bolago, Finlayson, Garner, & Links, 1996). Thus, having TBI might also result in symptoms of mental illness, substance abuse, or violence which could exacerbate the likelihood of arrest.

Traumatic Brain Injury and Recidivism

The above studies have documented higher rates of TBI among inmates than the general population and established that TBIs are associated with behaviors that could lead to involvement in the criminal justice system (i.e., violence and substance abuse); however, there have been few prospective studies that examine the likelihood of criminal justice involvement following TBI. The only studies to prospectively look at arrest following TBI use Finnish birth cohort data and find that adolescents with TBI, based on hospital diagnosis, were significantly more likely to have been arrested than those without (Luukkainen, Riala, Laukkanen, Hakko, & Rasanen, 2012; Rantakallio, Koiranen, & Möttönen, 1992; Timonen et al., 2002). Thus, further research is needed to determine whether TBI is associated with the initial involvement in the criminal justice system but also whether TBI is associated with subsequent recidivism.

The present research seeks to advance the TBI crime literature by providing the first study to prospectively examine whether inmates with TBI are more likely to be rearrest post-release than those without TBI. We used the OSU-TBI-ID—a well-established and validated instrument—to measure the presence of TBI among a cohort of male inmates and link this to follow-up data to assess rearrests post-release. While we are unable to determine whether TBI was associated with initial involvement in the criminal justice system our study examines an equally important question regarding barriers to prisoners reentering their community, which is the association between TBI and subsequent involvement in the criminal justice system.

Methods

Setting

The short version of the OSU-TBI-ID was employed as a screening instrument for all incoming male inmates in Indiana for approximately one month. This instrument was designed to provide both a valid and reliable method to assess lifetime exposure to TBI. Indeed, prior research has shown acceptable to high levels of reliability including both inter-rater and test/retest reliability (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007a, 2007b; Corrigan, et al., 2012; Ferguson, et al., 2012). Similar levels of predictive validity have been demonstrated by examining the relationship between lifetime history of TBI and effects that are commonly associated with TBI including cognitive performance, interpersonal functioning, and violence and aggression (Bogner & Corrigan, 2009; Corrigan & Bogner, 2007a, 2007b; Corrigan, et al., 2012; Ferguson, et al., 2012). Additionally, the OSU-TBI-ID is becoming a widely recognized valid instrument as evidenced by its adoption in a variety of research and clinical practices including, for example, the "TBI Model Systems National Database Syllabus" (TBIMS, 2016) and the National Institute of Health's "National Institute of Neurological Disorders and Stroke Common Data Elements" (NINDS, 2016). Thus, there is considerable evidence that the OSU-TBI-ID instrument is a reliable and valid method to assess lifetime exposure to TBI.

The instrument is administered through a structured interview lasting approximately 10 minutes. Individuals are asked to recall injuries involving the head or neck that resulted in altered consciousness or a loss of consciousness. For example, questions include "Have you ever been hospitalized or treated in an emergency room following an injury to your head or neck," "Have you ever injured your head or neck in a car accident or from some other moving vehicle accident," "Have you ever injured your head or neck in a fall or from being hit by something? Have you ever been injured playing sports or on the playground," "Have you ever injured your head or neck in a fight, from being hit by someone, or from being shaken violently? Have you ever been shot in the head," and "Have you ever been nearby when an explosion or a blast occurred? If you served in the military, think about any combat-related incidents." For each of the instances the respondent is also asked how long they were unconscious and at what age the injury occurred. Based on the age of the first injury, number of injuries, severity (i.e., a loss of consciousness), and the length of time unconsciousness, the OSU-TBI-ID places respondents in one of five TBI categories: improbable, possible, mild, moderate, or severe. TBIs that resulted in losing consciousness (excluding, for example, loss of consciousness due to drug overdose) for greater than 30 minutes are classified as 'severe.' Those where unconsciousness lasts less than 30 minutes are coded as 'mild.'

For approximately one month, all male inmates entering the Indiana state prison system were screened for TBI at the Reception Diagnostic Center prior to incarceration. Intake specialists gather information on criminal history and medical needs. Based on this information, inmates are then placed into one of several Indiana Department of Corrections (hereafter IDOC) facilities. All intake specialists were trained on how to administer the short version of the OSU-TBI-ID. The instrument was then incorporated into the electronic IDOC intake data collection system from November 5, 2012 to December 3, 2012 in attempt to determine the overall rate of TBI among 831 male inmates.

In this study we examine data from a subsample of 155 who were released to Marion County (Indianapolis), Indiana within 18 months (June, 2014) following the OSU-TBI-ID intake survey. Indiana does not have a statewide jail database system so we were only able to capture reliable jail data from Marion County; therefore, for this subsample we collected prior and follow-up data on all arrests that resulted in jail in Marion County. After list-wise deletion of missing cases our final sample included 151 inmates.

Analytic Procedure

Follow-up criminal justice data for the subsample released by June, 2014 (*N* = 151) were collected August, 2015, which provided for a minimum of 12-months at risk for recidivism. However, most inmates were released earlier than that, with the earliest being two-months following intake screening. Thus, inmates risk-period for rearrest ranged from 12 to 29 months with an average of 19.9 months (*SD* = 6.6). We examined time to recidivism using Cox regression survival analysis. One of the strengths of survival analysis techniques is the management of censored data: left censoring occurs when data on the starting point are not available and right censoring when there are no data on the ending point, which often occurs when studying recidivism. In short, survival analysis methods are able to correct for the unequal distribution of follow-up time by using censored and uncensored (i.e., those that did recidivate) cases to calculate the probability of surviving (i.e., *not* recidivating) for each time point (Box-Steffensmeier & Jones, 2004). Therefore, it is able to examine both the likelihood of and time to recidivism while also being able to control for the effect of covariates on these outcomes. All analyses were conducted using IBM's Statistical Package for the Social Sciences© (SPSS) 21.

Measures

The dependent variable used in this study was recidivism, which was operationalized as any rearrest that resulted in jail, following discharge from the IDOC. The OSU-TBI-ID screening instrument provided data on the presence and severity of TBI (improbable, possible, mild, moderate, or severe), the likely age of the first TBI injury, and the source of the injury (accident, hit by an object, violence, or explosion). IDOC also provided socio-demographic information on offenders including age at intake, race/ethnicity categories, and education level. Offense type (person, property, controlled substance, or other) and the presence of a psychiatric disorder (1 = yes, 0 = no) were also provided; unfortunately, additional information on diagnosis were not available nor were data on substance abuse. Inmates were given a mental health screening prior to being sent to a prison facility. This determined whether the inmate had a psychiatric disorder that required additional services and whether this disorder caused functional impairment at the time of intake. Data were only available on whether the inmate had a psychiatric disorder; not on the specific diagnoses. Finally, the criminal history data also provided a total number of lifetime arrests in Marion County as well as total number of incarcerations in IDOC.

Results

Sample description

The descriptive characteristics are provided in Table 1. All of the subjects in this study are males and the average age at release was 31.2 (*SD* = 10.0). More than half (60.26%) of the population was identified as Black, 36.42% was White, and 3.1% was Hispanic. However, given the overall small sample size, the small number of individuals identified by IDOC as Hispanic, and well documented race/ethnic disparities in the criminal justice system, we dichotomized the race/ethnicity categories into “White” and “Race/Ethnicity Minority Status?” for subsequent analysis. Over half of the sample (53.64%) had either a high school diploma or GED at the time of intake, with 41.72% not having completed high school, and 4.64% having some secondary education beyond high school; however, because of the small sample size for the purposes of statistical analysis we dichotomized the education variable (1 = HS degree or more, 0=No HS degree). The most common offense type among this cohort was property crimes (41.72%), followed by person crimes (24.50%), controlled substances (16.56%), and other (17.22%). Lifetime prior arrests ranged from 0 to 39 with an average of 6.56 (*SD* = 6.93). Approximately half (51.66%) of the sample had 5 or fewer arrests (11.26% had no prior arrest and 4.6% had one arrest). A psychiatric diagnosis was present in 14.57% of the population which is consistent with studies on the prevalence of mental illness among prisoners (Fazel & Danesh, 2002; Steadman, Osher, Robbins, Case, & Samuels, 2009). Finally, over half (53.64%) of the sample had an arrest that resulted in jail following release from prison.

TBI Status

The results of the OSU-TBI-ID screening instrument's classifications are presented in Table 1 and show that approximately one-third of the sample screened positive for TBI. Of those, 9.26% were coded as possible, 64.81% as mild, 12.96% as moderate, and 12.96% as severe. Among those who screened positive for TBI (*n* = 54) we were also able to examine the age, self-reported prior hospitalization, and indictors of the TBI injury from the OSU-TBI-ID instrument. The self-reported age of the first TBI incident ranged from 3 to 42 years old with an average age of 18.76 (*SD* = 9.47); over a third (35.2%; *n* = 19) had the first TBI incident from age 14 or under. Over three-quarters (77.80%; *n* = 42) reported that they had been hospitalized or seen in an emergency following an injury to the head or neck. For the sources of head or neck related TBI related injuries 45.10% reported being in a car accident; 46.30% reported being hit by something and/or injured playing sports; 33.30% reported being in a fight, being shaken, or shot; and 7.40% reported being in an explosion or blast. While these were not mutually exclusive categories (respondents can identify multiple sources of injury), over two-thirds (68.5%) identified only one, 22.2% identified two sources, and 9.26% three.

[Table 1 about here]

In order to examine potential differences in the sample by TBI status we dichotomized the categories so that improbable indicated “No TBI” (64.2%; n = 97) and possible, mild, moderate, and severe indicated “TBI” (35.76%; n = 54). Means tests found no differences in TBI status by age and Chi-square tests found no significant differences by race/ethnicity minority status, or education by TBI status. However, those with TBI were more likely to have a psychiatric diagnosis than those without TBI (24.1% and 9.3% respectively, $\chi2 = 6.10$, $p = .014$), had a greater number of prior lifetime arrests than those without (8.04[SD = 6.63] and 5.73[SD = 6.99], $t = 2.67$, $p = .047$), and had significantly different offense types. Specifically, those with TBI were more likely to have been incarcerated on person offense type than those without TBI (42.6% and 14.4% respectively, $\chi2 = 21.24$, $p < .001$).

Survival Analysis Predicting Recidivism

During the 12 to 30 months of the follow-up period, 46.36% (n = 70) of the sample remained out of the criminal justice system while slightly over half (53.64%, n = 81) of the sample were rearrested. The number of days to recidivism ranged from 9 days to 700 days with an average of 221.70 days (SD = 166.75). Survival analyses were used to examine time to rearrest, which produces a life-table that describes duration distributions for the full sample or by key variable levels. One way to describe the life-table is to plot the cumulative proportion surviving at each time interval by a key covariate. Figure 1 shows the survival function for those with and without TBI, and illustrates that those without TBI went longer until recidivism event. For example, at 6 months the cumulative proportion of those without TBI who had not yet recidivated (i.e., surviving) was 74.23% compared to 64.81% of those with TBI. Similarly, at 12 months the survival rate for those without TBI was 62.89% and among those with TBI almost half (48.15%) had recidivated.

[Figure 1 about here]

In order to assess the effect of TBI on criminal recidivism, while controlling for covariates, we used Cox Regression survival analysis. Table 2 shows the results of Cox Regression models predicting the time to recidivism. Model 1 includes only the dichotomous TBI variable and suggests that those returning inmates with TBI have a hazard rate of recidivism that is 1.57 times greater than those who did not have TBI (*ExpB* = 0.79).[1] However, we want to assess whether there is an association between TBI and recidivism after controlling for other theoretically important predictors of recidivism. To do this, we included additional measures in subsequent Cox Regression models. Model 2 examines the effect of TBI on recidivism while controlling for several sociodemographic variables including age, race/ethnicity minority status, and education. The results suggest that TBI status and minority status are associated with

[1] In separate analyses that are not shown here we examined recidivism using each of the individual TBI indicators (i.e., hospitalization, car accident, violence, and explosion), none of which were statistically significant. We also explored alternate dichotomizations of the TBI categories and found that dichotomizing TBI to include mild, moderate, and severe was also significant and did not substantively change any of the results. However, when treated as separate categories the measures were not significant.

recidivism. Net of other factors, the hazard of recidivism increased about 69% for those with TBI. Whites were at a decrease hazard of recidivism when compared to minorities (*ExpB* = 0.63).

[Table 2 about here]

Model 3 includes four additional dichotomous variables measuring each offense type; person, property, and controlled substance, with other offenses as the reference group. While none of the offense type measures are significant, both TBI status and the dichotomous race/ethnicity variables remain significant. Moreover, adding these variables again increased the effect size of the TBI status variable. Finally, Model 4 includes a dichotomous variable measuring the presence of a psychiatric diagnosis as well as the number of prior arrests. In this final model, TBI status, minority status, and prior arrests are all associated with recidivism. Model 4 suggests that among this sample, controlling for the other variables in the model, the hazard of recidivism increases by 5.2% for each additional prior arrest, is 1.71 times greater for Race/Ethnicity Minority Groups, and 1.85 times greater for those with TBI.

Discussion

This study uses the OSU-TBI-ID to assess the relationship between TBI and recidivism among male offenders in Marion County, Indiana. Our findings suggest that those with TBI were more likely to recidivate post release than those without TBI. The results of our bivariate analysis indicate that those with TBI did not differ in terms of age, race/ethnicity minority status, or education. However, those with TBI did appear to be more likely to have a psychiatric diagnosis and a greater number of prior arrests than those without TBI. The majority of persons with TBI reported having been hospitalized or seen by a medical professional following their TBI. Additionally, individuals with TBI experienced a larger number of arrests for person offenses. This is supported by prior research that suggests that brain injuries are associated with violence and aggression (e.g., Bufkin & Luttrell, 2005; Fabian, 2010; Martell, 1996; Raine, 2002). We then used survival analysis to adequately adjust for the right censored nature of our recidivism measure. Our results suggest that those with TBI were more likely to recidivate and this relationship held when controlling for other theoretically relevant covariates including age, race/ethnicity, education, and type of offense. Thus, those with TBI tended to experience an arrest sooner than those without TBI. In addition to TBI, race/ethnicity minority status and the total number of prior arrests were also associated with time to recidivism. These findings are consistent with much of the criminal justice research on recidivism. Prior criminal activity or involvement in the justice system are among the strongest predictors of future criminal behavior in the initial years following release (Huebner & Berg, 2011; Langan & Levin, 2002; Ulmer 2001; Gendreau, Little, & Goggin, 1996); however, some studies suggest that the effect of prior arrests are no longer significant several years post release (Kurlychek, Brame, & Bushway, 2007; Huebner & Berg, 2011). Similarly, while research finds that recidivism is highest among African Americans (particularly males under the age of 18) (see Beck & Shipley, 1989; Langan & Levin, 2002) more recent studies suggest that this pattern is the result of the social context and structural conditions (i.e., racial inequality and poverty rate) to which African American ex-prisoners return (Reisig, Bales, Hay, & Wang, 2007; Visher & Travis, 2003; Kubrin & Stewart, 2006; Kaufman, 2005). Unfortunately the administrative data used in this study were limited and we were unable to look at long term recidivism patterns or the social contextual factors to which inmates returned; however, it is important to note the potential explanations for these results.

Our study has several strengths over existing research investigating the association between TBI and involvement in the criminal justice system. First, we use prospective data which allows us to establish the temporal precedence of the variables. Prior research investigating the relationship between TBI and crime has largely been descriptive or retrospective and compared rates of TBI in the offender population to rates of TBI in the general population. In this study we were able to first assess the presence of TBI and then determine post-incarceration recidivism. However, we were we are not able to determine whether the TBI occurred prior to their first criminal justice experience. In fact, those with TBI had a greater number of prior lifetime arrests than those without. While it is possible that prior arrests is also a driving factor in the TBI and recidivism we found that even when controlling for prior arrests in a multivariate model the presence of TBI was still associated with recidivism. Second, inmates in this study were screened using the OSU-TBI-ID, a validated clinical screening instrument (Bogner & Corrigan, 2009). Prior studies have typically used non-standardized methods to obtain information on TBIs. Moreover, the OSU-TBI-ID was used as a screening instrument among all incoming inmates in this study. Thus, our study may be more generalizable to the incarcerated population given that much of the prior research has only examined TBI in specific offense types or used convenience samples. Finally, many of the prior studies failed to control for other well-known predictors of criminal behavior including age, race/ethnicity, and prior criminal behavior.

While there has been virtually no prospective studies examining the relationship between TBI and involvement in the criminal justice system, our study is consistent with many retrospective, descriptive studies (Barnfield & Leathem, 1998; Langevin, 2006; Ray, Sapp, &

Kincaid, 2014; Shiroma, et al., 2012) though adds to this body of literature by suggesting that there is a relationship between having TBI while incarcerated and involvement in the criminal justice system following release. However, it is important to note that this association could operate through several mechanisms not measured in this study. For example, recent biological theories have shown disruptions in key areas of the brain post-head injury are responsible for impulse control, the regulation of emotions, and planning and judgment (Raine, 2014). TBI can lead to disruptions in executive functioning such as impulse control affecting levels of self-control, which is a consistent predictor of antisocial behavior and crime (Gottfredson & Hirschi, 1990), or attachments that restrain individuals from engaging in criminal behavior (Hirschi, 1969; Sampson & Laub, 1993) neither of which were measured in the present study. It is also possible that those with TBI become involved in the criminal justice system not directly because of their TBI but because their social background and TBI serve as barriers to prosocial activities with family and friends. This may lead to difficulties finding sufficient employment, or may lead them to self-medicate with alcohol and drugs. On re-entering the community, many inmates are ill prepared for life outside an institution and too often return to disorganized, high crime neighborhoods lacking supports for housing, employment, social activities, and mental health and substance abuse treatment where they resume antisocial behavior patterns (see Fisher et al., 2014; Hartwell, 2004). Moreover, it is also possible that offending patterns are similar across groups, but those without TBI are better at concealing crimes than those with TBI.

Although the current study fills an important gap in the literature, it is not without limitations. First, we do not have post-release supervision data on the inmates. In other words, we do not know if the offenders in our analysis had court-ordered supervisions upon their release from IDOC (i.e. parole) which would affect post-release criminal behavior and the discovery of those behaviors. For those under supervision, their criminal behavior may be more easily discovered. Second, the sample used in this analysis only consisted of males who returned to Marion County, Indiana. Moreover, our measure of recidivism extended only to this county; while this might adjust for potential regional variations in recidivism it limits the generalizability of our findings. Extending this study beyond Indiana and including female offenders could increase the generalizability of the findings. Third, while the OSU-TBI instrument is a reliable instrument, there is a potential for recall bias as it relies on retrospective reporting of TBIs from the inmates during the intake screening. There is also concern that inmates may self-report TBIs more or less often than those in the general population. However, recent research shows the validity of TBI self-reports to be fairly consistent when comparing self-reports in the incarcerated population to the general population (Bogner & Corrigan, 2009). Lastly, we were unable to directly test potential underlying causal mechanisms linking TBI to initial involvement in the criminal justice system or subsequent recidivism. For example, we were unable to measure personality traits or disorders (such as substance abuse, psychopathic traits, or other personality disorders) that might be associated with an increased risk of TBI, arrest, and recidivism. Future research should attempt to examine these specific mechanisms longitudinally to determine whether there is a direct or indirect relationship between TBIs and self-reported criminal behaviors as well as involvement in the criminal justice system.

Conclusion

Only recently have researchers started to examine TBI within a criminal justice context as studies consistently showed higher rates of TBI within incarcerated populations than the general population. While the results of this study suggest a link between TBI and rearrest following incarceration perhaps more importantly it highlights both the need and manner by which criminal justice institutions can screen for the presence of TBI. The short version of the OSU TBI-ID can be easily implemented into existing screening instruments to detect the presence of TBI among inmates. Once inmates are identified, they can be placed into programs that address their individual needs and develop proper intervention strategies. If inmates get the appropriate treatment for brain injuries while incarcerated, they may be less likely to engage in criminal behavior after release. Moreover, detecting TBI as early as possible in the criminal justice process could reduce the burden of TBI on initial and repeat offending.

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Endnotes

[i] These areas of the brain are most likely to be affected when TBI occurs as they are situated against rigid and rough bone and because of the neck's position posteriorly to the skull (see Raine, 2002).

TABLES

Table 1

Sample Characteristics

	N	%	M	SD	Range
Age			31.2	10.0	18/60
Race/Ethnicity					
White	55	36.42			
Black	91	60.26			
Hispanic	5	3.31			
Education					
Less than HS Education	63	41.72			
HS or GED	81	53.64			
Any Post Secondary	7	4.64			
Offense Type					
Person	37	24.50			
Property	63	41.72			
Controlled Substance	25	16.56			
Other	26	17.22			
Psychiatric Diagnosis					
Yes	22	14.57			
No	129	85.43			
TBI					
Improbable	97	64.24			
Possible	5	3.31			
Mild	35	23.18			
Moderate	7	4.64			
Severe	7	4.64			
Prior Jail Bookings			6.56	6.93	0/39
Recidivism Post-Exit					
Yes	81	53.64			
No	70	46.36			

N=151

Table 2

Cox Regression Predicting Recidivim Post Exit

	Model 1		Model 2		Model 3		Model 4	
	B (SE)	Exp *b* (95% CI)	*B (SE)*	Exp *b* (95% CI)	*B (SE)*	Exp *b* (95% CI)	*B (SE)*	Exp *b* (95% CI)
Traumatic Brain Injury (1=Yes)	0.45 (0.23) *	1.57 (1.01-2.44)	0.52 (0.23) *	1.69 (1.07-2.67)	0.64 (0.27) *	1.89 (1.12-3.18)	0.61 (0.27) *	1.85 (1.08-3.15)
Age			0.00 (0.01)	1.00 (0.97-1.02)	-0.01 (0.01)	0.99 (0.97-1.02)	-0.02 (0.01)	0.98 (0.96-1.01)
Race/Ethnicity (1=White)			-0.47 (0.23) *	0.63 (0.40-0.99)	-0.46 (0.24) *	0.63 (0.40-1.00)	-0.54 (0.24) *	0.58 (0.36-0.94)
Education (1=HS degree or above)			-0.26 (0.25)	0.77 (0.47-1.26)	-0.30 (0.26)	0.74 (0.45-1.22)	-0.30 (0.26)	0.74 (0.44-1.23)
Person (1=Yes)					-0.36 (0.45)	0.70 (0.29-1.69)	-0.49 (0.45)	0.61 (0.25-1.49)
Property (1=Yes)					-0.11 (0.40)	0.90 (0.41-1.98)	-0.36 (0.41)	0.70 (0.31-1.57)
Controlled (1=Yes)					-0.16 (0.46)	0.86 (0.35-2.12)	-0.23 (0.47)	0.80 (0.32-1.99)
Weapons (1=Yes)					-0.06 (0.57)	0.94 (0.31-2.85)	-0.29 (0.57)	0.75 (0.24-2.31)
Other (reference category)					-	-	-	-
Psychiatic Diagnosis (1=Yes)							-0.31 (0.32)	0.74 (0.39-1.39)
Number of Prior Jail Bookings							0.05 (0.01) ***	1.05 (1.02-1.08)
-2 log likelihood x^2	755.37*		750.47*		749.49*		738.12**	

*p<.05, **p<.01, ***p<.001; Notes: TBI group includes possible, mild, moderate, and severe. Race/Ethnicty reference group includes Black and Hispanic.

FIGURE

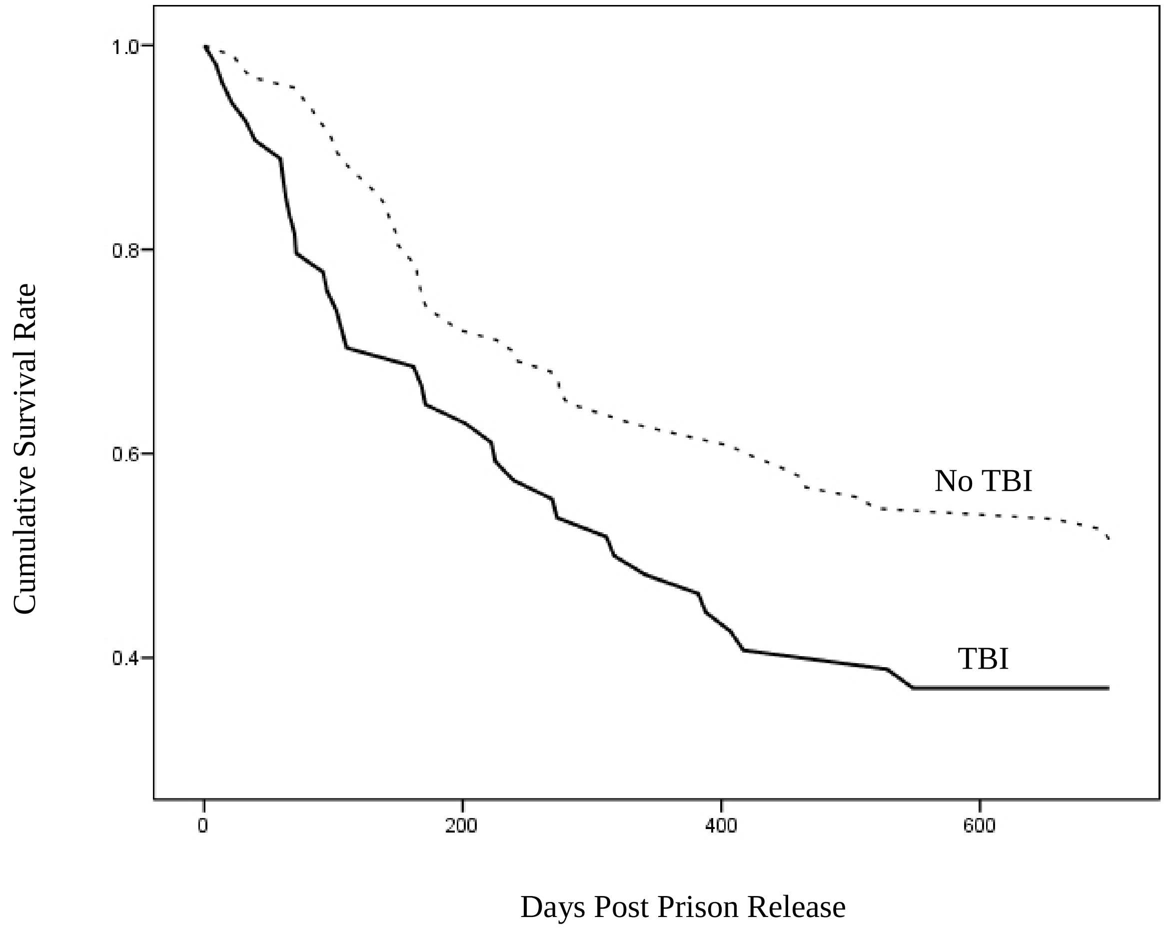

Figure 1: Time to Rearrest Post Prison Release by Traumatic Brain Injury Status

Note: TBI category includes possible, mild, moderate, and severe.